UNIVERSITI TEKNIKAL MALAYSIA MELAKA

TEMPERATURED-CONTROLLED DEVICE FOR MEDICAL APPLICATION USING PELTIER EFFECT

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

by

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DECLARATION

I hereby, declared this report entitled “Temperature controlled device for medical application by using peltier effect” is the results of my own research except as cited in references.

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Date : 13/12/2016

APPROVAL

This report is submitted to the Faculty of Engineering Technology of UTeM as a partial fulfillment of the requirements for the degree of Bachelors of Electrical Engineering Technology (Industrial Automation and Robotics). The member of the supervisory is as follow:

……
(SUZIANA BINTI AHMAD)

ABSTRAK

Dalam era globalisasi, penggunaan produk yang menjana suhu sejuk dan panas telah digunakan secara meluas di hospital untuk tujuan penyimpanan atau penggunaan kakitangan perubatan dan pesakit. Dengan penciptaan alat ini dapat membantu pihak perubatan dalam penggunaan dan penyimpanan alatan perubatan. Kerja-kerja penyelidikan dan pembangunan yang dijalankan oleh pelbagai jenis penyelidik. Pembangunan alat ini menggunakan sistem Peltier telah diteliti semula. Dalam tahun-tahun kebelakangan ini, dengan peningkatan kesedaran terhadap pencemaran alam sekitar disebabkan oleh pengeluaran, penggunaan dan pelupusan Klorofluorokarbon Carbons (CFC) dan Hydro Klorofluorokarbon (HCFC) sebagai cecair pembawa haba dalam penyejukan dan penyaman udara sistem konvensional telah menjadi satu perkara yang membimbangkan dan menyebabkan kajian yang luas dalam pembangunan penyejukan dan penyaman ruang. penyejukan termoelektrik menyediakan alternatif R & teknologi AC cerah kerana kelebihan tersendiri. Penggunaan kesan termoelektrik untuk meningkatkan COP sistem penyejukan yang sedia ada telah juga dikaji dalam kertas ini. Kawalan suhu boleh dicapai dengan membawa kepada tenaga yang lebih panas untuk pada dasarnya dihidupkan dan di luar seperti yang ditunjukkan oleh di bawah atau di atas keadaan suhu secara individu

ABSTRACT

In the era of globalization, the use of products that generate cold and hot temperatures are widely used in hospitals for the purpose of storage or consumption of medical staff or patients. With the creation of temperature controlled device for medical application by using peltier can help hospitals in the storage and use of medical goods. The research and development work carried out by different researchers on development of temperature controlled device using peltier system has been thoroughly reviewed in this paper. In recent years, with the increase awareness towards environmental degradation due to the production, use and disposal of ChloroFluoro Carbons (CFCs) and Hydro Chlorofluorocarbons (HCFCs) as heat carrier fluids in conventional refrigeration and air conditioning systems has become a subject of great concern and resulted in extensive research into development of novel refrigeration and space conditioning technologies. Thermoelectric cooling provides a promising alternative R&AC technology due to their distinct advantages. Use of Thermoelectric effect to increase the COP of existing cooling system has been also reviewed in this paper. The very control of temperature can be accomplished by bringing on warmer energy to be basically turned on and off as indicated by an under or over temperature condition individually

DEDICATION

To my beloved parents

To my kind lecturers

And no forgetting to all my fellow friends

For their

Love, Sacrifice, Encouragement, and Best Wishes

ACKNOWLEDGEMENT

Some time recently, while and after I doing my business to finish this venture, I have gotten such a variety of assistance from my chiefs, instructors, specialists, relatives furthermore my kindred companions.

As a matter of first importance, I need to give my gratitude to my director, miss Suziana who gave me a great deal of consolation, a genuine direction and extremely strong.

