

**AN EVALUATION OF PHOTOVOLTAIC AND
THERMOELECTRIC INDIRECT COUPLING FOR MAXIMUM
SOLAR ENERGY EXPLOITATION**

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UNIVERSITI TEKNIKAL MALAYSIA MELAKA

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THERMOELECTRIC INDIRECT COUPLING FOR
MAXIMUM SOLAR ENERGY EXPLOITATION**

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**This report is submitted in partial fulfilment of the requirements
for the degree of Bachelor of Electronic Engineering with Honours**

**Faculty of Electronic and Computer Engineering
Universiti Teknikal Malaysia Melaka**

2018

BORANG PENGESAHAN STATUS LAPORAN
PROJEK SARJANA MUDA II

Tajuk Projek : An Evaluation Of Photovoltaic And Thermoelectric Indirect Coupling For Maximum Solar Energy Exploitation
Sesi Pengajian : 2017/2018

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APPROVAL

I hereby declare that I have read this thesis and in my opinion this thesis is sufficient in terms of scope and quality for the award of Bachelor of Electronic Engineering with Honours.

Signature :

Supervisor Name : Dr. Azdiana Binti Md Yusop

Date : 1st June 2018

DEDICATION

For baba and mama

ABSTRACT

This research aims to the photovoltaic and thermoelectric, PV-TE for generating voltage energy from the indirect coupling using state-of-the-art thermal transfer calculations. A new concept based on an indirect (instead of direct) PV-TE coupling using state-of-the-art thermal transfer calculations is an interesting alternative to maximize solar energy exploitation. This project is a green technology project since it uses solar panel module which is a renewable sun energy source. The main reason in evaluate an indirect coupling solar panel is because of the high cost solar panel for maximum energy exploitation. Furthermore, the less efficient of the direct coupling photovoltaic cell of solar panel also is one of the reasons of doing this project. Besides that, the project will be design an indirect coupling method by using the solar panel module. Next, the feasibility and potential of the indirect coupling efficiency to gain voltage will be verified in this project. Other than that, the software platform that will be used in this project is Matlab R2016a whereas the hardware is 5V Solar Panel Module. The maximum output voltage of this project is 5.5V in an indirect coupling hybrid method of PVTE which is significantly improves the overall efficiency that is very promising for future photovoltaic developments.

ABSTRAK

Kajian ini bertujuan bagi fotovoltaiik dan thermoelektrik, PV-TE untuk menjana tenaga voltan daripada gandingan tidak langsung menggunakan pengiraan pemindahan haba yang terkini. Konsep yang baharu ini adalah berdasarkan penggabungan PV-TE secara langsung (tidak langsung) menggunakan pengiraan pemindahan termal yang terkini adalah alternatif yang menarik untuk memaksimumkan eksploitasi tenaga solar. Projek ini adalah projek teknologi hijau kerana ia menggunakan modul panel solar yang merupakan sumber tenaga matahari yang boleh diperbaharui. Sebab utama dalam menilai panel solar gandingan tidak langsung adalah kerana panel solar yang tinggi untuk eksploitasi tenaga maksimum. Selain itu, projek ini akan merekabentuk kaedah gandingan tidak langsung dengan menggunakan modul panel solar. Seterusnya, kemungkinan dan potensi kecekapan gandingan tidak langsung untuk mendapatkan voltan akan disahkan dalam projek ini. Selain itu, platform perisian yang akan digunakan dalam projek ini ialah Matlab R2016a manakala perkakasan adalah Modul Panel Suria 5V. Voltan tertinggi keluaran projek ini adalah 5.5V dalam kaedah hybrid gandingan tidak langsung PVTE yang secara signifikan dapat meningkatkan keseluruhan kecekapan yang sangat menjanjikan unruk perkembangan fotovoltaiik masa depan.

ACKNOWLEDGEMENTS

In The Name of Allah the Most Merciful and Most Compassionate.

