



SHOE POWER GENERATION USING PIEZOELECTRIC



**BACHELOR OF ELECTRICAL ENGINEERING
TECHNOLOGY (Industrial Power) WITH HONOURS**

2020



Faculty of Electrical and Electronic Engineering Technology

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SHOE POWER GENERATION USING PIEZOELECTRIC

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UNIVERSITI TEKNIKAL MALAYSIA MELAKA

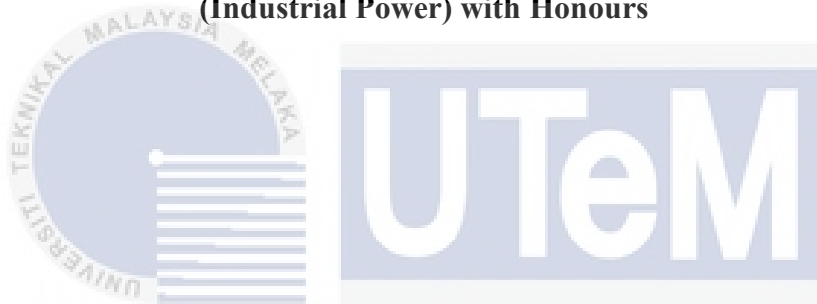
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(Industrial Power) With Honours**

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SHOE POWER GENERATION USING PIEZOELECTRIC

NURUL SYAZWANI BINTI MD ZURAINI

A thesis submitted
in fulfillment of the requirements for the degree of
Bachelor of Electrical Engineering Technology
(Industrial Power) with Honours



Faculty of Electrical and Electronic Engineering Technology

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

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APPROVAL

This report is submitted to the Faculty of Electrical and Electronic Engineering Technology of Universiti Teknikal Malaysia Melaka (UTeM) as a partial fulfilment of the requirements for the degree of Bachelor of Electrical and Electronic Engineering Technology (Industrial Power) with Honours. The member of the supervisory is as follow:



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ABSTRAK

Dalam era globalisasi ini, tenaga sangat penting untuk kehidupan dan semua organism hidup. Pilihan dan keputusan tenaga kita mempengaruhi system semula jadi Bumi dengan cara yang mungkin tidak disedari oleh manusia, jadi penting untuk memilih sumber tenaga dengan berhati-hati. Tenaga digunakan untuk pertanian, pengangkutan, teknologi maklumat dan komunikasi manusia. Tenaga boleh diperbaharui harus digunakan dan bukannya tenaga tidak boleh diperbaharui untuk mengurangkan pelepasan gas rumah hijau. Piezoelektrik adalah sumber penuaian tenaga yang biasa. Penuaian tenaga adalah proses mengekstraksi, menukar dan menyimpan tenaga dari persekitaran yang dapat menjana dari tekanan, getaran dan pergerakan. Piezoelektrik dapat menghasilkan tenaga apabila tekanan dikenakan keatasnya, bahan-bahan tersebut akan menukar tenaga mekanikal menjadi tenaga elektrik dan sebaliknya. Tujuan projek ini adalah untuk menghasilkan sumber tenaga yang boleh diperbaharui untuk kegunaan peribadi semasa keadaan kecemasan, untuk membangunkan system penjanaan tenaga piezoelektrik pada kasut yang dapat menjana elektrik. Penjanaan tenaga kasut ini menggunakan projek piezoelektrik menggunakan elemen sensor piezoelektrik yang ditekan sebagai input untuk menjana elektrik dan menyimpannya dalam bateri untuk tujuan pengecasan semasa kes kecemasan. Penyearah jambatan digunakan untuk menukar voltan AC ke voltan DC. Hasilnya, prototaip system penuai tenaga piezoelektrik perlu menuai tenaga dan menukarnya menjadi tenaga elektrik untuk mengecaskan bateri dan outputnya. Data yang dikumpulkan dari system prototaip projek kemudian dianalisis, dinilai dan dikekalkan untuk peningkatan selanjutnya.

