CERTIFICATION OF SUPERVISOR

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HOT COLD TUMBLER

was submitted by

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in partial fulfilment of the requirement for

BACHELOR OF ENGINEERING TECHNOLOGY (ELECTRICAL) WITH HONS.

This report was accepted and examined

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Date: 9/1/2017

FACULTY OF ENGINEERING TECHNOLOGY

UNIVERSITI MALAYSIA PAHANG

GAMBANG PAHANG

STATEMENT OF AWARD FOR DEGREE

1. **Bachelor of Engineering Technology**

Thesis submitted in fulfilmentof the requirements for the award of the degree of Bachelor of Engineering Technology in Electrical.

SUPERVISOR'S DECLARATION

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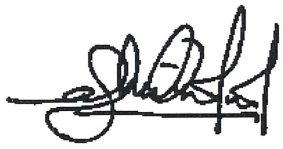
Signature: 

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I hereby declare that the work in this thesis is my own except for quotations and summaries in which have been duly acknowledged. The thesis has not been accepted for any degree and is not concurrently submitted for award of other degree.

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ABSTRACT

Thermoelectric effect has created a lot of impacts in human life. Since 1894, we developed so many ways of making use of thermoelectric for preserving food, cooling water, and heating. Nowadays, people are looking for products which are cheap, efficient and long lasting.

Our research focused on inculcating all these characteristics and enables users to carry a multifunctional bottle anywhere and everywhere. Our tumbler enables users to choose to prepare hot or cold water with just a click of a button and it only takes around 30 minutes. When the water reached the desired temperature, user will be able to consume the water directly from our bottle or even make delicious drinks. The bottle is portable, reusable and affordable.

The goal is to produce a controller circuit that can control the heating and cooling process of the Peltier chip and find a proper power supply for the system.

ABSTRAK

Kesan termoelektrik telah mencipta banyak kesan dalam kehidupan manusia. Sejak tahun 1894, kami telah membangunkan banyak cara untuk menggunakan termoelektrik untuk memelihara makanan, air penyejukan, dan pemanasan. Pada masa kini, orang mencari produk yang murah, berkesan dan tahan lama.

Kajian kami memberi tumpuan kepada memupuk semua ciri-ciri ini dan membolehkan pengguna untuk membawa botol pelbagai fungsi mana-mana sahaja dan di mana-mana. Tumbler kami membolehkan pengguna untuk memilih untuk menyediakan air panas atau sejuk dengan hanya satu klik butang dan ia hanya mengambil masa lebih kurang 30 minit. Ketika air mencapai suhu yang dikehendaki, pengguna akan dapat untuk mengambil air secara langsung dari botol kami atau membuat minuman lazat. botol adalah mudah alih, boleh diguna semula dan berpatutan.

Matlamatnya adalah untuk menghasilkan litar pengawal yang boleh mengawal proses pemanasan dan penyejukan cip Peltier dan mencari bekalan kuasa yang betul untuk system ini.

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LIST OF SYMBOLS

LiFePO4	Lithium iron phosphate
V	Volt
A	Ampere
Ah	Ampere-hour
C	Charge
W/Kg	Watt per Kilogram
Wh/Kg	Watt-hour per Kilogram
Li	Lithium
NiCd	nickel cadmium
NiMH	nickel metal hydride
Li-ion	lithium ion
LiPo	lithium ion polymer
LIB	Lithium ion battery
mAh/g	miliAmpere-hour per gram
LNM	Li-[Ni0.5−xMn1.5+x]O4
LiCoO2	Lithium cobalt oxide
°C	Degree Celsius
Wh	Watt-hour
%	Percentage
s	Second
m/s	meter per second
min	Minute
T	Temperature

kW/m^3	kilowatt per meter cube
k	kilo
Ω	ohm
SW	switch
R	resistor
Vc	Collector Voltage
Vs	Voltage source
I_{CE}	Collector-emitter current
Vb	Base-emitter junction voltage drop
I_{BE}	Base-emitter current
mA	mili-Ampere
Vin	Input Voltage

LIST OF ABBREVIATION

LED	Light-emitting Diode
PCB	Printed Circuit Board
SEI	Solid Electrolyte Interphase
SOC	State of charge
DOD	Depth of discharge
SPDT	Single Pole Double Throw
DPDT	Double Pole Double Throw
IC	Integrated circuit
DIP	Dual in-line
IO	Input-Output
NPN	N-doped P-doped N-doped bipolar transistor
DC	Direct current
AC	Alternating current
DSPT	Double-Sided Plated Thru
LCD	Liquid Crystal Display

CHAPTER 1 INTRODUCTION

The Hot Cold Tumbler aims to heat and cool drinking water without using wired electrical supply thus making it portable. The installed power supply or battery within the tumbler is also rechargeable. The costs of production aims to be lower than the market price. Another objective of this tumbler is to manufacture a miniature version of the bulky water dispenser.

This report presents the design of a controlling circuit using Arduino Nano microprocessor chip for the tumbler. When respective process is selected, the circuit will also turn on responding LED where red LED represents heating process and green LED represent cooling process. The controlling circuit consist of relays that will turn off the power supply to a fan attached to the Peltier Chip when either heating or cooling process is done. A yellow LED which serves as both power indicator and process completion indicator will blink when the process is complete. All the above actions are controlled by a program inside the Arduino Nano chip which is programmed using Arduino Software. The Arduino Nano chip receives input from a LM35 temperature sensor that is attached to the water container.