Alhamdulillah, praise be to Allah for the blessings and giving me the strength and ability to complete this Projek Sarjana Muda II (PSM II). This was a valuable experience and great opportunity for me to work on this project. I would like to asseverate the intense thankful and appreciation to my supervisor, Dr. Azdiana Binti Md Yusop for dedicating me the chance to cooperate with her and for her guidance, motivations and advices. Under her supervisory, I have learned, developed, and achieved the completion of this project. Due to her constructive ideas and unrelenting less support, I had been able to complete this project with a certain degree of quality. Besides that, I would like to express gratitude to the lecturers, technicians, postgraduate students, and friends for being with me during the project time, and for being involved directly or indirectly, for their knowledge, supports, kindness and the time they spent together. Other than that, I would also like to convey my wholehearted admiration to my father, my mother and my fellow family for their fondness, incitement, blessing and supports. Then, I would like to praise thankfulness to sovereignty of Universiti Teknikal Malaysia Melaka, UTeM for allocating proper facilities to complete this project.

TABLE OF CONTENTS

Declaration	
Approval	i
Dedication	i
Abstract	i
Abstrak	ii
Acknowledgements	iii
Table of Contents	iv
List of Figures	ix
List of Tables	xii
List of Symbols and Abbreviations	xiii
List of Appendices	xiv
CHAPTER 1 INTRODUCTION	15
1.1 Introduction	15
1.2 Problem Statement	16

1.3	Objectives	17
1.4	Scope of Work	17
1.5	Brief Description of Methodology	17
1.6	Thesis Outline	19
CHAPTER 2 BACKGROUND STUDY		21
2.1	Introduction to Photovoltaic Module	21
2.2	Introduction to Solar Concentrator Photovoltaic Cell (SCPV)	22
2.3	Introduction to Thermoelectric Generator	24
2.3.1	Formation of TEG	26
2.3.1.1	Calcium-Manganese Oxide (CaMnO_3)	27
2.3.1.2	Calcium-Cobalt Oxide ($\text{Ca}_3\text{Co}_4\text{O}_9$)	27
2.3.1.3	Bismuth Telluride (Bi_2Te_3)	28
2.4	Thermoelectric Effect	29
2.4.1	Peltier Effect	29
2.4.2	Thomson Effect	29
2.4.3	Seebeck Effect	29
2.5	Characterization and Behavior Analysis of a Thermoelectric Module Energy Harvesting System Exposed to Transient Sources	30
2.6	Introduction to PV-TE Indirect Coupling	31
2.7	Chapter Summary	35
CHAPTER 3 METHODOLOGY		36

3.1	Introduction	36
3.2	Thermal Accumulation and Distribution from indirect coupling of PV-TE with concentrator lens	37
3.3	Voltage Generation and Thermal Gradient of Photovoltaic Waste heat	38
3.3.1	MATLAB Software	38
3.3.2	PicoLog Recorder Software	40
3.3.3	Basic Configuration of TEG Different Cascade of White Configuration Model	43
3.3.4	Effect of Different cascade of TEG generator	44
3.3.4.1	A layer of TEG generator	44
3.3.4.2	Triple layer of TEG generator	45
3.3.4.3	6 layer of TEG generator	45
3.3.5	Flowchart Summary	46
3.3.6	Effect of different distance between optical concentrator with the solar panel substrate and thermoelectric generator	47
3.3.7	Effect of different condition with cooling and without cooling agent	47
3.4	Flowchart Summary	48
3.5	Effect of Different Loads	49
3.6	Flowchart Summary	50
3.7	Basic Configuration of Black and White Configuration Model	51
3.8	Application to USB connection of 6cm distance optical concentrator	53

3.9	Chapter Summary	54
CHAPTER 4 RESULTS AND DISCUSSION		55
4.1	Introduction	55
4.2	Different number of cascaded of TEG used	56
4.2.1	1 cascaded of TEG	56
4.2.2	3 Cascaded of TEG	58
4.2.3	6 Cascaded of TEG	60
4.3	Voltage Generation and Thermal Gradient of PVTE Indirect Coupling	62
4.3.1	Effect of Hot Side and Cold Side on Voltage Generation and Thermal Gradient of the Thermoelectric	62
4.3.2	Effect of Voltage and Thermal Gradient in Coupling Performance	63
4.3.2.1	Different Conditions of Voltage Generation	63
4.3.2.2	Different Conditions of Thermal Gradient	65
4.3.2.3	With Cooling Fan	65
4.3.2.4	Without Cooling Fan	67
4.3.2.5	4cm Load Resistor	68
4.3.2.6	6cm Load Resistor	70
4.4	Power Generation of PVTE indirect coupling	72
4.4.1	Effect of Temperature	72
4.5	Luminance Accumulation and Efficiency Distribution of PVTE indirect coupling.	73