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INTRODUCTION

1.1 Project Briefing

Temperature-controlled device for medical application by using Peltier is used in hospital. The device can be cooled and hot by controlling temperature. This device is suitable used in the hospital because it can help the staff or patient, which to use water hot and cool. These devices not only function for cooling and heating water, it is also can used for keeping blood that as usual keeps in refrigerator. Today, did not have hospital can function effectively without blood. Blood has to be provided to the patient in need in right time and right quantity. Cooling and heating of circulating blood was introduced as a tool of physiological research in 1921 [1] and has subsequently proved to be a valuable aid in surgery. The thermo-electric effect has two sides, a p-type and n-type semiconductor [2]. The heat has brought from one side to the other when DC current flows through the device. The Peltier device, creates a voltage when there is a different temperature on each side [3]. Conversely, when a voltage is applied, the temperature difference created. The Peltier effect can use to generate electricity, measure temperature or change the temperature of an object. Because the heating and cooling is determined by the polarity of the applied voltage. The thermo-electric device is efficient temperature controller [3]. Temperature is measured flow cell using LM-35 temperature sensor. The operational amplifier circuit was generated the signal and sends to the PID algorithm to take up the necessary action [4].

1.2 Problem Statement

Blood is an important thing in human life. Today, many people need transfusion blood for surgery, low blood pressure and others. When a person donates blood, a container preserves the blood need to be made. Therefore, I was building the temperature-controlled device to make sure the blood will store in cater favorable ambience. Before this, the blood was stored in the refrigerator. The problem is when the blood is want to use, it is must store in the blood warmer device because refrigerator cannot store in hot condition. So, it is not practical and use human effort to switch the blood from the refrigerator to blood warmer. Besides, the refrigerator is difficult to carry that means is not portable. The temperature of the refrigerator is not more accurate because it is set in analog and not display the data of temperature. The medical device such as apparatus, instrument, material and other that uses hot and cooling water to wash the device also can use temperature-controlled device. The other problem is rural areas. In this country, rural area is difficult to go because not have enough facilities such as road, public transport and so on. The people that live in rural area are difficult to gain health facilities. This is because the some medical items are large and not portable. The certain rural areas also not have the electricity that indispensable for medical items to function. In this problem, I am cannot solve all problems, but temperature-controlled device still can help a person need health aid that suitable with this device. In the other hand, we know the country of Malaysia has the road accident statistics are high and it is increasing every year. So, using portable equipment, it will help speed of treatment for accident victims.

1.3 Project Objective

a) To study temperature controlled concept using Peltier effect
b) To develop a temperature controlled device by using Peltier effect
c) To keep the medical device in hot water or cool water.
d) To analyze efficiency of temperature controlled range in medical application

1.4 Work Scope

A project involves several parts including:

a) Peltier

i. Peltier that has rectangular thin ceramic plate
ii. When a DC current flows through the device, it brings heat from one side to another, so that one side gain cooler while the opposite one gets hotter [1].
iii. The heat sink must attach at two thin ceramic plates to pull their temperature in environment for application

b) DS18B20 sensor

i. The sensor is an object that detect physical parameter and convert into electrical signal
ii. Signal will send to the microcontroller
iii. Microcontroller will process the signal and display the output of the signal

c) Microcontroller

i. All parts must connected to microcontroller work properly
ii. Burning the program in the microcontroller
iii. Using microcontroller Arduino UNO

d) Blood bank

i. Platelets are stored at room temperature, 20-24ºC, because below 18ºC their lipid bilayer membrane undergoes a phase change which allows the aggregation of surface glycoprotein [5].
ii. Many studies have suggested acceptable storage temperature and times for routine coagulation tests [6] [7] [8].

e) Heating and cooling water

i. This project is universal to use in hospital.
ii. The hospitality device can keep in cool or hot water to protect the component.
iii. The patient and staff can use the water to drink.
iv. The patient will use for towel, bath.

f) Arduino controller

i. Combine the Arduino controller with microcontroller to obtain a model of system control.
ii. Specify the desired closed loop performance on the basis of known temperature
iii. Adopt controller strategies that would achieve the desired result
iv. Implement the resulting controller using suitable platform
v. Validity the controller performance and modify accordingly if required

CHAPTER 2

LITERATURE REVIEW

2.0 Introduction

To make any project, we must have the ideas and some ideas from other researchers to support the main idea. The ideas can take from their research like mechanical design, electrical wiring design, control technique, program development, journal, books and methodology. Thus, the literature review is beginning step to understand the ideas to develop this temperature-controlled device for medical application by using Peltier. In this chapter, detailed summaries of the project ideas from previous researchers are determined and the present project will be compared and discussed.

