BLOOD COOLER TRANSPORTATION BOX WITH GSM TECHNOLOGY

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2017

ENDORSEMENT

I hereby acknowledge that I have read this report and I find that its contents meet the requirements in terms of scope and quality for the award of the Bachelor of Electronic Engineering Technology (Medical Electronic) With Honours

Signature : .....

Name of Supervisor : .....

Date : .....

DECLARATION

I hereby declare that the final year project book is an authentic record of my own work carried out of one year Final Year Project for the award of Bachelor of Electronic Engineering Technology (Medical Electronic) With Honours, under the guidance of Madam Fariza Binti Zahari from 7 September 2016 to 25 May 2017

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ABSTRACT

In today's advanced world lots of innovative applications are built on mobile phone based on technologies are being developed. Mobile phone based technologies such as the Short Message Service (SMS) and Global System for Mobile Communications (GSM) technology to communicate among users and utilize information as notification. This portable blood cooler box is specially designed for hospital usage and to transport blood from one to another place and can be weighing about below 5 pints of blood. The present cooler box is using ice pack and a thermometer to monitor the temperature reading. This cooler box is specially made for hospital usage by nurses. The purpose of this project is to improve the existing cooler box to be more comfortable to use, and also operate in DC adapter by using GSM technology to monitor temperature through display. Furthermore, this blood box is able to reduce physical maintenance. This will made users life ease and convenient during shipment from one to another place. During the usability test, the device has tested on 20 subjects, and data collected by distributing questionnaire to all the subjects. The collected data was analyzed by using Microsoft Excel Software. The results has shown that, majority are strongly agree that the improvement of device are comfortable to be used. And some subjects slightly agree of comfortability of the device. As a Cooler box will overcome the shipment issue to maintain the temperature and preventing it from being contaminated

ABSTRAK

Pada era globalisasi ini, terdapat banyak aplikasi yang telah diinovasikan pada telifon mudah alih berasakan teknologi yang sedang dibangunkan seperti Perkhidmatan Pesanan Ringkas (SMS) dan Sistem Global untuk Komunikasi Mudah Alih teknologi (GSM) untuk berkomunikasi di kalangan pengguna dan menggunakan telefon mudah alih untuk menghantar isyarat kepada pengguna. Peti simpanan darah mudah alih direka khas untuk kegunaan hospital dan untuk membawa darah dari satu tempat ke tempat yang lain dan boleh memuatkan sebanyak lima beg darah. Peti simpanan darah yang sedia ada menggunakan air batu dan thermometer untuk memantau bacaan suhu. Peti simpanan darah mudah alih dibuat khas untuk kegunaan hospital untuk memudahkan kerja-kerja jururawat. Tujuan projek ini adalah untuk menambah baik peti simpanan darah yang sedia ada kepada yang lebih efisien dan ia juga boleh beroperasi secara arus terus (DC) adapter dan menggunakan teknologi GSM untuk memantau suhu melalui paparan skrin. Tambahan pula, peti simpanan darah ini dapat mengurangkan penyelenggaraan fizikal berbanding peti simpanan darah sedia ada. pengubahsuaian ini dibuat bagi memudahkan pengguna dan mudah untuk membuat pemindahan darah dari satu tempat ke tempat yang lain. Semasa ujian kebolehgunaan, alat ini telah diuji pada 10 jururawat dan 10 orang awam, dan data telah dikumpul dengan mengedarkan soal selidik kepada semua responden. Data yang dikumpul telah dianalisis menggunakan Microsoft Excel. Keputusan telah menunjukkan bahawa majoriti adalah sangat setuju bahawa penambahbaikan peti simpanan darahtersebut selasa untuk digunakan. Tidak kurang juga beberapa responden kurang setuju untuk pengubahsuaian peti simpanan darah. Kesimpulannya peti simpanan darah akan mengatasi isu penghantaran untuk mengekalkan suhu dan mengelakkannya daripada dicemari.

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CHAPTER 1

INTRODUCTION

1.1 BACKGROUND OF STUDY

Specimen may lose their effectiveness if they become too hot or too cold at any time. Blood also called as specimen.[1] Specimen naturally biodegrade over time, and storage outside of the recommended temperature range including during transport may speed up loss of potency, which cannot be reversed. This may result in the failure of the specimen to create the desired immune response and consequently provide poor protection. However, the blood cold chain is a systematic process for the safe storage and transportation of blood from its collection from the donor to its administration to a patient who requires transfusion

.

It is referred to as a 'cold chain' because blood, being a biological substance, must be kept cold in order to reduce bacterial contamination and to prolong its life. By providing an appropriate logistics information that will empower manage of health care programs to improve management of the blood cold chain. Whole blood is warm when collected but must be cooled down to 4 °C and kept at this temperature until the point of transfusion[2]

However, with therapeutic intervention, it may delay and carries the risk of transmission of infectious such as human immunodeficiency virus (HIV), hepatitis viruses. The insulation in domestic equipment is poor and, in the event of power failure, They will not hold temperatures well. Furthermore, domestic refrigerators do not have temperature monitoring devices, such as audiovisual alarms for temperatures

outside the set limits for the products being refrigerated. Therefore, it is important to develop a portable cooler box which can be easily transport and the cooling performance will not affected by the outside temperature[3]

1.2 PROBLEM STATEMENT

The existing Cooler box is unable to control using latest technology. There is a need to improve a cooler box with mobile monitoring so that the initial location user will know the temperature of blood stored inside the device during transportation to the final location. A fall in temperature less than 2°C can cause freezing injury to the red cells leading to haemolysis. If haemolysed blood is transfused to a patient, it can lead to fatal consequences and temperatures more than 10°C can lead to overgrowth of non-specific bacteria which may have entered the blood unit during collections or component preparation[2]. Besides, maximize the probability of internal temperature easily to change and lead to the activeness of microbes to spoil the blood[4].

1.3 OBJECTIVE

The main objective of this study is:-

1. To display the internal temperature of cooler box through LCD screen
2. To develop a blood cooler transportation box with Global System for Mobile Communications (GSM) technology

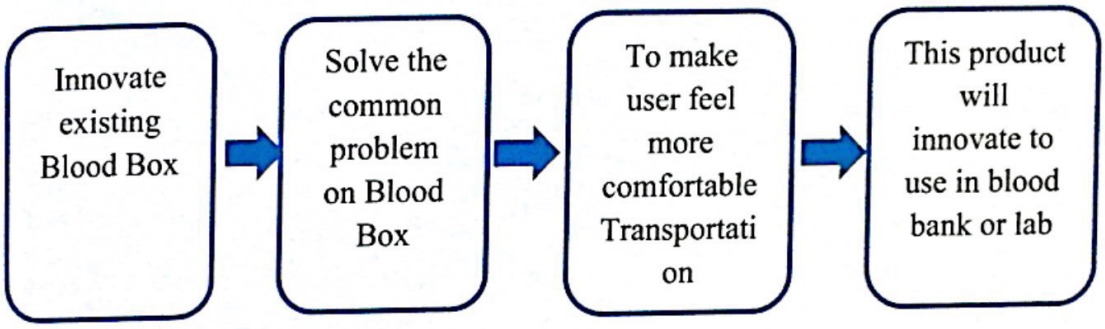
1.4 SCOPE OF STUDY

This cooler box is design for Hospital usage to be easy to monitor the temperature by using Global System for Mobile Communications (GSM) technology. By developing this cooler box is to reduce the exchanges of heat performance easier and convenient to user.