4.5.1	Effect of Different Distance	73
4.6	Load Dependent Analysis	75
4.7	Application to USB Connection of 6cm distance optical concentrator	76
4.8	Chapter Summary	77
CHAPTER 5 CONCLUSION AND FUTURE WORKS		78
5.1	Conclusion	78
5.2	Recommendation	79
REFERENCES		81
APPENDICES		87
Appendix A		87
Financial Budget		87
Appendix B		89
Data Sheet		89

LIST OF FIGURES

Figure 1.1: Flowchart of the project	18
Figure 2.1: 2D view of basic configuration of the SCPV design	23
Figure 2.2: 3D view and schematic for the sun position of basic configuration of the SCPV design	23
Figure 2.3: 3D model of a thermoelectric generator	24
Figure 2.4: Seebeck effect	25
Figure 2.5: Structure of thermoelement	26
Figure 2.6: TEM in a generator mode	27
Figure 2.7: X-ray diffraction patterns of hydrothermally Te-coated Bi powders (10 μm to 150 μm)	28
Figure 2.8: PV-TE electrical equivalent circuit	31
Figure 2.9: Schematic of photovoltaic- thermoelectric hybrid system with multiple thermoelectric generators consisting of n- and p-type doped semiconductor legs	32
Figure 2.10: 3D variation power of photovoltaic-thermoelectric system	32
Figure 2.11: Direct coupling photovoltaic-thermoelectric system	33
Figure 2.12: Indirect coupling photovoltaic-thermoelectric system	34
Figure 3.1: Indirect coupling of PV-TE with optical concentrator	37

Figure 3.2: Source code in editor window	39
Figure 3.3: Output graph draft	40
Figure 3.4: PicoLog Recorder window	40
Figure 3.5: Recording Method window	41
Figure 3.6: Sampling Rate window	42
Figure 3.7: Converter Details window	42
Figure 3.8: Monitor window in the PLW Recorder	43
Figure 3.9: Basic Configuration	44
Figure 3.10: Flowchart of methodology in first part	46
Figure 3.11: Flowchart of methodology in second part	48
Figure 3.12: Flowchart of methodology in third part	50
Figure 3.13: Set-up of black configuration model	51
Figure 3.14: Set-up of white configuration model	52
Figure 3.15: Inside of the configuration model	52
Figure 3.16: Position of the TEGs, heatsink and cooling fan	53
Figure 3.17: Assemble of the application to USB connection	54
Figure 4.1: Temperature of the hot side and cold side of a cascaded of TEG	56
Figure 4.2: Graph of voltage against time of a cascaded of TEG	57
Figure 4.3: Graph of hot side and cold side of a cascaded of TEG	58
Figure 4.4: Temperature of the hot side and cold side of triple cascaded of TEG	58
Figure 4.5: Graph of voltage against time of triple cascaded of TEG	59
Figure 4.6: Graph of hot side and cold side of triple cascaded of TEG	60
Figure 4.7 Temperature of the hot side and cold side of six cascaded of TEG	60

Figure 4.8: Graph of voltage against time of six cascaded of TEG	61
Figure 4.9: Graph of hot side and cold side of six cascaded of TEG	62
Figure 4.10: Voltage generation against time	64
Figure 4.11: Voltage generation against luminance of light	65
Figure 4.12: Thermal gradient of black configuration model with cooling fan	66
Figure 4.13: Thermal gradient of white configuration model with cooling fan	66
Figure 4.14: Thermal gradient of black configuration model without cooling fan	67
Figure 4.15: Thermal gradient of white configuration model without cooling fan	68
Figure 4.16: Thermal gradient of black configuration model 4cm load resistor.	69
Figure 4.17: Thermal gradient of white configuration model 4cm load resistor	70
Figure 4.18: Thermal gradient of black configuration model 6cm load resistor	71
Figure 4.19: Thermal gradient of white configuration model 6cm load resistor	72
Figure 4.20: Power generation of two different temperature $T=30^{\circ}\text{C}$ and $T=40^{\circ}\text{C}$.	73
Figure 4.21: Luminance of light of different distance optical concentrator.	74
Figure 4.22: Energy efficiency of the hybrid system as a function of PV cooling.	75
Figure 4.23: Voltage generation of different load resistance	76