2.1 Temperature-controlled device for medical application by using Peltier

Thermo-electric impact is generally utilized as a part of numerous zones of science and innovation. In medical practice that temperature is an essential variable in the treatment of numerous infections of the human life form [13]. Before this, fluid nitrogen is utilized as a part of a framework to accomplish low temperatures. The fluid nitrogen is constrained use in healing facilities essentially. There are numerous cases such devices is cumbersome, without legitimate temperature control and warm modes propagation [4]. Along these lines, to utilize warm impacts on the patient is stood up to with a few troubles and is lessened primarily to the use of ice and boiling point water. By utilizing the temperature-controlled devices can take care of this issue. This is on account of temperature-controlled devices is convenient if contrasted with traditional strategies of warm impacts. The another usefulness of

temperature-controlled devices is capacity blood transfusion. These days, blood is put away in the fridge and when a man needs a transfusion, the blood must keep warm. Along these lines, the blood hotter gadget is utilized to keep warm the blood in a reasonable temperature to use in the human body. In this way, it is utilized, human push to change the blood from the cooler to blood hotter that is not pragmatic. The temperature-controlled devices can take care of this issue to diminish human exertion and temperature-controlled devices is versatile. Lately, with the expansion mindfulness towards ecological corruption because of the generation, utilize and release of Chlorofluorocarbons (CFCs) and Hydro Chlorofluorocarbons (HCFCs) as warmth transporter liquids in customary refrigeration frameworks has turned into a subject of extraordinary concern and brought about broad examination into advancement of refrigeration advances. Thermoelectric worked cooler gives a best option in refrigeration innovation because of their unmistakable points of interest. While utilizing thermoelectric impact as a part of framework the COP of the framework likewise increases.

