



UNIVERSITI TEKNIKAL MALAYSIA MELAKA

**A STUDY ON THE POTENTIAL OF PELTIER IN GENERATING
ELECTRICITY USING NATURAL RESOURCES**

This report submitted in accordance with requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor of Electrical Engineering Technology (Industrial Automation & Robotic) with Honours.

By

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APPROVAL

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ABSTRAK

Hari ini, manusia sibuk dengan kerja-kerja harian mereka. Dengan jadual yang sibuk, seseorang itu akan mencari jalan bagi meluangkan masa mereka untuk merehatkan minda. Mereka akan keluar dari bandar besar untuk melakukan beberapa aktiviti untuk melepaskan tekanan mereka contohnya seperti merentas hutan, mendaki bukit, perkhemahan dan lain-lain. Apabila melakukan aktiviti ini, masalah utama mereka adalah penggunaan elektrik adalah terhad untuk digunakan selama melakukan aktiviti luar. Biasanya mereka hanya akan bergantung kepada “*power bank*” tetapi dengan anggaran, penggunaan elektrik hanya akan bertahan selama dua kali cas penuh dengan kapasiti 10,000mAh “*power banks*”. Oleh kerana batasan ini, satu kaedah telah dicadangkan untuk mengatasi masalah ini untuk menjana tenaga elektrik dengan menggunakan peranti Peltier. Dengan menggunakan Peltier, membolehkan untuk membangunkan sistem penjanaan mudah alih dengan menggunakan sumber semula jadi. Secara umumnya, sistem penjanaan yang digunakan untuk mengecas telefon dengan menggunakan sumber semula jadi sama ada sungai atau api perkhemahan. Sistem penjanaan boleh digunakan pada pelbagai jenis barangan komputer seperti kipas kecil, lampu dan lain-lain. Oleh itu, hasil yang akan diperolehi dari segi voltan dan arus. Voltan yang dihasilkan adalah 5v dan arus adalah 1A, jadi sistem penjanaan ini boleh mengecas telefon.

ABSTRACT

These days, human's life is busy with their daily works. With busy schedule, man will find a way to spend their time to relax their's mind. They will go out from big city to do some activities to release their stress such as jungle trekking, hill climbing, camping and et cetera. When do this activities, their main problems is the usage of electricity is limited for use during doing these outdoor activities. Usually they will only rely on power banks but by some estimation, the electricity usage will last for two time's full charge with 10 000mAh capacity of power banks. Because of this limitation, a method has been proposed in order to overcome this problem to generate electricity by using peltier device. By using peltier, it is possible to develop a portable generating system by using natural resources. Generally, the generating system is used to charge a phone by using either river or camp fire. This generating system can be applied on many types of computer items such as small fan, light and et cetera. Therefore, the result will obtain in term of voltage and current. The voltage produced is 5v and current is 1A, so this generating system can charge a phone.

DEDICATION

To my beloved parents, thank for the support that they provided me through my entire life and in particular. Words cannot express how grateful I am to my mother and father for all of the sacrifices and prayer that they have made on my behalf.

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TABLE OF CONTENT

ABSTRAK	i
ABSTRACT	ii
DEDICATION	iii
ACKNOWLEDGEMENT	iv
TABLE OF CONTENT	v
LIST OF TABLES	viii
LIST OF FIGURES	ix
LIST OF ABBREVIATIONS, SYMBOLS AND NOMENCLATURE	x
CHAPTER 1	1
INTRODUCTION	1
1.0 Introduction	1
1.1 Background	1
1.2 Problem Statement	3
1.3 Project Objective	3
1.4 Project Scopes	4
1.5 Thesis Outlines	4
CHAPTER 2	6
LITERATURE REVIEW	6
2.0 Introduction	6
2.1 A Study on Improved Efficiency and Cooling LED Lighting using a Seebeck Effect	6
2.2 Renewable Energy Lamp to Replace Kerosene Lamp	7
2.3 Thermoelectric Generators as Alternate Energy Source in Heating Systems	7
2.4 Self – Energy Generating Cook Stove	8
2.5 Waste heat energy harvesting using thermo electric generator	8
2.6 Thermoelectric generators in renewable energy	9
2.7 Performance Analysis of A Prototype Small Scale Electricity-Producing Biomass Cooking Stove	9