1.5 SIGNIFICANT OF STUDY

This study is to develop a blood cooler transportation box with Global System for Mobile Communications (GSM) technology which is to upgrade Cooler box. It will be easier for the nurse to carry the cooler box and it better when these blood be place in a portable cooler box.It will overcome the shipment issue which is to deliver all types of blood to the laboratory as soon as possible after collection.

1.6 THEORETICAL OF STUDY



CHAPTER 2

LITERATURE REVIEW

2.1 BLOOD COMPONENT

Blood is the only liquid tissue in the body. It is a connective tissue. It consists of formed elements (cells and cell fragments) in a liquid intercellular matrix (plasma) however blood function as transportation, regulation and protection. Blood transports oxygen and nutrients to cells, CO2 and waste away from cells, hormones to target tissues. In regulation, it helps maintain stable body temperature, pH, water and electrolyte levels. Blood has several roles in protection, blood clotting prevents fluid loss, and white blood cells protect body against disease.[3]

In spite of this, composition of blood can be classified as a connective tissue and consists of two main components that are plasma, which is a clear extracellular fluid and formed elements, are made up of the blood cells and platelets. The formed elements are so named because they are enclosed in a plasma membrane and have a definite structure and shape[3]. All formed elements are cells except for the platelets, which are tiny fragments of bone marrow cells. Formed elements are Erythrocytes also known as red blood cells (RBCs), leukocytes also known as white blood cells (WBCs) and platelets.

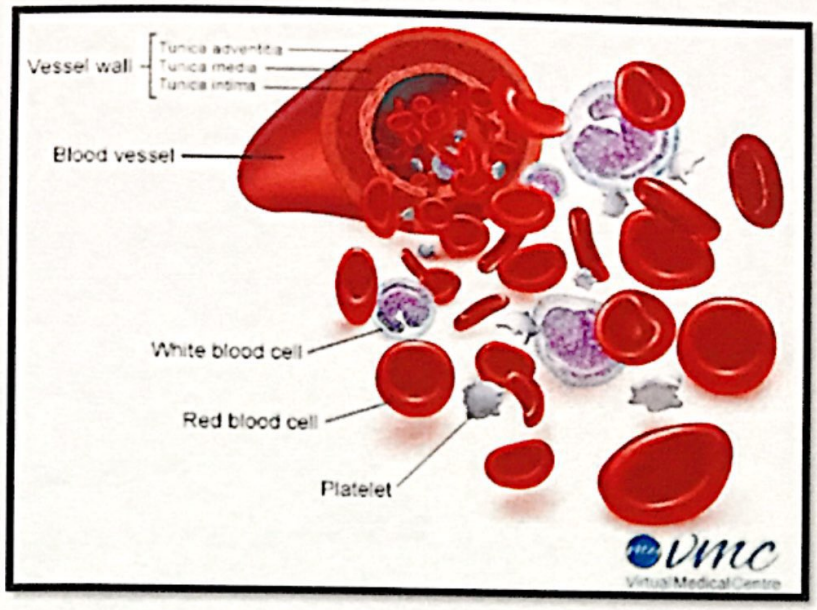


Figure 2.1: Blood Component

2.1.1 Whole Blood

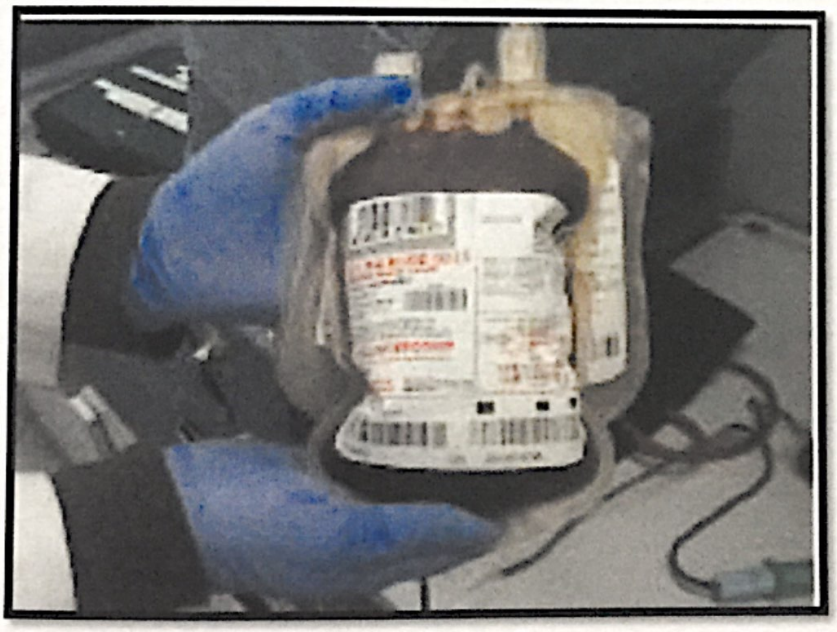


Figure 2.2: Whole Blood

Whole blood and red cell concentrate must always be stored between 2°C and 10°C. A fall in temperature less than 2°C can cause freezing injury to the red cells leading to haemolysis. If haemolysed blood is transfused to a patient, it can lead to fatal consequences.[3] Temperatures more than 10°C can lead to overgrowth of non-specific bacteria which may have entered the blood

2.1.2 Blood Storage

After the processing of blood into blood components, safe and adequate storage of these components is of immense value for two main reasons which are to maintain therapeutic efficacy and life span of the constituents and to prevent bacterial over growth.[2] Blood Cold Chain is one key component for Blood Safety and comprises different activities involving equipment that need to offer a perfect storage and transport from the beginning (collection) to the end (transfusion). Blood is collected at a body temperature (~ 37°C),[2] for keeping it safe and to avoid bacterial contamination it has to be cooled and to be stored between +2°C and +10°C, with a set point of +4°C.[2].

2.1.3 Physical and Biochemical Effects of Storage

The conditions of storage will invariably produce changes in the physical and chemical properties of blood and blood components and in turn effect the red cell recovery.

Abnormalities resulting from storage of blood are collectively discussed as below

2.1.3.1 Effect on red cell function and survival

i) Storage effect on red cell metabolism

The red cell is dependent on anaerobic glycolytic pathway for the formation of ATP, which plays a central role in determining its viability and maintaining its shape. During preservation the metabolic

cycle must continue in vitro for red cells to remain viable with adequate post transfusion survival and function.

ii) Effect on oxygen release and 2,3 Diphosphoglycerate (DPG)

2,3 DPG is known to profoundly lower the affinity of hemoglobin for oxygen at concentration found in red cells. Depletion of 2,3 DPG in stored blood temporarily adversely affects oxygen release by hemoglobin.

ii) Effect on survival

In almost all cases cells that survive 24 hours will remain viable and circulate for the remainder of their expected life span. Maximum allowable storage time, referred to as shelf life is defined by requirement of 70% recovery at 24 hours i.e. at least 70% of the transfused red cells remain in the recipient's circulation 24 hours after transfusion.

2.1.3.2 Effect of anticoagulant preservative

One of the most important factors influencing red cell recovery after blood storage is the anticoagulant solution used

i. Trisodium citrate

Rapid deterioration, only 50% cells viable after 1 week. B.Heparin: Rapid deterioration and an added disadvantage of being progressively neutralized by plasma therefore, most unsuitable for storage.

ii. Heparin

Rapid deterioration and an added disadvantage of being progressively neutralized by plasma therefore, most unsuitable for storage

iii. Acid Citrate dextrose

Storage/viability for 28 days, 24 hours survival of 77%, DPG level better maintained at 1 week because of the favourable effect of higher pH.

iv. Citrate phosphate dextrose-adenine

Storage or viability 35 days improved storage due to adenine which maintains high ATP level in the RBC.