ABSTRACT

In this era of globalization, energy is essential to life and all living organisms. Our energy choices and decision impact Earth's natural systems in ways that people may not be aware of, so it is essential to choose the energy source carefully. Energy is used for agriculture, transportation, information technology and human communication. Renewable energy should be used instead of non renewable energy to reduce greenhouse gas emission. Piezoelectric is a common sources of energy harvesting. Energy harvesting is a process of extracting, converting and storing energy from the environment that can generate from pressure, vibrations and motion. Piezoelectric can generate energy when pressure applied to it, the materials will convert mechanical energy to electrical energy and conversely. The aim for this project is to produce a renewable energy source for personal use during emergency situation, to develop a piezoelectric power generation system on shoe that can generate electricity and to develop a piezoelectric power generation on shoes that can generate electricity. This shoe power generation using piezoelectric project used a pressed piezoelectric sensor element as an input to generate electricity and to store it in a battery for charging purpose during an emergency case. The bridge rectifier is used to convert the AC voltage to DC voltage. As the result, the piezoelectric energy harvester system prototype needs to harvest the energy and convert it to electrical energy to charge the battery and the output. The data collected from the project prototype system are then analyzed, evaluated and maintained for the further improvement.

DEDICATION

The whole paper are fully devoted to my beloved parents, who were my inspiration and gave the support when I felt like giving up. They also are the one who keep giving me moral, spiritual, financial and emotional guidance. Next, to my siblings and friends who expressed their support and motivation throughout this journey. To my supervisor and lecturers, who taught and helped me to finish this report. Thank you very much.



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TABLE OF CONTENTS

	PAGE
ABSTRAK	vi
ABSTRACT	vii
DEDICATION	viii
ACKNOWLEDGEMENT	ix
TABLE OF CONTENTS	x
LIST OF TABLES	xiv
LIST OF FIGURES	xv
LIST OF APPENDICES	xvii
LIST OF SYMBOLS	xviii
CHAPTER 1 INTRODUCTION	1
1.1 Background	1
1.2 Problem statement	2
1.3 Objective	3
1.4 Scope	3
1.5 Thesis outline	3
CHAPTER 2 LITERATURE REVIEW	5

2.1	Introduction	5
2.2	Renewable energy	5
2.3	Piezoelectric	7
2.4	Piezoelectric effects	9
2.5	Properties of piezoelectric material	9
2.5.1	The difference between a non-piezoelectric material and a piezoelectric material	11
2.5.2	Type of piezoelectric material	14
2.6	Piezoelectric sensor	15
2.7	Piezoelectric motor	17
2.7.1	Categories of piezoelectric motor	18
2.8	Comparison of piezoelectric energy harvester	20
CHAPTER 3 METHODODOLOGY		25
3.1	Introduction	25
3.2	Process flow of piezoelectric	25
3.3	Design of the project	30
3.3.1	Circuit design	30
3.4	List of components	31
3.4.1	Piezoelectric sensor	31
3.4.2	Schottky diode	32

3.4.3	Lithium polymer battery	33
3.4.4	Capacitor	34
3.4.5	DC to DC converter step up boost module with USB	36
3.4.6	Multimeter	36
3.5	Gantt chart	37
 CHAPTER 4 RESULT & DISCUSSION		 39
4.1	Introduction	39
4.2	Generation analysis of the piezoelectric shoe	39
4.3	Hardware	39
4.4	Generation analysis using Schottky diode (SB 160) as a bridge rectifier	41
4.5	Generation analysis using general purpose diode (1N4001) as a bridge rectifier	45
4.6	Result of the project	49
4.7	Charging and discharging capacitor test	51
 CHAPTER 5 CONCLUSION & RECOMMENDATION		 54
5.1	Introduction	54
5.2	Conclusion	54
5.3	Recommendation for future work	55