This report also presents the reasoning of selecting LiFePO4 battery and its battery connection. LiFePO4 battery is chosen as the power supply because it has a high charge/discharge rate, high cycle of battery life and high safety despite LiFePO4 batteries are constantly characterized with lower nominal voltage. The battery connection chosen is series-parallel connection. In order to reduce overall size of the battery, 8 LiFePO4 battery cells are divided into 4 cells per pack. Each cell in a pack is connected in series to gain a total output of 13.2V and 1.5A. Each pack is then connected in parallel to gain a total output of 13.2V and 3A which will increase the operating period of the whole system.

Overall size of controller circuit and battery size can be further reduced with PCB and custom made batteries. PCB have copper connections printed on the board that will totally eliminate the usage of connecting wires in the circuit, thus giving the circuit a more clean and tidy look. Double-sided PCB consist of printed circuits at both sides, even further reducing the overall size of the controller circuit and will reduce the size of the tumbler. Custom made LiFePO4 batteries allow the customization of the shape and control over the maximum size it can achieve. This overall helps reduce the tumbler's size even more.

CHAPTER 2 LITERATURE SURVEY

The Peltier effect is the presence of heating or cooling at an electrified junction of two different conductors. The Peltier effect is named after Jean Charles Peltier (1785-1845) who first observed it in 1834. Peltier found that the junctions of dissimilar metals were heated or cooled, depending upon the direction in which an electrical current passed through them. The Peltier effect had no practical use for over 100 years until dissimilar metal devices were replaced with semiconductor Peltiers which could produce much larger thermal gradients.

When a current is made to flow through a junction between two conductors, A and B, heat may be generated or removed at the junction. The Peltier heat generated at the junction per unit time, $\dot{Q}$, is equal to

$$\dot{Q} = (\Pi_A - \Pi_B) I$$

Where Π_A (Π_B) = the Peltier coefficient of conductor A (B)

I = electric current from A to B

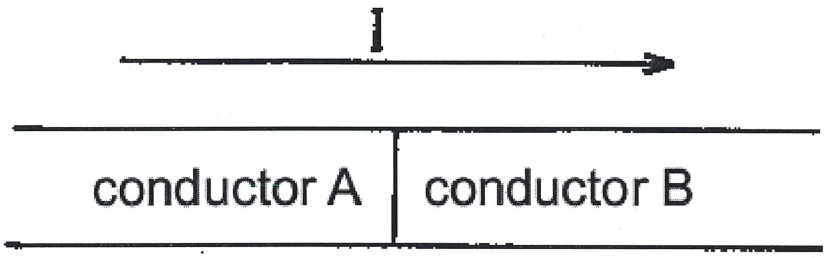

Fig 1. Setup for Observing the Peltier Effect.

The sign of $\dot{Q}$ can be positive as well as negative. A negative sign means cooling of the junction. In contrast to Joule heating, the Peltier effect is reversible and depends on the direction of the current to decide the heating and cooling effects. In short, Peltier effect is more flexible compared to normal heating or cooling.

The Peltier chip has a characteristic of switching its heating and cooling sides if the polarity of the power supply is reversed. Due to the confining space of the tumbler, mechanical methods of

reversing the Peltier chip or the power supply is unpractical. Therefore we want to design a circuit is able to electronically reverse the polarity of the power supply when needed.

The Peltier chip also dissipates a large amount of heat when performing the cooling process. Proper heat dissipation through heat sink and air circulation is crucial to allow the Peltier chip to function under maximum efficiency. Therefore we need to design a circuit that allows the fan that serves as air circulation to operate when needed and stop as we switch off the power supply.

Heating process consumes a lot of power from the power supply. Thus the battery selected must be able to discharge current for a long period of time in order to sustain the functionality of the tumbler. Since the battery will be working in a hot environment, high safety features is an important aspect of the battery as we do not want a battery that will reduce its life span or explode when exposed to a lot of heat energy.

Different sorts of controllers had been audited. The benefits of utilizing diverse Arduino board are: Arduino Uno-effectively replaceable, Arduino Leonardoeliminates the need of optional processor and Arduino Dueused in convoluted venture. Arduino small scale –enables quicker prototyping, Lily cushion Arduino – wearable's and e-materials, Arduino Esplora-has joysticks, amplifier, and sensors on info side and ringer on yield side, Arduino yun-bolster cloud based administrations, Arduino Robot-bolster our own particular customed equipment parts. This review gives a wide portrayal about Arduino processor; it will be useful for some automated specialists. [1] In this way, the Arduino ATMEGA 328 microcontroller can be utilized for different applications, for example, modern and research facility applications. These Arduino ATMEGA 328 microcontrollers are the most appropriate microcontroller for the mechanical applications. These Arduino ATMEGA 328 microcontrollers can be broadly utilized as a part of robotization process businesses. [2]

LiFePO4 has pulled in extensive consideration as cutting edge cathode material of lithium particle battery for electric vehicles; in any case, the cathode material LiFePO4 has poor rate capacity ascribed crediting to low electronic conductivity and low thickness. For acquiring elite of anode and battery, three sorts of olivine mixes LiFePO4, which were combined by strong state response and provided by various makers. It was established that immaculate and all around solidified LiFePO4 materials with little molecule sizes, and homogeneous molecule estimate

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