2.1.3.3 Effect on PH

There is a gradual fall in pH during storage due to accumulation of lactic acid.

2.1.3.4 Effect of temperature

Optimum storage temperature for whole blood and red cells is between 2°-6° with occasional elevation to 10°C (e.g. during transportation) being acceptable. Delaying refrigeration increases the loss of 2,3 DPG over this period. Platelets and granulocyte retain better function when stored at room temperature. Labile coagulation factors in plasma are best maintained at temperature of -30°C or lower. Refrigeration and freezing additionally minimize proliferation of non-specific bacteria that might have entered the unit during venipuncture.[4]

2.1.3.5 Effect on electrolytes & coagulation factors

i) Electrolytes

The only important electrolyte change in stored blood is that of K. During blood storage there is a slow but constant leakage of K+ from cells into the surrounding plasma. In severe kidney disease even small amount of K+ fluctuations can be dangerous and relatively fresh or washed red cells are indicated. Due to a higher K+ content of stored blood, blood < 5 days old is recommended for neonatal exchange and top-up transfusion.

ii) Coagulation factors

Labile coagulation factors, Factors 2.3.1.4 lose their activity by 50% within 48-72 hours of storage in whole blood stored at 4°C.[4]

2.1.3.6 Effect on cellular elements

White cells lose their phagocytic and bactericidal property within 4-6 hours of collection and become non-functional after 24 hours of storage. It is important to remember that they do not lose their antigenic property and are capable of sensitizing the recipient to produce nonhaemolytic febrile transfusion reactions. Few lymphocytes may remain viable even after 3 weeks of storage. Platelets lose their haemostatic function within 48 hours in whole blood stored at 4°C

2.2 COOLER BOX

Cooler box the most commonly is an insulated box used to keep food or drink cool. Ice cubes are most commonly placed in it to help the things inside stay cool. Ice packs are sometimes used, as they either contain the melting water inside, or have

a gel sealed inside that stays cold longer than plain ice. Coolers are often taken on picnics, and on vacation or holiday.[5] Where summers are hot, they may also be used just for getting cold groceries home from the store, such as keeping ice cream from melting in a hot automobile. Even without adding ice, this can be helpful, particularly if the trip home will be lengthy [14]

2.2.1 Existing Cooler Box

There are many various technology of blood transportation box available on market. It is suitable to be installed on ambulance, blood transportation vehicle and vaccine transportation vehicle of medical organizations. It can be used in extremely hostile environment. Ambient temperature ranges from -2℃ to 43℃ and humidity can either be above 80%.[1]

The safety system is built with perfect alarming system involved both buzzers alarming and flashing light alarming are available for over temperature, power failure, sensor error, abnormal power supply and high ambient temperature. Inner battery storage provides power supply for temperature display, audible and visible alarm for 48 hours. It control by intelligentized microcomputer, real-time supervision on electricity of vehicle. Giving priority to the power supply of vehicle or boat to guarantee transportation safety however forced air cooling system, roll over good control of air flow and blowing rate make inner temperature stable and uniform.[6] It also provide finned type evaporator effectively raise cooling area and speeds up cooling rate [5].

Besides, blood bank refrigerators are used to store blood bags under controlled temperature. The control range for temperature from + 4 degree C with setting accuracy of +/- 0.1 degree C of temperature controller. The specialities of temperature control is fixed with forced-air cooling, electrically heated balancing and microprocessor controlling system ensure a constant temperature within 4±1℃. Digital display showing average temperature, upper

and lower set points with resolution of 0.1℃ for observation and monitoring. The temperature set points within 2~8℃ with an increment of 0.1℃. It is using five digital integrated sensors to display and control. The temperature recorder is to monitor safety system whole course.[2]

Vaccine refrigerators are designed to store vaccines and other medical products at a stable temperature to ensure they do not degrade. In developing countries with a sunny climate, solar-powered vaccine refrigerators are common. Many vaccines must be stored at low temperatures, some below -15°C, and others between 2 and 10°C. If vaccines are not stored correctly they can lose their effectiveness.[5]

2.2.2 Fabrication

A cool box for passenger car refers to a kind of box which is designed and fabricated using well insulating materials [7]in order to ensure the coolness inside the cool box is always stable.[8] The coolness inside of cool box depends on the refrigerant cycles of the car air conditioning system.[9]

2.3 GSM TECHNOLOGY

A GSM modem is a specialized type of modem which accepts a SIM card, and operates over a subscription to a mobile operator, just like a mobile phone. From the mobile operator perspective, a GSM modem looks just like a mobile phone. This allows the computer to use the GSM modem to communicate over the mobile network. While these GSM modems are most frequently used to provide mobile internet connectivity, many of them can also be used for sending and receiving SMS[10]. A GSM modem can be a dedicated modem device with a serial, USB or Bluetooth connection, or it can be a mobile phone that provides GSM modem capabilities.[11]

A GSM modem exposes an interface that allows applications such as (NowSMS) to send and receive messages over the modem interface. The mobile

operator charges for this message sending and receiving as if it was performed directly on a mobile phone. To perform these tasks, a GSM modem must support an "extended AT command set" for sending/receiving SMS messages. Due to some compatibility issues that can exist with mobile phones, using a dedicated GSM modem is usually preferable to a GSM mobile phone. This is more of an issue with MMS messaging, where if you wish to be able to receive inbound MMS messages with the gateway, the modem interface on most GSM phones will only allow you to send MMS messages. This is because the mobile phone automatically processes received MMS message notifications without forwarding them via the modem interface.[15]

It should also be noted that not all phones support the modem interface for sending and receiving SMS messages. In particular, most smart phones, including Blackberries, iPhone, and Windows Mobile devices, do not support this GSM modem interface for sending and receiving SMS messages at all at all. Additionally, Nokia phones that use the S60 (Series 60) interface, which is Symbian based, only support sending SMS messages via the modem interface, and do not support receiving SMS via the modem interface.

2.3.1 Advantages of GSM

Advantages in GSM There are numerous handset and service providers available in the market. Hence the buyers can choose from a variety of options. They come with a variety of plans with cheaper call rates, free messaging facility, limited free calls and so on. The quality of calling in GSM is better and also better secured than CDMA. A number of value-added services such as GPRS The consumption of power is less in GSM mobiles. With the tri band GSM,[12] one can use the phone anywhere around the world. The SIM card or subscriber recognize unit card which transmits subscriber and exchange info, secures purchaser info. SIM cards also permit consumers to handover their subscription info and telephone book info from one receiver to add at any period.

2.3.2 Disadvantages of GSM.

Signal can be detected easily in GSM as compared to CDMA. Calls made through GSM mobiles can be tampered. If the SIM gets lost, one can lose all the data, if the same is not saved in the phone. GSM has fixed max call site range of 120 km, which is imposed by technical limitations. This is expanded from the old limit of 35 km. Can be detected easily in GSM as compared to CDMA[8].