REFERENCES

56

APPENDIX

59



LIST OF TABLES

TABLE	TITLE	PAGE
Table 2. 1:	Comparison of Piezoelectric Energy Harvester	20
Table 3. 1:	Gantt Chart of the Week Progress	38
Table 4. 1:	Analysis for 4 Piezoelectric connected to Schottky Diode as Bridge Rectifier Without Load and With Load	42
Table 4. 2:	Analysis for 8 Piezoelectric connected to Schottky Diode as Bridge Rectifier Without Load and With Load	44
Table 4. 3:	Analysis for 4 Piezoelectric connected to General Purpose Diode as Bridge Rectifier without Load and with Load	46
Table 4. 4:	Analysis for 8 Piezoelectric connected to General Purpose Diode as Bridge Rectifier without Load and with Load	48
Table 4. 5:	Analysis for Charging Capacitor Test with Load	50
Table 4. 6:	Analysis of Time Taken and Output Voltage for Charging Capacitor	52
Table 4. 7:	Analysis of Time Taken and Output Voltage for Discharging Capacitor	52

LIST OF FIGURES

FIGURE	TITLE	PAGE
Figure 2. 1:	Example of Renewable Energy	7
Figure 2. 2:	Quartz, Tourmaline and Rochelle Salt	10
Figure 2. 3:	Positive and Negative Charge when No Stress Applied	11
Figure 2. 4:	Positive and Negative Charge when Stress Applied	12
Figure 2. 5:	Positive and Negative Charge when No Stress Applied	13
Figure 2. 6:	Positive and Negative Charge when Stress Applied	13
Figure 2. 7:	Piezoelectric Sensor (Pin Type)	16
Figure 2. 8:	Piezoelectric Sensor (Lead Type)	16
Figure 2. 9:	The Specification of Piezoelectric Pin Type and Lead Type	17
Figure 2. 10:	Piezo-walk Drives Motor	20
Figure 3. 1:	Overall System Idea for Shoe Power Generation using Piezoelectric	26
Figure 3. 2:	Flowchart of the Project	27
Figure 3. 3:	Circuit diagram of the Project	30
Figure 3. 4:	Hardware Circuit Design	31
Figure 3. 5:	Piezoelectric Sensor	32

Figure 3. 6: Schottky Diode as Bridge Rectifier	33
Figure 3. 7: Lithium Polymer Battery	34
Figure 3. 8: Polarized Capacitor	35
Figure 3. 9: Non Polarized Capacitor	35
Figure 3. 10: DC to DC Converter Step Up Boost Module with USB	36
Figure 3. 11: Multimeter	37
Figure 4. 1: Hardware of the Project	40
Figure 4. 2: Hardware Connection of the Piezoelectric	40
Figure 4. 3: Graph of Number of Step vs Output Voltage for 4 Piezoelectric When used Schottky Diode as Bridge Rectifier	42
Figure 4. 4: Graph Number of Step vs Output Voltage for 8 Piezoelectric When used Schottky Diode as a Bridge Rectifier	44
Figure 4. 5: Graph Number of Step vs Output Voltage for 4 Piezoelectric when used General Purpose Diode as a Bridge Rectifier	46
Figure 4. 6: Graph of Number of Step vs Output Voltage for 8 Piezoelectric that used General Purpose Diode as a Bridge Rectifier	48
Figure 4. 7: Graph of Number of Step vs Output Voltage for Charging Capacitor Test with Load	50
Figure 4. 8: Graph of the Output Voltage vs Time Taken for Charging and Discharging Capacitor	53

LIST OF APPENDICES

APPENDIX	TITLE	PAGE
	Appendix 1: Piezoelectric 7BB-20-6L0 Datasheet	59
	Appendix 2: Diode 1N4007	61
	Appendix 3: Diode SB160	64



LIST OF SYMBOLS

AC	-	Alternating Current
DC	-	Direct Current
A	-	Current
V	-	Voltage
B	-	Magnetic Induction
E	-	Electric field vector
D	-	Electrical induction
H	-	Magnetic field



