UNIVERSITI TEKNIKAL MALAYSIA MELAKA

SYSTEM LIQUID-COOLED PANEL AIR CONDITIONERS USE WATER AS A COOLANT APPLYING THE PELTIER EFFECT

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

by

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TAJUK: SYSTEM LIQUID-COOLED PANEL AIR CONDITIONERS USE WATER AS A COOLANT APPLYING THE PELTIER EFFECT

SESI PENGAJIAN**: 2015/2016 Semester 2**

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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 Engineering Technology (Industrial Automation & Robotics) with Honours.

…….

(Encik Mohamad Haniff Bin Harun)

ABSTRACT

This project focused on the replacement of the outdoor unit to the System panel liquid-cooled air conditioners. The Peltier is to modify the existing cooling system that uses gas to a cooling system using water from the Peltier effect. Thermo-electric coolers are solid-state heat pumps that operate according to the Peltier effect. A theory that claims a heating or cooling effect occurs when an electric current passes through two conductors. A voltage applied to the free ends of two dissimilar materials creates a temperature difference. With this temperature difference, Peltier cooling will cause heat to move from one end to the other. With the use of Peltier effect it can cool the water and replace the air conditioning system that uses gas as the main source of cooling. This can reduce the cost of the project in terms of maintenance, electricity bill, the cost of materials and the use of gas. This system is based on green technology.

ABSTRAK

Projek ini memberi tumpuan kepada penggantian unit luar panel Sistem cecair sejuk penghawa dingin. “Peltier” adalah untuk mengubahsuai sistem penyejukan yang sedia ada yang menggunakan gas kepada sistem penyejukan menggunakan air daripada kesan “Peltier” itu. Thermo - penyejuk elektrik adalah alat yang mempunyai haba panas dan sejuk dengan beroperasi mengikut kesan “Peltier” itu. Teori yang mendakwa kesan pemanasan atau penyejukan berlaku apabila arus elektrik melalui dua konduktor . Voltan dikenakan pada dua bahan yang tidak serupa mewujudkan perbezaan suhu. Dengan perbezaan suhu ini, “Peltier” penyejukan akan menyebabkan haba untuk bergerak dari satu hujung ke hujung yang lain. Dengan menggunakan kesan Peltier ia boleh menyejukkan air dan menggantikan sistem penghawa dingin yang menggunakan gas sebagai sumber utama penyejukan. Ini boleh mengurangkan kos projek dari segi penyelenggaraan, bil elektrik, kos bahan dan penggunaan gas. Sistem ini adalah berasaskan kepada teknologi hijau.

DEDICATIONS

To my beloved parents, I acknowledge my sincere indebtedness and gratitude to them for their love, dream and sacrifice throughout my life. I am really thankful for their sacrifice, patience, and understanding that were inevitable to make this work possible. Their sacrifice had inspired me from the day I learned how to read and write until what I have become now. I cannot find the appropriate words that could properly describe my appreciation for their devotion, support and faith in my ability to achieve my dreams Lastly, I would like to send my gratitude to any person that contributes to my final year project whether it is directly or indirectly. I would like to acknowledge their comments and suggestions, which are crucial for the successful completion of this study

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AIST	-	National Institute of Industrial Science and Technology
HVAC	-	Heating, Ventilating and Air-conditioning
IAQ	-	Indoor Air Quality
A	-	Area
C_v	-	Specific heat capacity with constant volume
EU	-	Europian Union
G	-	Gravity
H	-	Height
M	-	Mass
$\dot{m}$	-	Mass Flow Rate
P	-	Pressure
ΔP	-	Difference in Pressure
Q	-	The amount of heat / heat radiation
R	-	Radius
S	-	Irradiance
T	-	Temperature
ΔT	-	Difference in temperature
V	-	Volume Flow Rate
W	-	Weight

CHAPTER 1
INTRODUCTION

1.0 Background

This project focused on the replacement of the outdoor unit to the System panel liquid-cooled air conditioners. The Peltier is to modify the existing cooling system that uses gas to a cooling system using water from the Peltier effect. Thermo-electric coolers are solid-state heat pumps that operate according to the Peltier effect. A theory that claims a heating or cooling effect occurs when an electric current passes through two conductors. A voltage applied to the free ends of two dissimilar materials creates a temperature difference. With this temperature difference, Peltier cooling will cause heat to move from one end to the other. With the use of Peltier effect it can cool the water and replace the air conditioning system that uses gas as the main source of cooling. This can reduce the cost of the project in terms of maintenance, electricity bill, the cost of materials and the use of gas. This system is based on green technology.

The regular thermo-electric module is fabricated utilizing two meager clay wafers with a progression of P and N doped bismuth-Telluride semiconductor material between them. The fired material on both sides of the thermoelectric includes inflexibility and the essential electrical protection. The N type material has an abundance of electrons, while the P type material has a shortage of electrons. One P and one N make up a couple, as appeared in Figure 1. The thermo-electric couples are electrically in arrangement and thermally in parallel. A thermo-electric module can contain one to a few hundred couples. As the electrons move from the P type material to the N type material through an electrical connector, the electrons hop to a

higher energy state engrossing heat energy (cold side). Proceeding through the cross section of material , the electrons stream from the N type material of the P type material through an electrical connector, dropping to a lower energy state and discharging energy as heat to the heat sink (hot side).