2.4 ARDUINO UNO

The Arduino Uno board is a microcontroller based on the ATmega328. It has 14 digital input/output pins in which 6 can be used as PWM outputs, a 16 MHz ceramic resonator, an ICSP header, a USB connection, 6 analog inputs, a power jack and a reset button. This contains all the required support needed for microcontroller. In order to get started, they are simply connected to a computer with a USB cable or with a AC-to-DC adapter or battery. Arduino Uno Board varies from all other boards and they will not use the FTDI USB-to-serial driver chip in them. It is featured by the Atmega16U2 (Atmega8U2 up to version R2) programmed as a USB-to-serial converter.[13]

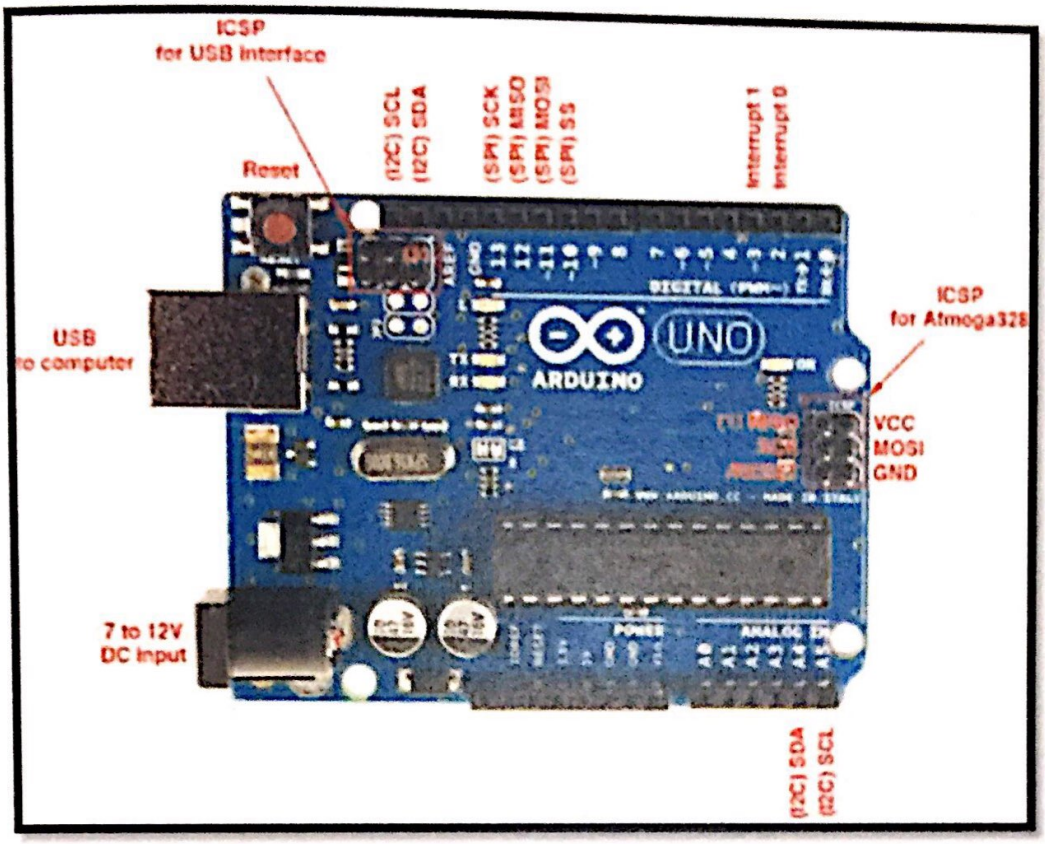


Figure 2.3: Arduino UNO Module

There are various types of Arduino boards in which many of them were third-party compatible versions. The most official versions available are the Arduino Uno R3 and the Arduino Nano V3. Both of these run a 16MHz Atmel ATmega328P 8-bit microcontroller with 32KB of flash RAM 14 digital I/O and six analogue I/O and the 32KB will not sound like as if running Windows. Arduino projects can be stand-alone or they can communicate with software on running on a computer. For e.g. Flash, Processing, Max/MSP). The board is clocked by a 16 MHz ceramic resonator and has a USB connection for power and communication. You can easily add micro SD/SD card storage for bigger tasks.

2.4.1 Features of the Arduino Uno Board

It is an easy USB interface. This allows interface with USB as this is like a serial device. The chip on the board plugs straight into your USB port and supports on your computer as a virtual serial port. The benefit of this setup is that serial communication is an extremely easy protocol which is time-tested and USB makes connection with modern computers and makes it comfortable.

It is easy-to-find the microcontroller brain which is the ATmega328 chip. It has more number of hardware features like timers, external and internal interrupts, PWM pins and multiple sleep modes.[9]

It is an open source design and there is an advantage of being open source is that it has a large community of people using and troubleshooting it. This makes it easy to help in debugging projects. It is a 16 MHz clock which is fast enough for most applications and does not speeds up the microcontroller. It is very convenient to manage power inside it and it had a feature of built-in voltage regulation. This can also be powered directly off a USB port without any external power. You can connect an external power source of up to 12v and this regulates it to both 5v and 3.3v[9].

13 digital pins and 6 analog pins . This sort of pins allows you to connect hardware to your Arduino Uno board externally. These pins are used as a key for extending the computing capability of the Arduino Uno into the real world. Simply plug your electronic devices and sensors into the sockets that correspond to each of these pins and you are good to go.

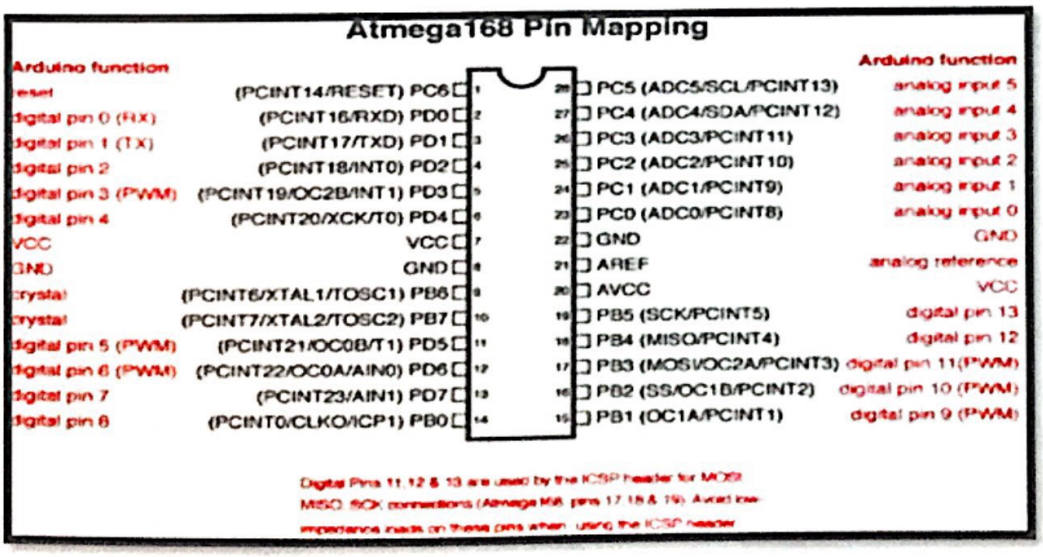


Figure 2.4: Pin Mapping

2.4.2 Programming

- The Arduino integrated development environment (IDE) is a cross-platform application written in Java, and is derived from the IDE for the Processing programming language and the Wiring projects
- The Arduino Uno board can be programmed with the Arduino software.
- Select "Arduino Uno from the Tools > Board menu (according to the microcontroller on your board).
- The ATmega328 on the Arduino Uno comes preburned with a bootloader that allows you to upload new code to it without the use of an external hardware programmer. It communicates using the original STK500 protocol.
- You can also bypass the bootloader and program the microcontroller through the ICSP (In-Circuit Serial Programming) header.
- The ATmega16U2 (or 8U2 in the rev1 and rev2 boards) firmware source code is available.