2.2 System Development

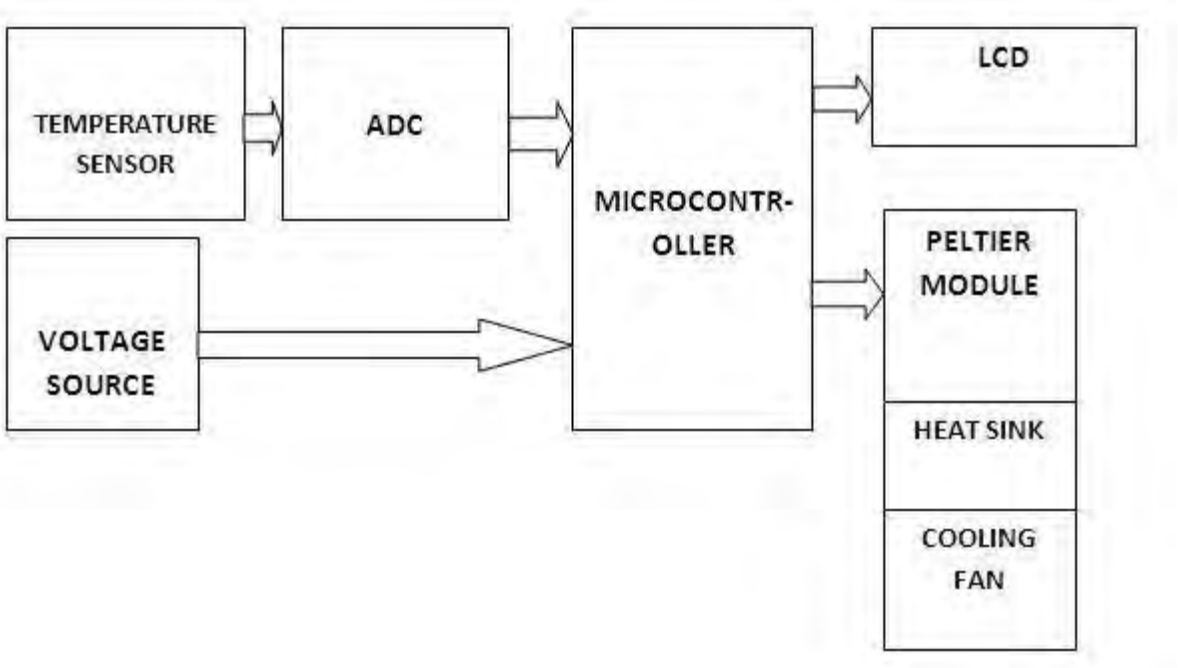

Figure 2.0: Block Diagram of System [15]

Figure 2.0 shows the block diagram of system, which consists of temperature sensor, voltage source, analog to digital converter, microcontroller, LCD display. A microcontroller is used to control mechanism of Peltier module, voltage control source and LCD display. LCD displays for display the data of temperature sensor. The fans are connected to the hot face of the cooling units are bigger than those entering the chilly chamber. This is on the grounds that the last fans just have assimilated heat from the load, though the previous need to pass this warmth, and in addition that created in the thermocouples on to environment [15].

2.3 Temperature Control System

Temperature control is made to control the temperature of a system. The circuit keeps up the temperature of the system in a specific extent. The temperature of Peltier will build control by the voltage of Peltier and the other way around. For the circuit, it comprises temperature detecting DS18B20, exchanging devices, fan, Peltier, microcontroller. It will work in view of the qualities or scope of temperature in the system which is identified by the temperature sensor. The temperature comprises of a DS18B20 IC. The temperature sensor is associated with the ADC contribution of the Arduino microcontroller. It changes over the simple contribution to a computerized position by the Analog-to-digital converter (ADC). The Arduino is associated with an exchanging devices transfer. It is utilized to switch on the Peltier. At the point when the temperature is hot, temperature sensor will identify and it sent signs to a microcontroller that will show the estimation of temperature. The estimation of the temperature is shown on the 16x2 line LCD. The circuit keeps up of the system in a specific reach. A Peltier and fan are utilized for controlling the temperature of the system. The temperature of Peltier increment with expansion in temperature and the other way around. At the point when the present temperature is underneath the lower furthest reaches of the coveted extent, the system must be warmed by utilizing a warming component, Peltier heater.

2.4 Arduino Controller

Arduino controller is generally utilized as a part of the procedure control industry because of moderately basic structure in execution. Arduino controller is executed in an input control circle in order to accomplish the control objective. This criticism procedure control circle, the control is converse acting and a Peltier is utilized as the detecting component, which is actualized in the input way of the control architecture. The temperature of Peltier is measured by the temperature sensor and the yield of the channel (voltage) is sent to the transmitter unit, which in the end changes over the temperature yield to an institutionalized sign. This yield of transmitter unit is given to the controller unit. In this warmth exchanger framework a Arduino controller has been taken as the controlling unit. The Arduino controller actualizes the control calculation, contrasts the yield and the set point and after that gives the outcome to the last control component through the LCD show that get the information from Arduino.

