



UNIVERSITI TEKNIKAL MALAYSIA MELAKA

**ENERGY HARVESTING FROM ASPHALT PAVEMENT
ROADWAYS VEHICLE-INDUCED STRESSES FOR STREET
LIGHTING**

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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FACULTY OF ENGINEERING TECHNOLOGY

2017

BORANG PENGESAHAN STATUS LAPORAN PROJEK SARJANA MUDA

TAJUK: Energy Harvesting From Asphalt Pavement Roadways Vehicle Induced Stresses For Street Lighting

SESI PENGAJIAN: 2017/18 Semester 2

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DECLARATION

I hereby, declared this report entitled “ENERGY HARVESTING FROM ASPHALT PAVEMENT ROADWAYS VEHICLE-INDUCED STRESSES FOR STREET LIGHTING” 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

Penjelasan di sebalik kajian ini adalah untuk menghasilkan satu potensi kuasa penjaanaan dengan penuaian tenaga menggunakan piezoelektrik dari kenderaan di jalan. Pendekatan baru untuk mengumpul sendiri akan digunakan dan diramalkan bahawa yang akan sesuai untuk menghasilkan voltan arus terus, sebagai contoh lampu jalan. Sensor piezoelektrik adalah bahagian yang penting dalam projek ini. Ia berfungsi dengan kuasa yang diletakkan di atasnya sebagai tenaga mekanikal untuk berubah kepada tenaga elektrik. Sistem pengumpulan tenaga piezoelektrik akan diletakkan diantara dua plat segi empat tepat di atas jalanraya. Hasil akan disumbangkan oleh mana-mana kenderaan dimana kenderaan akan memijak pada plat, dengan cara ini akan bergetar dan memberi tenaga untuk sensor piezoelektrik untuk menghasilkan kuasa. Selain itu, kuasa yang dihantar dalam voltan adalah untuk mengecas semula superkapasitor sebagai alat penyimpanan sebelum diselaraskan untuk digunakan bagi lampu jalan. Projek ini adalah sangat meyakinkan dan dilengkapi untuk digunakan sebagai salah satu lagi strategi untuk penuaian tenaga yang terlepas untuk membina satu sistem yang boleh menghasilkan kuasa daripada pergerakan menggunakan konsep kesan piezoelektrik. Kelebihan utama dari sudut positif untuk adalah bahawa kuasa akan terus dihantar selagi kenderaan akan terus melalui plat piezoelektrik itu. Tambahan pula,projek ini juga akan mengambil berat kepentingan teknologi hijau seperti yang disyorkan dan lampu jalan boleh dijana dengan sistem ini.

ABSTRACT

The explanation behind the review is to improve one of the potential power generate by the energy harvesting using piezoelectric from the vehicles on roadway. This different approach for gathering itself will be used and foreseen that would suitable for creating a DC voltage harvest, for instance street lighting. The piezoelectric sensor is the essential part in the project. It workings through the force located on it as a mechanical energy to be distorted over into electrical energy. The piezoelectric energy gathering system will be connected among two rectangular plates on the roadway. The results will be funded by any force of vehicle which the vehicle will stepping on the plates, in this way wills give force and then providing the energy to the piezoelectric sensor to harvest power. Besides that, the power delivered in voltage is to recover the supercapacitor as capacity device before adjusted to be used for street lighting. The development of this project is an amazingly convincing and equipped to use as another strategy for the missed energy harvesting to build up a system that can produce power from movement utilizing the concept of piezoelectric transducer. The progressive side to yield as the key advantages is that the power will continue delivered as long as the vehicle will keep pass thorough on plate of the piezoelectric. Furthermore, this project is making the important of the green technology element as recommended and the street lighting can be generated through the system.

DEDICATION

To my beloved father and mother, my family's, my lecturer and my friends, thank you for the support, knowledge and assistance given to me on finishing this thesis.

ACKNOWLEDGEMENT

First of all, I would like to thanks to Allah S.W.T for the opportunity giving to me for finish and thorough this report “Projek Sarjana Muda 1” with a success after I went through a lot of obstacles with patience. This report would not be completed without the kindness and generosity of my supervisor, Madam Emy Zairah Binti Ahmad. She was very patient with me and willing to guide me in order to accomplish this final year project. Besides that, she gave valuable knowledge and a lot of information in completing this project. Her willingness to help me contributed tremendously to my progress, and she had inspired me greatly with her encouragement and motivation to carry on with my project. Not to forget, I would like to thank others lectures and staffs of Faculty Engineering Technology that willing spends their time to help me to solve the problem. A lot of thank for the cooperation and great commitment during complete the project. Moreover, special thank go out to my family and friends, especially my parents. They have shown me the virtue of endurance in the face of extreme adversity. On the other hand, their wonderful support and understanding throughout completing this project. Last but not least, I would like to thank to authority of Universiti Teknikal Malaysia Melaka (UTeM) for providing me with a good and more convenient environment and facilities to complete this project.