CHAPTER 3

METHODOLOGY

3.1 INTRODUCTION

This chapter will cover the details explanation of methodology that is being used to make this project complete and working well. Many methodology or findings from this field mainly generated into journal for others to take advantages and improve as upcoming studies. The method is use to achieve the objective of the project that will accomplish a perfect result. In order to evaluate this project, the methodology based on blood cooler transportation box with GSM technology.

3.2 BLOCK DIAGRAM

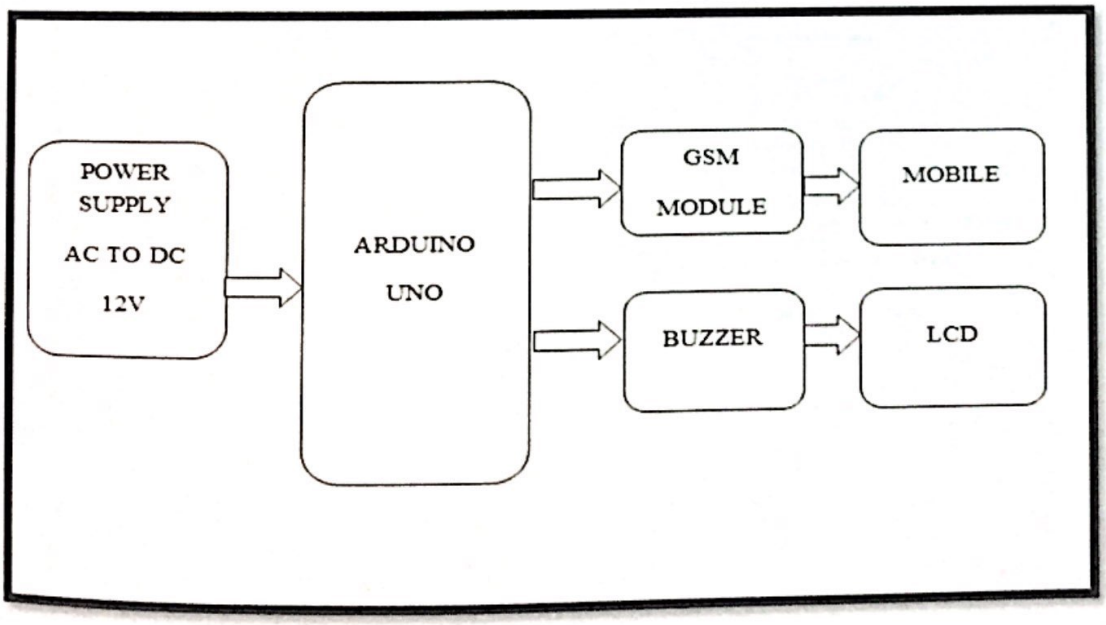


Figure 3.1: Block diagram of project

3.2.1 Power Supply

Some DC power supplies use AC mains electricity as an energy source. Such power supplies will sometimes employ a transformer to convert the input voltage to a higher or lower AC voltage. A rectifier is used to convert the transformer output voltage to a varying DC voltage, which in turn is passed through an electronic filter to convert it to an unregulated DC voltage.

The filter removes most, but not all of the AC voltage Variations; the remaining AC voltage is known as *ripple*. The electric load's tolerance of ripple dictates the minimum amount of filtering that must be provided by a power supply. In some applications, high ripple is tolerated and therefore no filtering is required. For example, in some battery charging applications it is possible to implement a mains-powered DC power supply with nothing more than a transformer and a single rectifier diode, with a resistor in series with the output to limit charging current.

3.2.2 Arduino Uno

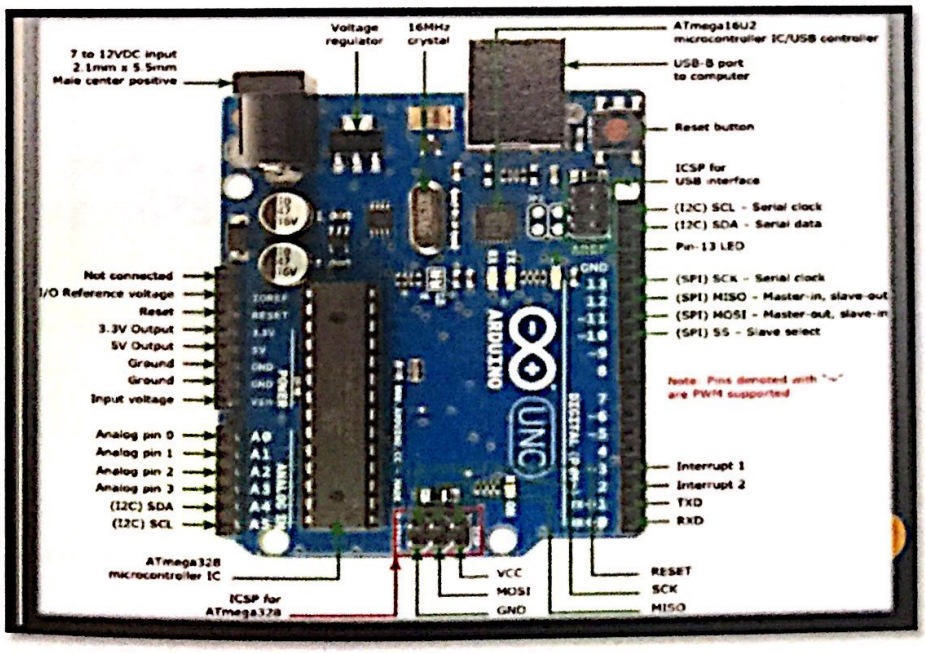


Figure 3.2: Pin Out Arduino Uno

The Arduino Uno is a microcontroller board based on the ATmega328 (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. The Uno differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it features the Atmega8U2 programmed as a USB-to-serial converter. "Uno" means one in Italian and is named to mark the upcoming release of Arduino 1.0. The Uno and version 1.0 will be the reference versions of Arduino, moving forward. The Uno is the latest in a series of USB Arduino boards.

3.2.3 Thermoelectric

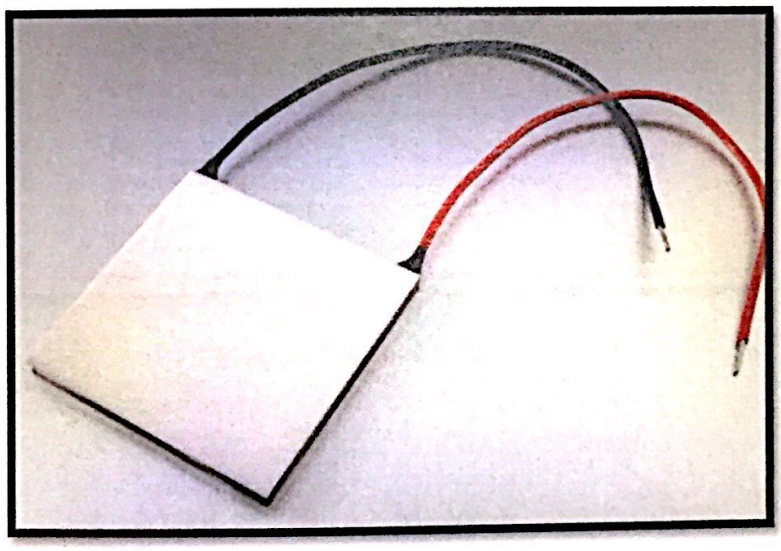


Figure 3.3: Thermoelectric

Thermoelectric technology is an active thermal management technique based on the Peltier effect. It was discovered by J.C.A Peltier in 1834, this phenomenon involves the heating or cooling of the junction of two thermoelectric materials (bismuth and telluride) by passing current through the junction. During operation, direct current flows through the TEC module causing heat to be transfered from one side to the other. creating a cold and hot

side. If the direction of the current is reversed, the cold and hot sides are changed. Its cooling power also can be adjusted by changing its operating current. A typical single stage cooler consists of two ceramic plates with p and n-type semiconductor material (bismuth, telluride) between the ceramic plates. The elements of semiconductor material are connected electrically in series and thermally in parallel.