2.5 Peltier

The temperature-controlled devices for medical application can be produced utilizing Peltier effect. The Peltier is one of parts in temperature-controlled devices that is the fundamental segment of the devices. Peltier is otherwise called thermo-electric [11] has two sides that is a p-sort and a n-sort semiconductor. The Peltier will work when the DC current moves through the devices, it conveys heat from one side to the next that one side gets cooler while the inverse one get to be more hotter. Peltier coolers comprise of a Peltier component and warmth sink blend. Peltier components come in different structures and shapes. Ordinarily, they comprise of a bigger measure of thermocouples organized in rectangular form and bundled between two thin earthenware plates. This devices is so capable on the grounds that it can solidify great measure of the water inside a few minutes [11]. The Peters is in solid state that is not required support and long administration lifetime. Peltier device is shown in Figure 2.1

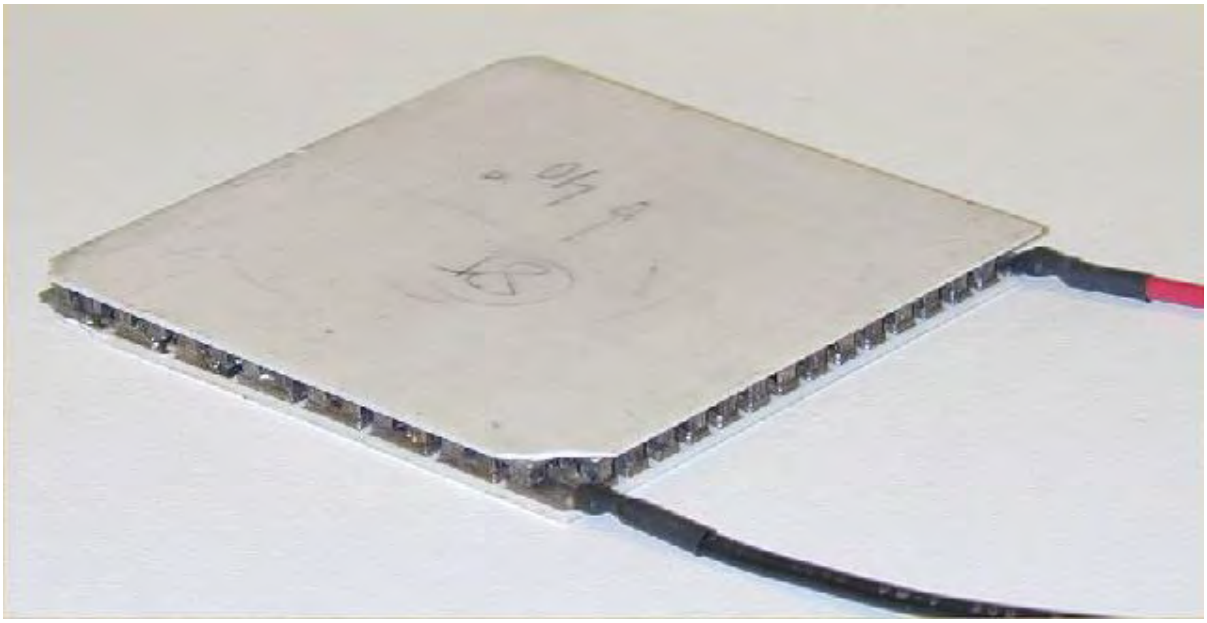

Figure 2.1: Peltier

2.6 Microcontroller

Arduino is an open-source stage [17] utilized for developing and programming of hardware. It can get and send data to most devices and even through the web to order the particular electronic devices, it utilizes an equipment called Arduino UNO [18] circuit board and programming project to program the board. Arduino is utilized a great deal as a part of microcontroller [19] programming in addition to other things because of its easy to understand or simple to utilize setting. An Arduino can read the data from a temperature sensor and send data to a yield evicesd that is LCD screen and temperature control. An Arduino board as appeared in Figure 2.2 can be grouped into two parts that is hardware and software.