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LIST OF ABBREVIATIONS, SYMBOLS AND NOMENCLATURE

mA	-	Mili ampere
mW	-	Mili Watt
A	-	Ampere
P	-	Power
I	-	Current
V	-	Voltage
D1	-	Diode 1
D2	-	Diode 2
D3	-	Diode 3
D4	-	Diode 4
AC	-	Alternating Current
DC	-	Direct Current
CAD	-	Computer-Aided Design
CAE	-	Computer-Aided Engineering
BaTiO ₃	-	Barium Titanate
PZT	-	Lead Zirconate Titanate
LED	-	Light Emitting Diode
RE	-	Renewable Energy
EMI	-	Electromagnetic Interference
MEMS	-	Micro Electro Mechanical System

MM	-	Milimeter
Kg	-	Kilogram
PSM	-	Projek Sarjana Muda

CHAPTER 1

INTRODUCTON

1.0 Introduction

Project background, objectives, scope, problem statement and project significant will be describes detail in this section.

1.1 Background

Nowadays most of entire lifetime is need on electricity. Electricity is one of the usually used approaches of energy. It is important in our day-to-day life because without electricity a lot of works cannot be complete on time. But, now source that can produce electricity are decreasing year by year. So that, renewable energy is used for accommodate the reducing of source electricity. Renewable energy also identified as natural energy sources. It can be used as a part of an extreme long choice of times and without a hesitation to never run out. Currently, several states all over the world are focused on certain choice methods to produce power by recommending out a great deal of new approaches for energy saving because of the desire to cut the reliance of the present unsustainable sources. With all option recommended, piezoelectricity eras occur to be one approach of energy harvesting and can perhaps be formed to a huge scale and can harvest adequate quantity of power.

Furthermore, the statistics of vehicles on the road now are increasing quickly. The traffic actuated strains and stresses delivered by the vehicles can be possibly used for the energy harvesting purposes. Harvesting energy from the asphalt pavement roadways as they transform mechanical strain energy into electrical voltage using piezoelectric devices is perfect. In this project, the roads are used to generate electricity with the piezoelectric present. As we know, the total statistics of vehicle on the road are increasing day by day so from this the total of electricity that can be harvest also can increase. This electricity produced can be used for different purpose such as backup for solar street lighting at night.

The planned system involves a certain movement or vibrations on the piezoelectric material to change vibration to electric current. Hence, the system is designed to be applied on the roadways because have vibration when the vehicle through the roadways.

1.2 Problem Statement

As a quickly creating country, Malaysia isn't accepted since the difficulties. Malaysia too has started systems toward limit the harmful ecological effect in the energy source chain. In 1979, the National Energy Policy was figured to guarantee ampleness, security and cost-effectiveness of energy supply, and in addition to advance the proficient usage of energy. This was additionally underlined in the Ninth Malaysia Plan where efforts in the use of sustainable power source assets and effective utilization of energy were additionally advanced. In this manner, Malaysia's significance in motivating the news that „clean and green' is the path advancing to making an economy that depends on reasonable preparations inspired by the foundation of the Ministry of Energy, Green Technology and Water .

Energy is the essential requirement for the economic development of our nation. In our everyday life, utilizes energy greater amount for different reason like domestic, industrial and business reason. Electrical energy is creating from energy available in different structures in nature. We can produce power by utilizing renewable and non-renewable sources. These sources are wind, sun, water, fuel, sea and so on. By utilizing such regular conventional sources for the generation of electrical power, it will dirty the environment. Without these sources television can't be on the grounds that no power supply, cell phone could be charge when out of battery, roadways will be dull around evening time since road light can't light on and so on.

By utilizing sustainable power source, it gives numerous potential advantages particularly in human life and condition. Sustainable power source have such a large number of categories. Sunlight is one of the greater part of these sustainable power sources. The straight outcome of differential warming of the Earth's surface which prompts air moving and precipitation shaping as the air is lifted, for example such as Wind and hydroelectric power. Besides that, energy supply from the sunlight is the

straight change of sunlight utilizing boards or collectors. Other example which contained in plants like biomass energy is put away the sunlight. With a continuous supply of sustainable power source, the world will have more energy supplies to maintain planet, keep human race, generation and also bring economic benefit to numerous regional region.

Nowadays, many vehicles can we see on the road. However, have we thought about the amount of energy wasted by each vehicle on the road every day. From the vehicle on the road, it can produces energy that can be applied and used as a sustainable power sources. But, the main challenging for this sustainable power sources system is, the budget are greater than non-sustainable power sources and sometimes it contribute to assist air pollution problem. New concepts are being verified by several advanced engineer and researchers from all over the world. Besides that, some example such as hydroelectric power generators can be further solutions that can be explored to be assigning as new assets. So that, the easiest alternative that are cheapest and suitable to eco-system must be consider first.

1.3 Objectives

There are a few goals need to be reached and achieve after complete and finish this final year project due to the following features below:

- i. To investigate a suitable piezoelectric material for generating electrical power those are sustainable, economic and feasible.
- ii. To design piezoelectric free energy harvester.
- iii. To develop the piezoelectric prototype as energy harvester.

1.4 Scope

The energy harvesting from asphalt pavement roadways vehicle-induced stresses is the main scope of this final year project. This project will focus on designing and developing a prototype of energy harvester using piezoelectric material. The piezoelectric material that use in this project must be suitable. Other than that, this project also will focus on generating free energy which is give a lot of advantages to the community. The generating of free energy harvester is for the usage of the street light. Moreover, this project will focus on how the piezoelectric operate as a renewable energy that gives a lot of benefit as green technology. The project will be test and check to ensure to get on the performance of piezoelectric.