Heat and cool can be used to thermoelectric, depending on the direction of the current. In both heating and cooling application requiring, the design should focus on the cooling mode. The internal heating and the load from the cold side is pumped to the hot side because it using a thermo-electric in the heating mode is very efficient.To achieve the desired heating it need to reduces the power needed

1.1 Problem Statement

The comparison between the air conditioner 1hp(horse power) and Peltier cooling system. Use of electricity and voltage too high to existing air conditioning now causes users to have to pay higher electric bill. This is because the air conditioning system now using a HVAC system that requires the use of voltage and high current. It also uses "Freon gas" In AC, which is merely a marker name for dichlorodifluoromethane. It will add to ozone depletion and thus the Global warming effects. Because, when the CFC escape from the unit it quickly rises up to the ozone layer. (Gehring, Hüttner, & Huebener, 2001)(Qian & Ren, 2016)(Huang, Weng, Chang, Chen, & Ke, 2010)(Faraji, Goldsmid, & Akbarzadeh, 2014)(Yilmazoglu, 2016)(Ahammed, Asirvatham, & Wongwises, 2016)

1.2 Project Objective

This product is used as a Peltier, water block and indoor unit. Its concept is almost the similar like air conditioner but has been change from gases to water and it will cold by Peltier cooling effect. The objective of this product is:

1. To design a suitable controller to improve the temperature of Pelter effect
2. To compare existing cooling system that uses gas to a cooling system using water from the Peltier effect.
3. To reduce costs of material, electricity and maintenance

1.3 Project Scopes

The scope of this study is:

a) To design the effective circuit for reduce current and voltage usage
b) Design a panel cooling system that use in the project
c) Compare the efficiency with existing 1Hp cooling system with a Peltier cooling system

Build an outdoor unit that uses water from the Peltier effect that allows controlling the entire part of the existing.

1.4 Project Significance

This project focused on the replacement of the outdoor unit to the System panel liquid-cooled air conditioners. The Peltier is to modify the existing cooling system that uses gas to a cooling system using water from the Peltier effect. Thermo-electric coolers are solid-state heat pumps that operate according to the Peltier effect. A theory that claims a heating or cooling effect occurs when an electric current passes through two conductors. A voltage applied to the free ends of two dissimilar materials creates a temperature difference. With this temperature difference, Peltier cooling will cause heat to move from one end to the other. With the use of Peltier effect it can cool the water and replace the air conditioning system that uses gas as the main source of cooling. This can reduce the cost of the project in terms of maintenance, electricity bill, the cost of materials and the use of gas. This system is based on green technology.

1.5 Thesis Outlines

System liquid-cooled panel air conditioners use water as a coolant applying the Peltier effect topic such as introduction, literature review, research Methodology, result , discussion, conclusion and further development that can be applied in this project.

Chapter 1 basically is an introduction of the project. In this chapter, the main idea about the background and objectives of the project will be discussed. The full design and basic concept of the project will be focused in this chapter. The overview of the entire project also will be discussed in this chapter to show proper development of the project.

Chapter 2 is about the literature review and the methodologies for the development of the System liquid-cooled panel air conditioners use water as a coolant applying the Peltier effect .This includes the future project development that can be added in this project.

Chapter 3 will discussed about the design of this project development. In this chapter, it will explain how to create a system cooling using water block , radiator , peltier , indoor unit and water pump

CHAPTER 2
LITERATURE REVIEW

2.0 Introduction

The research from previous journal and chapter about the air conditioner has been set up. The project need to build by requires the knowledge that are not readily offhand. It have a main part to investigated in this project ,there are Peltier , temperature controller and microcontroller specification. To create hot and cooling air , the Peltier is one of the methods will use. Peltier are the most importance parts of air conditioner platform. Moreover, a sensor is a device which detects a temperature in air conditioner. The main objective are the use of Peltier technology in air conditioner system and modify the existing cooling system that uses gas to a cooling system using water from the Peltier effect .

2.1 Components of heating and cooling system

To achieve the Air-conditioner system, the review is based on literature review, which will be discussed in detail in this chapter. For the heating and cooling system, research more on Peltier, temperature controller and air-conditioner system.

2.1.1 Peltier

Peltier impact that creates a temperature distinction between the intersections of electric channels have two diverse sorts of materials, thermoelectric cooling utilizes when power is made to move through the circuit. A Peltier cooler utilized as a part of current work exchanges heat from hot district to the similarly chilly area of space with the utilization of group of thermoelectric gadgets known as Peltier module, a semiconductor based icebox looking like level square plate , where heat is retained from one side (cold side) and dispersed on the inverse side (hot side), with utilization of power. This cooling is a strong state strategy for heat exchange produced utilizing P-type and N-type semiconductor, as a rule bismuth telluride (Jose, D'souza, Dandekar, Karamchandani, & Kulkarni, 2015).