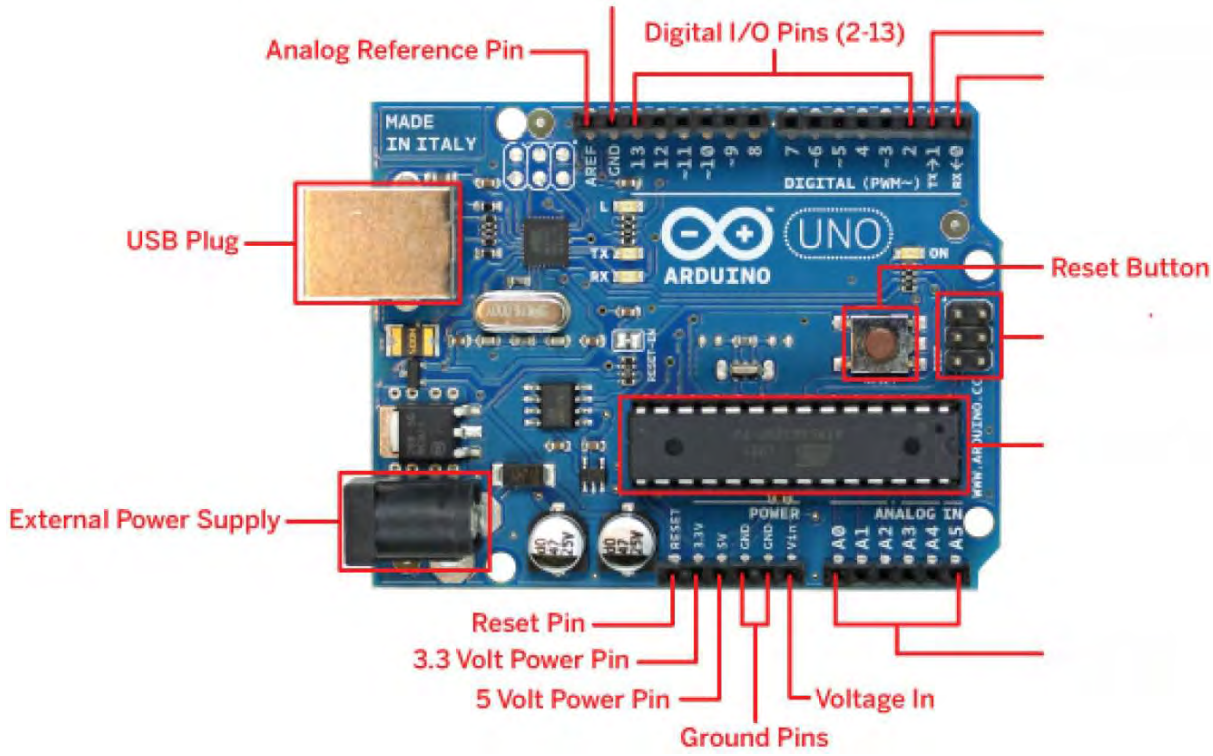

Figure 2.2: Labelled Arduino Board

The temperature sensor is connected to the ADC input of the PIC microcontroller. It converts the analog input to a digital value. The PIC is connected to a switching device relay. It is used to switch on the Peltier. When the temperature is hot the temperature sensor will detect it and sent signals to a microcontroller that will display the value of temperature. There are two types of Arduino that is Arduino UNO and Arduino Mega. The Arduino UNO board, which is in view of the ATmega 328, is mounted vertically on the wooden case alongside the MEGA board. The Table 1 shows the different between Arduino UNO and Arduino Mega

Table 2.1: Comparison between Arduino UNO and MEGA [16]

UNO		MEGA	
Microcontroller	ATmega328	Microcontroller	ATmega2560
Operating Voltage	5V	Operating Voltage	5V
Input Voltage (recommended)	7-12V	Input Voltage (recommended)	7-12V
Input Voltage (limits)	6-20V	Input Voltage (limits)	6-20V
Digital I/O Pins	14 (of which 6 provide PWM output)	Digital I/O Pins	54 (of which 15 provide PWM output)
Analog Input Pins	6	Analog Input Pins	16
DC Current per I/O Pin	40 mA	DC Current per I/O Pin	40 mA
DC Current for 3.3V Pin	50 mA	DC Current for 3.3V Pin	50 mA
Flash Memory	32 KB (ATmega328) of which 0.5 KB used by bootloader	Flash Memory	256 KB of which 8 KB used by bootloader
SRAM	2 KB (ATmega328)	SRAM	8 KB
EEPROM	1 KB (ATmega328)	EEPROM	4 KB
Clock Speed	16 MHz	Clock Speed	16 MHz