LIST OF TABLES

Table 4.1: The temperature effectiveness and output voltage of the 6cm concentrator distance from solar panel	63
Table 4.2: Application to USB connection of optical concentrator distance 6cm	77

LIST OF SYMBOLS AND ABBREVIATIONS

PV	:	Photovoltaic
TE	:	Thermoelectric
TEM/TEG	:	Thermoelectric Module
PVTE	:	Hybrid system of photovoltaic and thermoelectric
ΔT	:	Thermal gradient/Temperature difference
CaMnO ₃	:	Calcium-Manganese Oxide
Ca ₃ Co ₄ O ₉	:	Calcium-Cobalt Oxide
Bi ₂ Te ₃	:	Bismuth Telluride
ZT	:	High figure-of-merit/Impedance Temperature

LIST OF APPENDICES

Appendix A: Financial Budget.....	87
Appendix B: Data Sheet.....	89

CHAPTER 1

INTRODUCTION

Basically, this chapter will describe about the main factors that affect the aim of this overall project in deliberately. Other than that, there are also scopes of works and brief methodology that is discussed thoroughly in this chapter.

1.1 Introduction

Nowadays, there is a low demand of solar energy usage in Malaysia. There are many factors that affect to this issue in our country. One of the factor is regarding the highly cost consume of the solar panel device for the electricity energy exploitation. Industrial Revolution 4.0 era in Malaysia has transformed the pattern of the engineering technology which promising in the sustainable latest generation of high technology. The project also is a green technology which can gather the energy source from the sunlight that does not affect to any pollution to happen by the used

of photovoltaic cells (PV) of solar panel which is among the most promising renewable-energy generation systems. However, there are several disadvantages of using the PV cell alone. Thus, in this project the combination of photovoltaic cell with the thermoelectric system will be introduced.

A new concept based on an indirect (instead of direct) PV-TE coupling using state-of-the-art thermal transfer calculations is an interesting alternative to maximize solar energy exploitation [1]. This project is a green technology project since it uses solar panel module which is a renewable sun energy source. The main reason in evaluate an indirect coupling solar panel is because of the high cost solar panel for maximum energy exploitation. Furthermore, the less efficient of the direct coupling photovoltaic cell of solar panel also is one of the reasons of doing this project. Then, there is a lack of new generation of photovoltaic system from the past few years. Besides that, the project is design an indirect coupling method by using the solar panel module. A photovoltaic and thermoelectric indirect coupling for maximum solar energy exploitation is evaluated. Next, the feasibility and potential of the indirect coupling efficiency to gain voltage is verified in this project. However, this project is only focusing on the construction of assembles of indirect coupling solar energy exploitation and determines the voltage gain. The output of this project is there is an indirect coupling which is significantly improves the overall efficiency which is very promising for future photovoltaic developments.

1.2 Problem Statement

The problem statement of this project focus on that there is a high cost of solar panel for maximum energy exploitation. Currently, the available solar panel module is quite expensive with the used of direct coupling photovoltaic system. The indirect

coupling photovoltaic system will reduce the cost with the addition of the concentrator. Other than that, there is a low efficiency of the direct coupling as compared to the indirect coupling of solar energy power. The addition of the concentrator at the indirect coupling solar panel will increase the efficiency of the photovoltaic, PV and thermoelectric, TE system. Next, there is a high heat released from PV cell. By implementing to this project, the advanced technology of photovoltaic system will be improved in the new development.