Thermoelectric (Peltier effect) cooling is a popular but inefficient way to remove heat from high-power-dissipating electrical components. The requirements for heat removal from critical electronic components are increasing rapidly as electronics become more capable and at the same time more compact(Bass, Allen, Ghamaty, & Elsner, 2004). This type of system is highly needed by the industrial area in order to let different employee operate the same systems.

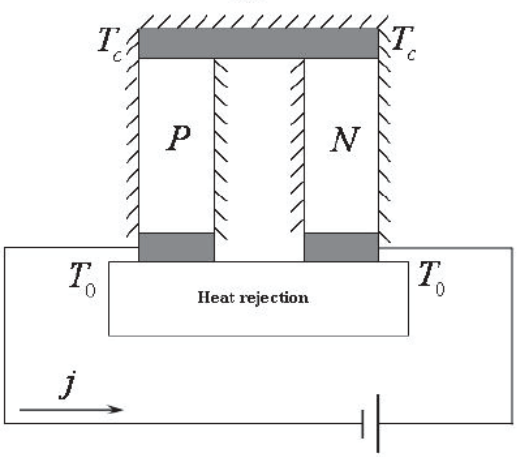

Figure 2.1 Diagram of Thermoelectric Module or Peltier Module

2.1.2 Temperature controller

The simplest example of a temperature controller is a common thermostat found in homes. For instance, a hot water heater uses a thermostat to control the temperature of the water and maintain it at a certain commanded temperature. Temperature controllers are also used in ovens. When a temperature is set for an oven, a controller monitors the actual temperature inside of the oven. If it falls below the set temperature, it sends a signal to activate the heater to raise the temperature back to the setpoint. Thermostats are also used in refrigerators. So if the temperature gets too high, a controller initiates an action to bring the temperature down.

According to the journal (Pathak & Goel, 2013) that research about the temperature said that in all thermal processes, maintain the certain temperature is the main requirement. In presented work the fast thermal response is achieved by using the peltier element. Peltier element works on the principal of Peltier effect. It states that the passage of an electric current through the junction of two dissimilar wires can either cool or heat the junction depending on the direction of current. Heat generation or absorption rates are proportional to the magnitude of the current and also the temperature of the junction. In this presented work, Set Point Temperature is achieved by using the PWM output micro-controller followed by low pass filter. Temperature is measured at flow cell using LM-35 temperature sensor. The set point voltage so obtained as above is compared with the current temperature (CT) and an error signal is generated by using an operational amplifier circuit and sends to PID algorithm to take up the necessary action. Moreover, controlling the temperature at desired set point, the temperature achieving rate has to made as fast as possible. This is made by using an enhanced current source by suitable designing the peltier driving circuit.

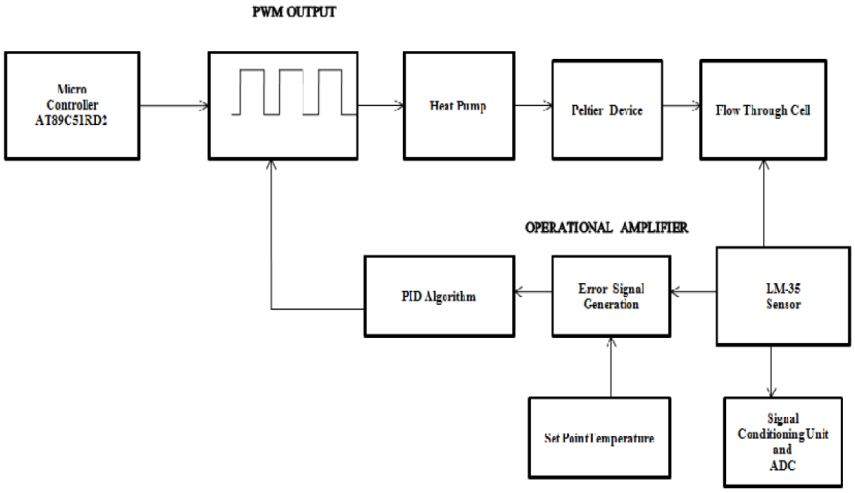

Figure 2.2 : block diagram of presented work

2.1.3 : Air conditioner system

Air conditioning is the process of altering the properties of air (primarily temperature and humidity) to more favorable conditions. The control of these conditions may be desirable to maintain the health and comfort of the occupants, or to meet the requirements of industrial processes irrespective of the external climatic conditions.

According to the journal (Jose et al., 2015) Useful features of a Peltier cooler compared to vapor compression system are absence of moving parts such as compressor, no leaks, no use of refrigerant gas. It gains advantages due to above features over a conventional vapor compression such as no noise, long life, high reliability, low maintenance, portable, compact, no ozone depletion potential. Disadvantages of Peltier modules are very high cost and very lower coefficient of performance. Many studies for improvement of module carried out are discussed in the section below and in future the limitations would get reduced, so making cooling system based on Peltier modules would surely contribute towards society growth. Figure 2.3 below shows the diagram of presented work.