2.7 Flow Chart of The System

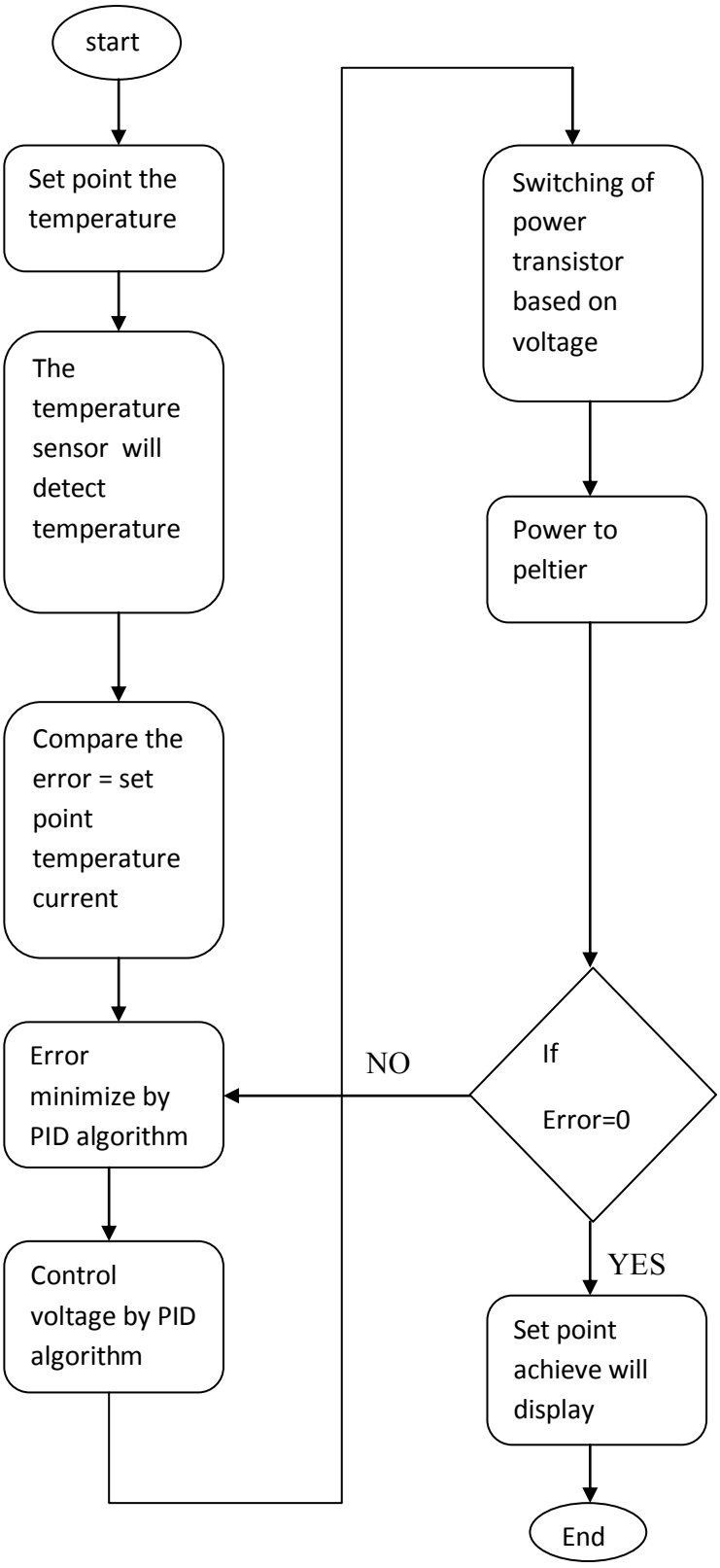

Figure 2.3: Flow Chart