3.2.4 GSM Module

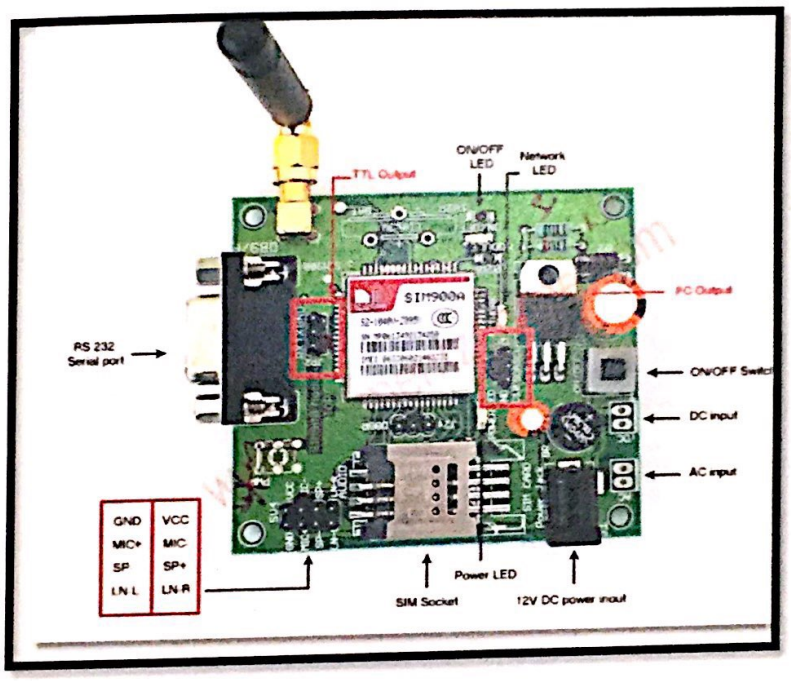


Figure 3.4: GSM Module

GSM (Global System for Mobile Communications) is a specialized type of modem which accepts a SIM card, and operates over a subscription to a mobile operator, just like a mobile phone. From the mobile operator perspective, a GSM modem looks just like a mobile phone. When a GSM modem is connected to a computer, this allows the computer to use the GSM modem to communicate over the mobile network. It operates at either the 900, 1800 or 1,900MHz frequency bands.

3.2.5 Liquid Crystal Display

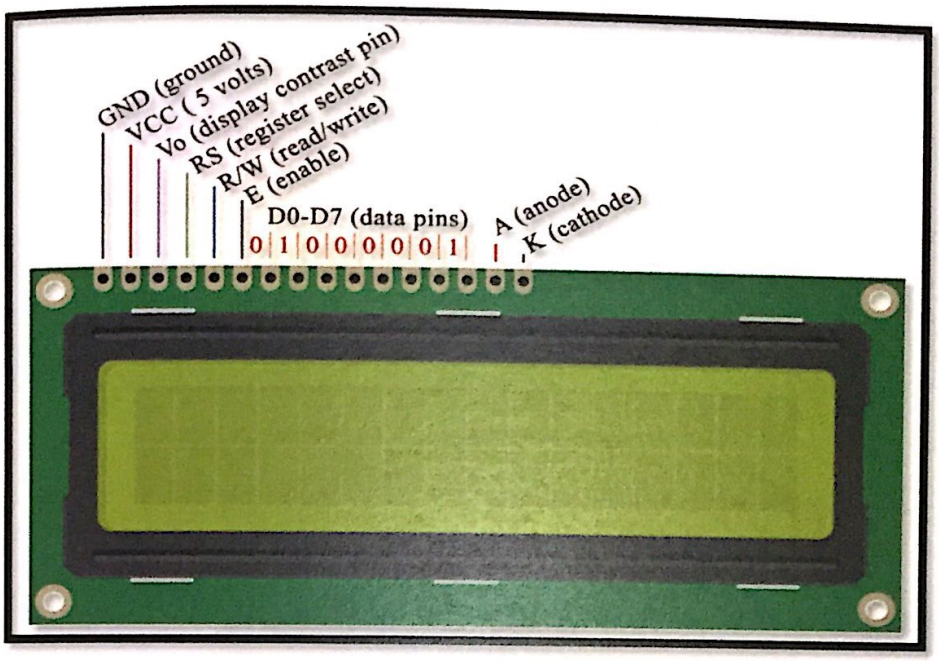


Figure 3.5: LCD

LCD (liquid crystal display) is the technology used for displays in notebook and other smaller computers. Like light-emitting diode (LED) and gas-plasma technologies, LCDs allow displays to be much thinner than cathode ray tube (CRT) technology. LCDs consume much less power than LED and gas-display displays because they work on the principle of blocking light rather than emitting it. An LCD is made with either a passive matrix or an active matrix display grid. The active matrix LCD is also known as a thin film transistor (TFT) display. The passive matrix LCD has a grid of conductors with pixels located at each intersection in the grid. A current is sent across two conductors on the grid to control the light for any pixel. An active matrix has a transistor located at each pixel intersection, requiring less current to control the luminance of a pixel. For this reason, the current in an active matrix display can be switched on and off more frequently and improved the screen refresh time.