CHAPTER 1

INTRODUCTION

1.1 Background

The conserved quantity which can be transferred to an object or heat is called energy. Energy can only be converted but cannot be destroyed or created. The common form of energy is kinetic energy, potential energy, elastic energy, chemical energy and thermal energy. Everyone needs energy supply to achieve their needs such as preparing food, lighting, heating, and transportation, in order to sustain efficient services. The development of energy resources must be safe and have low environmental impacts in order to ensure sustainable growth (Santos *et al.*, 2017). There are two types of energy that is renewable energy and non renewable energy. Non renewable energy is energy that will not be recharged in our lifetime. Renewable energy is a term used to describe to the types of natural energy that produced from the environment and the source that will continually regenerated. The example of renewable energy is wind energy, solar energy, geothermal, biomass, and hydropower. The word renewable energy or green energy should not be confused with alternative energy, which represents energy sources beyond usual one. As example is gasoline, which are perceived to be more environmentally friendly or less harmful.

The word 'piezo' comes from a Greek word meaning to squeeze or pressure. The first experiment about piezoelectric was by Pierre and Jacques Curie that published on 1880 (Poplavko and Yakymenko, 2020). It was about a connection of macroscopic

piezoelectric phenomena and crystallographic structure that consisted of a calculation of a surface charges that occur in special crystal which were applied to mechanical pressure. The crystals are tourmaline, quartz, topaz, cane sugar and Rochelle salt. Pierre and Jacques Curie discovered that pressure applied to a quartz crystal creates charge in the crystal, a phenomenon they called as direct piezoelectric effect. Piezoelectricity or also called piezoelectricity effect is an appearance of an electrical potential such as voltage across the side of a crystal when it have mechanical stress. In practical, the crystal is like a tiny battery with a positive charge and negative charge on each side. The current will flow if the both side is connected.

1.2 Problem statement

Nowadays, energy waste has been such a high alarming rate for us. Electric power was being wasted when just by leaving an electronic gadget running for a long time such as a computer and conditioning system. Therefore, we need to think a method on how to generate renewable energy for personal use and also can help to limit the energy source in the future.

Furthermore, the idea of developing technology of renewable energy is to focus on preserving our environment. This system will provide an emergency power source and to recharge the storage devices.

Walking is the most common activity in human life. Mechanical compression will happened on every step we take. Instead of just walking without generating any electricity, piezoelectric in shoes is created to produce electricity for personal use.

1.3 Objective

The main goals of this project are to:

- a) To produce a renewable energy source for personal use in an emergency situation.
- b) To develop a piezoelectric power generation system on shoes that can generate electricity.
- c) To analyze the performance of bridge rectifier circuit.

1.4 Scope

- a) Measuring the amount of AC electricity that is produced by the piezoelectric.
- b) Design a prototype of a shoe that can only use for walking.
- c) The hardware part section is to produce AC voltage from piezoelectric element and to convert it to DC voltage in the bridge rectifier to charge the rechargeable battery for charging a Smartphone in an emergency situation.

1.5 Thesis outline

The outline of this thesis will describe all about the shoe power generation using piezoelectric project. This thesis consists of five chapters in total. Chapter 1 provides the introduction of this project including the problem statement, objective and scope of the project.

Next, chapter 2 will discussed the literature review and the theoretical research about this project. The main background theory that related to the project will also be provided in chapter 2.

Chapters 3 are an overview of research methodology. The outcome and output of the project will be state in chapter 3. This chapter will discuss all the method including the circuit diagram, figures, charts and tables.

Chapter 4 are an overview about the result and discussion for hardware of the project. The analyses and result of the hardware are shown in this chapter.

Chapter 5 is the conclusion for this project. The accomplishment of the goals of the project is explained here. Future recommendations for this Shoe Power Generation using piezoelectric project are also explained.