1.3 Objectives

1. To design an indirect coupling by using the solar module.
2. To evaluate a photovoltaic and thermoelectric indirect coupling for maximum solar energy exploitation
3. To verify the feasibility and potential of the indirect coupling efficiency to gain voltage.

1.4 Scope of Work

The project is focus on the construction of assemble of indirect coupling solar energy exploitation and determine the voltage gain.

1.5 Brief Description of Methodology

Based on Figure 1.1 the simulation of the project is designed in order to obtain the correct platform of the project. The software platform that is used in this project is Matlab R2016a. Besides that, all the simulation design and mathematical source code is developed in this software platform.

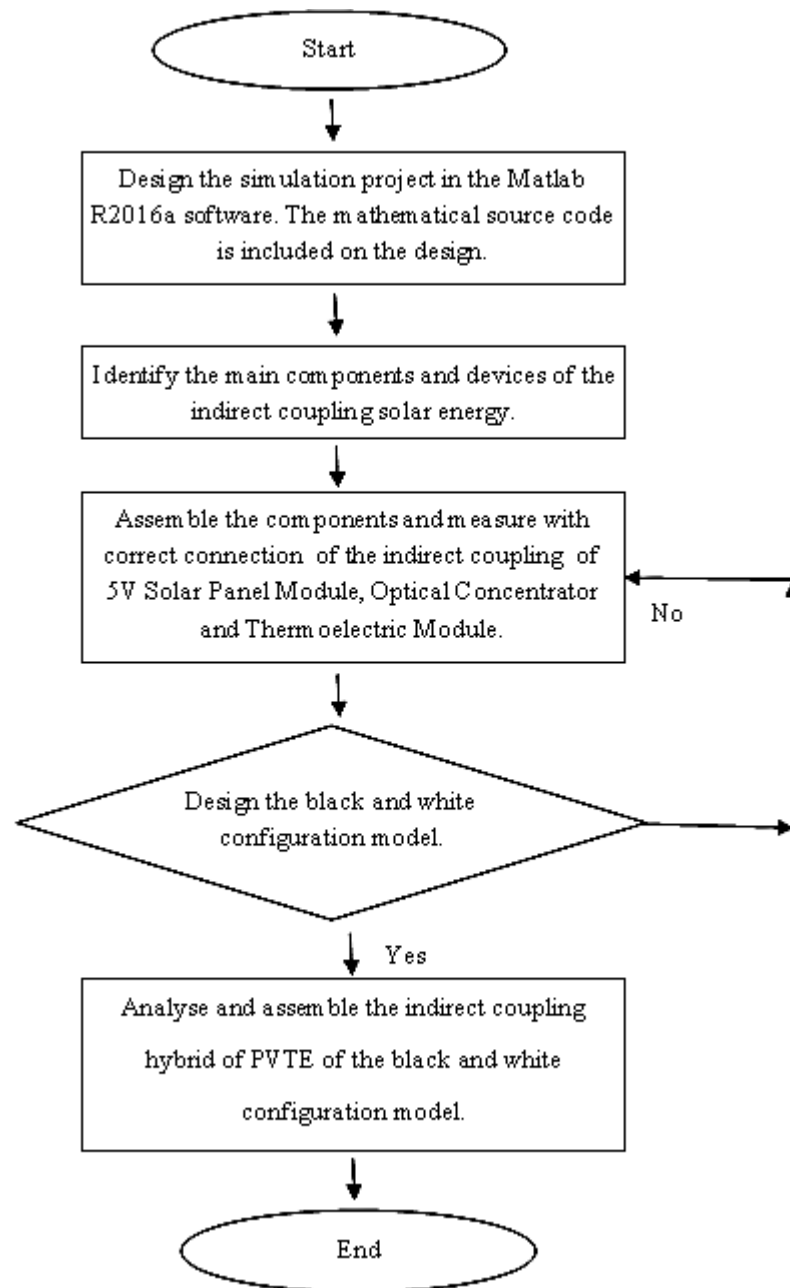


Figure 1.1: Flowchart of the project

Next, the main components and devices that are used are identified. Ensure that the component and devices that are needed in this project are collected. Identify the function of each components and devices that are used in this project. Make sure that the Solar Panel Module is in the range 5V that is used.