3.3 Flow Chart

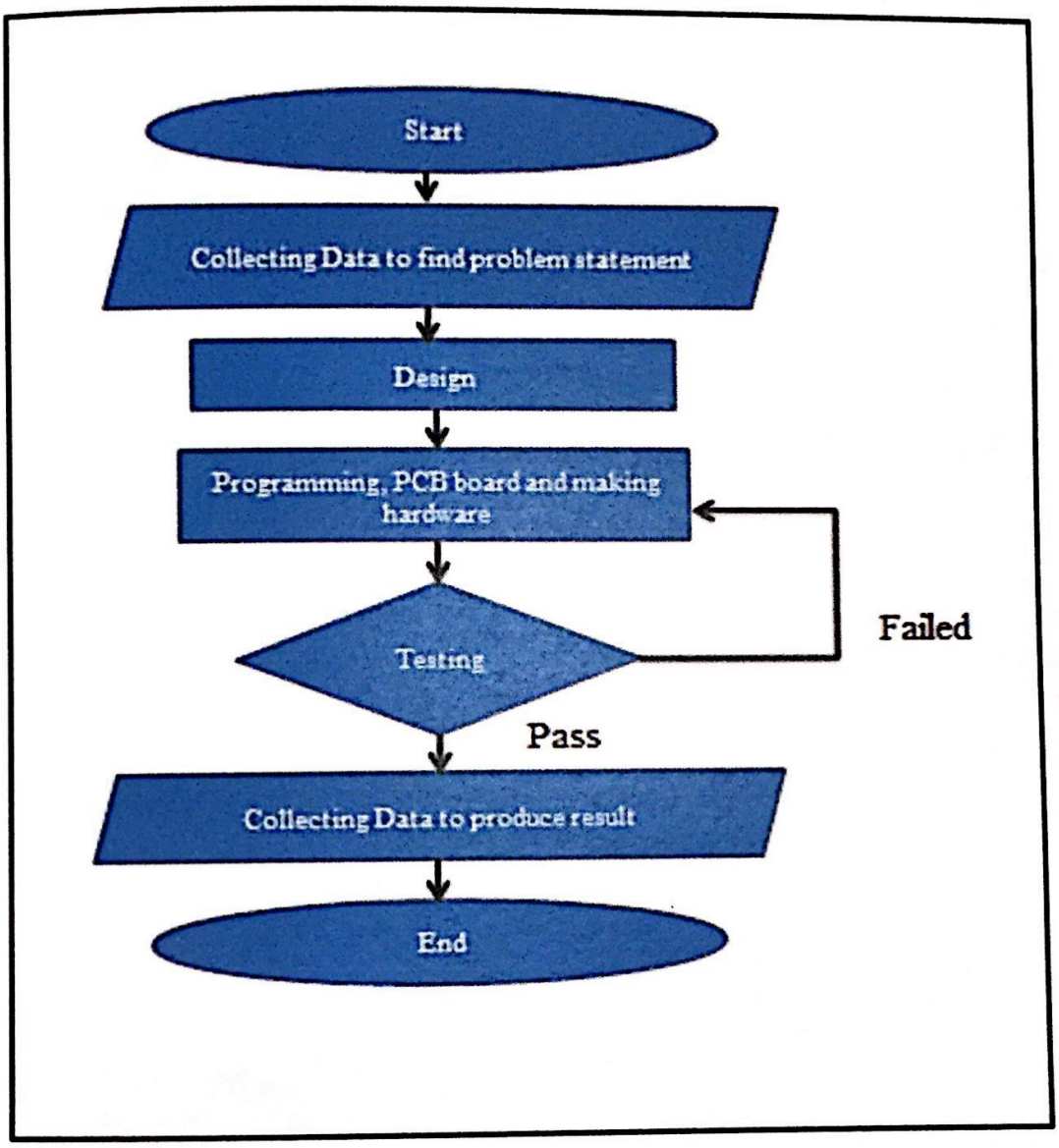


Figure 3.6: Flow Chart of Whole Project

Data collection was the first step of this study. To study the design and variety pattern of cooler Box, the after that, evaluate the data from study, then find and create the problems statement. After problems statement was created, design the shape and the device. Blood Cooler Transportation Box with GSM Technology is developed to overcome the issues. Design the suitable shape of the device according to problems statements. Determine the suitable hardware and software that will be attach. Planned the software that suitable used to control temperature, because it provides almost all of the many features found in Arduino Uno that are made by the many suppliers of these small yet comprehensive logic engines. This use offers advantages such as lower

voltage drop when turn on and the ability to control motors [9]. Besides that, GSM Technology was used in this study, because it commonly used in communication used to control or monitor temperature.

Arduino Uno is a microcontroller board based on the ATmega328. It acts as a Central Processing Unit in this device, and it used to control the electronic component to function well. It will used to monitor whether of temperature. Besides, designing and making the hardware for the devices can also executed. When the hardware is completed, the device is tested to ensure the device is working in good and safe aspect. (If testing failed, return to the step before, redo the process, testing again the devices).

Final step of project process is testing and collect data. Test the device on 20 subjects (10 Nurse and 10 public) for the clinical testing and usability testing. Then, collect the data from Nurse by distribute questionnaire and analysis the data by using SPSS. Discuss and conclude the result that analyzed.

3.4 Printed Circuit Board (PCB)

A printed circuit board (PCB) is the board base for physically supporting and wiring the surface-mounted and socketed components in most electronics. PCBs can be single sided (one copper layer), double sided (two copper layers) or multi-layer (outer and inner layers). Conductors on different layers are connected with vies. Multi-layer PCBs allow for much higher component density. For this study, the single sided (one copper layer) have used, because the schematics diagram for this study is not huge and complicated, so single sided PCBs is suitable to be used.

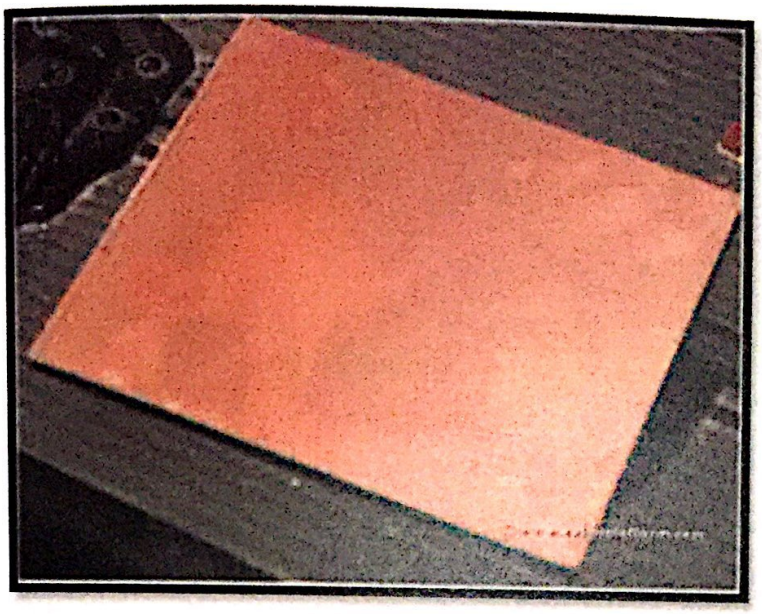


Figure 3.7: Printed Circuit Board (PCBs)

3.4.1 Process of making PCB

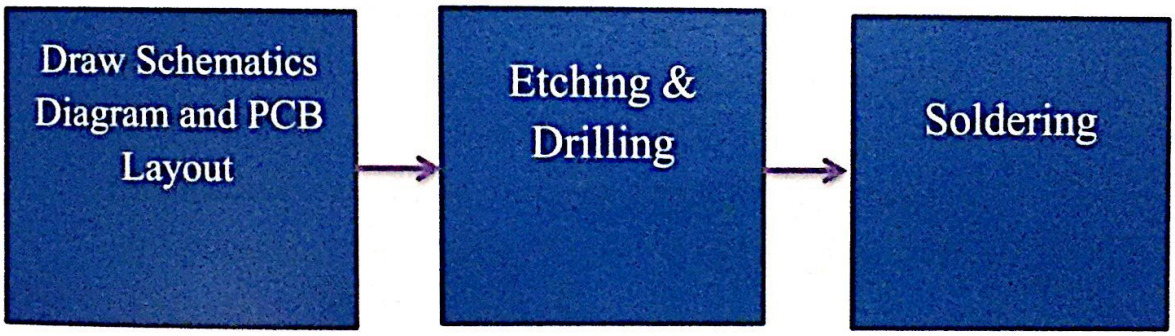


Figure 3.8: Block Diagram of Process Making PCBs

First step, draw the schematics diagram by using Eagle6.0, after the schematics have done, in the file menu, there's a "Switch to board" selection. Click on it to create the PCB layout. Once the layout had done, print the layout onto a glossy paper.