2.8	Automobile Exhaust Thermo-Electric Generator Design & Performance Analysis	10
2.9	Thermoelectric Power Generation Using Waste-Heat Energy as an Alternative Green Technology	10
2.10	Generation of Electricity from Gasoline Engine Waste Heat	11
2.11	Experimental Investigation of an Improved Exhaust Recovery System for Liquid Petroleum Gas Fuelled Spark Ignition Engine	11
2.12	Multipurpose Thermal Sensor Based on Seebeck Effect	12
2.13	Data Acquisition and Virtual Instrumentation System for the Study of Peltier and Seebeck Effects	12
2.14	The Effect of Aluminium Nanoparticle on the Seebeck Coefficient of Biomedical Thermoelectric Devices	13
2.15	Energy harvesting from multiple sources for Battery charging	13
2.16	Pilot Centralized Solar Power Station in Remote Village, Rompin, Pahang	14
2.17	Power Flow Control of Isolated Wind-Solar Power Generation System for Educational Purposes	15
2.18	Fuzzy Control of a Lead Acid Battery Charger	15
2.19	Development of Battery Charge/Discharge Regulator for Photovoltaic Systems	16
2.20	Optimum Design and Selection of Heat Sinks	16
2.21	Summary	17
CHAPTER 3		18
METHODOLOGY		18
3.0	Introduction	18
3.1	Methodology	19
3.1.1	First Phase	19
3.1.2	Second Phase	20
3.1.3	Third Phase	20
3.1.4	Forth Phase	20
3.1.5	Final Phase	21
3.2	Peltier	21
3.3	Cooling Part System	22
3.4	12V Rechargeable Lead Acid Battery	23
3.5	Arduino Uno Rev3	23

3.5.1	LM35 Temperature Sensor	24
3.5.2	Arduino 25V Voltage Sensor Module	24
3.5.3	Liquid Crystal Display	25
3.5.4	Programming Code	25
3.5.5	PLX-DAQ Data Recording	28
3.6	High Efficient Series PWM Controller	28
3.7	Overall System	29
CHAPTER 4		30
RESULT & DISCUSSION		30
4.0	Introduction	30
4.1	Preliminary Result	30
4.2	Voltage VS Temperature Differential	33
4.3	Current VS Temperature Differential	34
4.4	Final Result	35
4.5	Calculation of Generating System	39
4.6	Power Generated by Three Peltier TEG1 4199-5.3	40
4.7	Data Collected at Asahan	41
CHAPTER 5		42
CONCLUSION		42
5.0	Introduction	42
5.1	Conclusion of Generating System	42
5.1.1	Summary of Voltage Generated	42
5.1.2	Potential of Peltier TEG1 4199-5.3 to Generate Electricity using Natural Resources	43
5.2	Implications of Generating System and Future Work	43
5.3	Durability of Peltier in Generating Electricity	43
5.4	Limitations	44
REFERENCES		45
APPENDIX A		48
APPENDIX B		53
APPENDIX C		56

LIST OF TABLES

Table 3.1 : Thermal Conductivity	22
Table 4.1.2: TEG1 1263-4.3	30
Table 4.1.3: TEG1 1268-4.3	31
Table 4.1.4: TEG1 4199-5.3	32
Table 4.1.5: TEG1B 12610-5.1	32

LIST OF FIGURES

Figure 1.1: Seebeck Effect	2
Figure 3.1: Flowchart	18
Figure 3.2: TEG1 4199-5.3	21
Figure 3.3: Natural Cooling System using River Water	22
Figure 3.4: Battery	23
Figure 3.5: Arduino Uno Rev3	23
Figure 3.6: LM35 Temperature Sensor	24
Figure 3.7: 25V Voltage Sensor Module	24
Figure 3.8: Liquid Crystal Display	25
Figure 3.9: PLX-DAQ Data Recording	28
Figure 3.10: High Efficient Series PWM Controller	29
Figure 3.11: Overall Generating System	29
Figure 4.1: Voltage Vs Temperature Differential	33
Figure 4.2: Current Vs Temperature Differential	34
Figure 4.3: Temperature Vs Time for Hot Temperature	35
Figure 4.4: Temperature Vs Time using Cooling System	36
Figure 4.5: Relationship between Voltage and Current Vs Time for Hot Temperature	36
Figure 4.6: Relationship between Voltage and Current Vs Temperature Difference for Hot Temperature	37
Figure 4.7: Relationship between Voltage and Current Vs Time using Cooling System	38
Figure 4.8: Relationship between Voltage and Current Vs Temperature Difference using Cooling System	38
Figure 4.9: Data Collected at Asahan	41

LIST OF ABBREVIATIONS, SYMBOLS AND NOMENCLATURE

TEG	-	Thermo-electric Generator
UTeM	-	Universiti Teknikal Malaysia Melaka
°C	-	Degree Celsius or Centigrade
°K	-	Degree of Kelvin
V	-	Volt
A	-	Ampere
m/s	-	Meter per seconds
PWM	-	Pulse Width Modulation
USB	-	Universal Serial Bus
MOSFET	-	Metal Oxide Semiconductor Field Effect Transistor
MPU	-	Memory Protection Unit
r.m.s.	-	Root Mean Square
rpm	-	Revolutions per minute
pv	-	Photovoltaic

CHAPTER 1

INTRODUCTION

1.0 Introduction

This chapter is explained the basic knowledge about this project. In this section, the contents enclosed are background, problem statement, project objectives and project scopes.

1.1 Background

The design of this project is to generate electricity which the source of electricity is scarce. Usually outdoor enthusiasts only rely on power banks as a source of electricity but with this project anyone can easily produce electricity by depend on natural resources. This portable generating system is focus on the cell phone charging while doing outdoor activities by using renewable source. This charger makes the utilization of renewable source of energy like camp fire or a waterfall. The device that been used to make this generating system works is peltier device.

A Thermoelectric generator is a device that converts temperature differences into electrical energy called the Seebeck effect. In Seebeck effect theory, the electrons in the semiconductor act as transferring agent to transfer the heat from one medium to another medium according to the law of thermodynamics. By applying the Seebeck effect theory, this project had been proposed to design a device that generates electricity using natural resources. This project focused on the outdoor activities users.

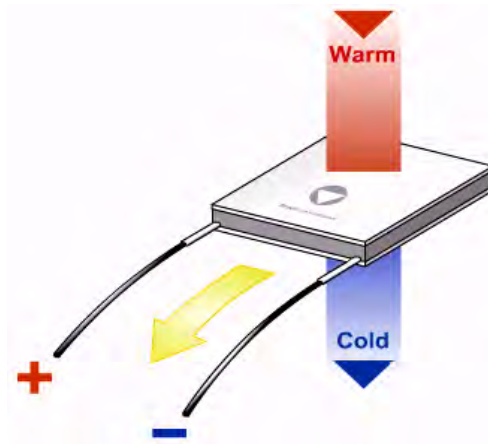


Figure 1.1: Seebeck Effect

In 1821, two wires of dissimilar metals joined by Thomas Seebeck (copper wire and bismuth wire) to form a loop or circuit and accidentally discovered Seebeck effect that produce electricity when the temperature difference is resulting from hot and cold npn junction type of semiconductors. Heat will be absorbed on the hot side and leaving to the cold side of the Peltier device. During the process, the electrons in the NPN semiconductor will active and vibrate due to heat then collides with each other in order to release the heat to the cold side.

According to “Energy Harvesting From Multiple Sources for Battery Charging” cell phones are becoming the most important personal communication device which is 60% of the world’s population users of cell phones (Therampilly 2012). Nowadays, to power up the cell phone is becoming an important need for 4.1 billion of users in the world, it is important to be able to power up cell phones wherever situated. There are people did not have access to electricity which is 1.4 billion people around the world according to the International Energy Agency, in 2010, (OECD/EIA 2010). There are people out there who cannot retrieve of electricity and use a cell phone because of this limitation.

1.2 Problem Statement

The difficulty of finding the source of electricity when doing outdoor activities is the factor to design a device for backup electrical supply for phone charger or other usage. When the source of electricity is scarce, usually outdoor enthusiasts only rely on power banks as a source of electricity. By some estimation, the electricity usage will last in three times. Thus, the usage of power banks is not a very effective device where there is a device that can generate electricity by using natural resources. In this case, the generating system must be portable so the outdoor enthusiasts could bring it anywhere they prefer. The project will study on the potential of peltier in generating electricity using natural resources when doing outdoor activities.

1.3 Project Objective

A method has been proposed in order to overcome this problem. The objectives of these project is

- a) To define the efficiency of generating electricity by using 4 types of peltier.
- b) To develop a portable generating system by using the best peltier in generating electricity for outdoor purposes.
- c) To analyse the performance of the proposed system in term of power, current and efficiency.

1.4 Project Scopes

The scope of this project is to study on the potential of peltier in generating electricity using natural resources when doing outdoor activities. The project is to develop a generating system by using the best peltier in generating electricity for outdoor purposes. Data will be analysing in term of power, current and efficiency. The scopes of this project are:

- a) The efficiency of generating electricity should exceed 10%.
- b) The peltier that is used in this project must be the best one so the efficiency of product achieves what is targeted.
- c) The current that are produced must be 1A; voltage must be 5v so this project can charge the phone.

1.5 Thesis Outlines

Portable generated system using natural resources as a medium for heating and cooling the peltier. Basically introduction, literature review, methodology, result & discussion, conclusion and further development that can be applied in this project is attached on the topic of generating energy which called Seebeck effect.

The introduction of the project is on chapter 1. The objectives of the project and the main idea about the background will be discussed in this chapter. The problem statement and scope of the project is also been describe. This chapter is the chapter where the idea is come up with to overcome the problem face by the society. In this chapter also will be discussed the overview of the entire project to show proper development of the project.

Chapter 2 is about the summarize and literature review of the entire journal for the development of the portable generating system by using natural resources as a medium of generating system. This includes the future project development that can be added in this project.

Chapter 3 will discussed about the methodology of this project development. In this chapter, it will explain the flow of the project to create a portable generating system. In this chapter also, describe about the parts that used in this development project such as peltier, heat sinks, battery and overall system.

Chapter 4 will brief about expected result that can be achieved by this portable generating system. The full design and basic concept of the project will be focused in this chapter.

Chapter 5 will conclude the overall system whether the portable generating system achieved what is targeted on the objective. The limitation and problem face when conducting this project will be also attached in this chapter.

CHAPTER 2

LITERATURE REVIEW

2.0 Introduction

This chapter describe what is Seebeck effect and thermoelectric generator which have been developed by the previous researchers. This chapter is done to investigate the peltier and other generating system parts. It also consists of the information which will be the parameter for the developing this project.

2.1 A Study on Improved Efficiency and Cooling LED Lighting using a Seebeck Effect

The objectives of these research is to study on thermal problem and develop higher performance cooling methods for LED lighting system and to compare each LED cooling system for 5 different cases. The method that the researcher used is the experiment had done for 5 different cases. It was measured only LED chips without the heat sink in case 1. Case 2 was performed experiment with heat sink. Used a peltier element in experiment devices are in the case 3 and 4. Case 3 powers is 0.2 W and 0.4 W is for case 4 were input in peltier element. Connected heat sink and LED chip is for case 5. The result obtained with seebeck element is 9% higher than heat sink and 4% lower than peltier element for cooling efficiency of LED. Electric power generated by seebeck element was 0.0035mW that produced from thermal energy on LED lighting. It is more efficiency in cooling system using a seebeck element.(Park & Huh 2012)

2.2 Renewable Energy Lamp to Replace Kerosene Lamp

The objective of this research is to develop a renewable energy lamp for people who live far away from the power delivery system depend on traditional kerosene lamp for light. This new lamp is built to store energy in a small battery when power is available. The battery power is used in the night to obtain light. This lamp is energized with a small solar panel. Battery power is sufficient to illuminate a common size room for 4 hours and the charger is capable to charge the small battery in day time. The voltages that are supply for battery charging is 4.3v and maintain 4.3v over time. The current that are charging the battery is for the first to 5 minute is 1.25A to 1A and reduce over time. The advantages of this project are risk of fire can be minimized due to absence of oil. Then, renewable energy sources produce clean power. Therefore room can be illuminated without polluting the environment. This does not produce hazardous fires & operational cost is minimal. So, the dependence on fossil fuel to generate light is reduced. This lamp doesn't have a flame so that it is safer than the kerosene lamp.(Jayawickrama 2014)

2.3 Thermoelectric Generators as Alternate Energy Source in Heating Systems

The objective of this research is to develop independent electric energy source in households and industrial heating for burning and heating systems. The thermoelectric generator used in this project are two peltier module TEP1 1264-1.5. P-type and n-type semi-conductor couples of 126 Bi₂Te₃ are a module for one generator. A net voltage will produce by connecting a hole conducting (p-type) and an electron conducting (n-type) material in series that can be driven through a load. 8.46 W per module maximal power generated at highest temperature difference 267.0 °C. Efficiency of thermoelectric generators is increasing and stabilizing with temperature difference and reaches 4.36 % at $\Delta T = 267.0$ °C. The amount of waste heat that leaves through flue pipe in burning process by generators can improve the efficiency of combustion.(Ozollapins & Kakitis 2012)

2.4 Self – Energy Generating Cook Stove

The objective of this research is to convert useful electrical energy in rural areas by emphasize on a sustainable way of utilizing waste thermal energy produced from the cook. The method used in this project is by using a thermoelectric generator (TEG) module; the process of converting thermal energy into electricity is achieved. To improve the efficiency of cook stove, the power gained from the TEG can be used for running a fan to provide sufficient air inside the combustion chamber. Due to limitation of HZ-14, it shows only 14W maximum power output of the module. Power generated by using this method also has limitation on temperature difference where Thermo Electric Generator cannot always produce constant ΔT . Next, HZ-14 also has high cost. HZ-9 module is chosen for the application due to these limitations of HZ-14. 3W is the power generated from the TEG. To improve combustion, the small DC brushless fan is required to cools the cold side of TEG and directs the air to the combustion chamber. A mobile phone will charges and LED light will glow because the generated voltage is boosted up to 5.2 V by a DC-DC boost converter.(Mal et al. 2012)

2.5 Waste heat energy harvesting using thermo electric generator

The objective of this research is to provide electrical energy from thermal energy (heat) based on “Seebeck effect”. The thermoelectric power cycle, with charge carriers serving as the working fluid, follows the fundamental laws of thermodynamics and intimately resembles the power cycle of a conventional heat loss from engine. By using this method, the efficiency of the system will increase from 4% to 7%. The day and night operation is possible because the source for the power generation is heat not light. It is considered as a green technology because mostly waste heat is converting into electrical energy. (Jacks et al. 2013)

2.6 Thermoelectric generators in renewable energy

The objective of this research is to understand the role of conversion of geothermal energy into electrical energy by using thermoelectric generators (TEGs). The *P*-type and *n*-type semiconductors will form the thermo element connecting in series as electrical. Then, to increase the operating voltage, a large number of the thermo elements are electrically connected in series and to increase the thermal conductivity, thermally connected in parallel. The result obtained considering reuse of waste energy gain is their efficiency is about 5–10%. The advantages of this method are TEGs have no moving parts, they are long-lived and work silently, scalable, and no greenhouse gas emissions which is environmentally friendly. On the other hand, it produces low conversion efficiency which is below 10% as their biggest disadvantage. (Ahiska & Mamur 2014)

2.7 Performance Analysis of A Prototype Small Scale Electricity-Producing Biomass Cooking Stove

The objective of this research is to investigate the power generated performance on the field trial of the devices over the first 80 days. The power produced by the TEG is primarily used to charge a 3.3 V lithium iron phosphate (LiFePO₄) battery. The generator stove is used to determine whether this method will be able to charge mobile phones, radios or lights. Due to its limitation, the experiment was done for 80 day period due to the thermal paste will drying out cause by the effects of thermal cycling on the generator system which reduces power output. However, this trial had successfully used to charge mobile phones, lights or radios that had done using the TEG-stoves.(O'Shaughnessy et al. 2015)