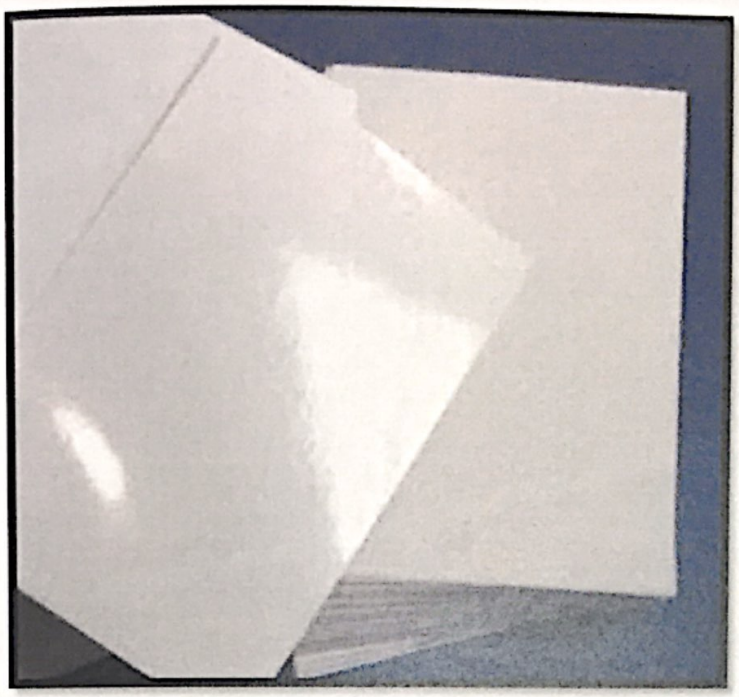


Figure 3.9: Glossy Paper

After that, faced the printed sides of the glossy paper to the Board, then iron it until the PCB layout have transfer onto the Board. Iron Process, which using heat of the iron, to transfer the toner from the glossy paper into the PCBs. Proceed to the next step which is etching and drilling process. During the etching process, ferric chloride has used to remove the unused copper on the board.

Figure 3.10: Iron Process

Figure 3.11: Ferric Chloride Powder

First, pour the ferric chloride into the warm water (warm water help to remove the copper more fast than cold water), then put the board with printed PCB layout into the water. Shaking will help to remove the copper more fasts. Once the unused copper had removed, proceed to the drilling step.

After the drilling process has done, place the components according the PCB layout diagram. Make sure the components have place with the right position and also with the right polarity. After that, solder by using soldering iron and solder lead.

3.5 HARDWARE IMPLEMENTATION

3.5.1 GSM module

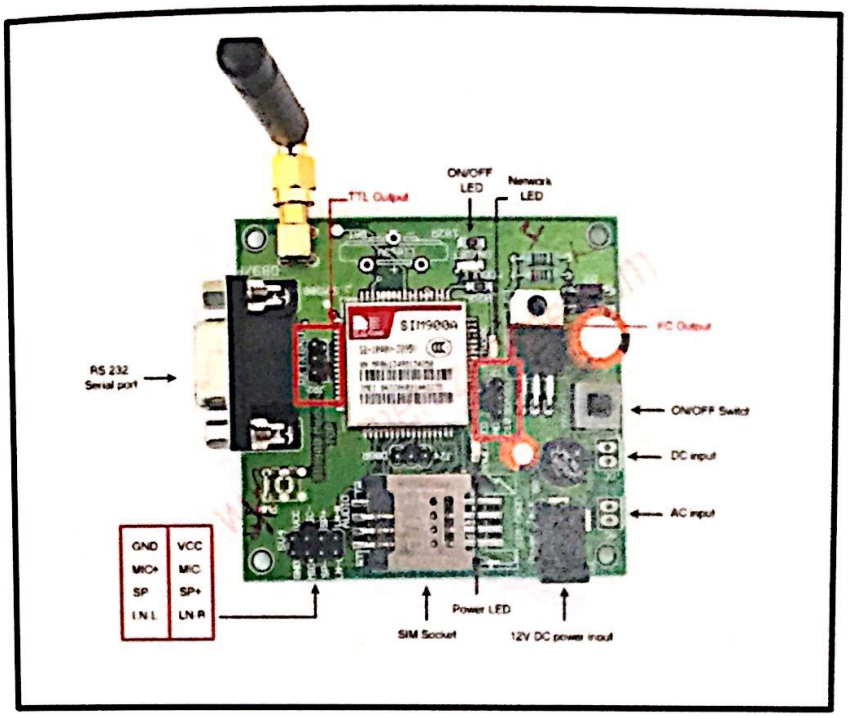


Figure 3.12: GSM module

GSM (Global System for Mobile Communications) is a specialized type of modem which accepts a SIM card, and operates over a subscription to a mobile operator, just like a mobile phone. From the mobile operator perspective, a GSM modem looks just like a mobile phone. When a GSM modem is connected to a computer, this allows the computer to use the GSM modem to communicate over the mobile network. It operates at either the 900, 1800 or 1,900MHz frequency bands.

3.5.2 Arduino Uno

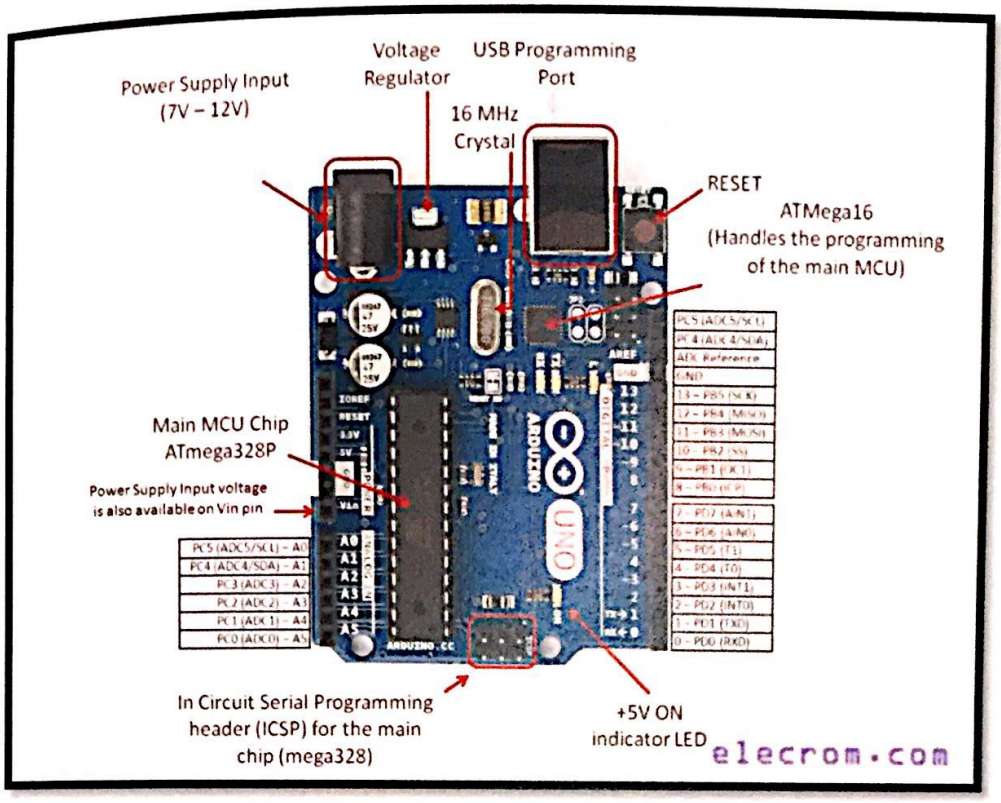


Figure 3.13: Arduino Uno

The Arduino Uno is a microcontroller board based on the ATmega328 (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. The Uno differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it features the Atmega8U2 programmed as a USB-to-serial converter. "Uno" means one in Italian and is named to mark the upcoming release of Arduino 1.0. The Uno and version 1.0 will be the reference versions of Arduino, moving forward. The Uno is the latest in a series of USB Arduino boards.

3.5.3 Thermoelectric

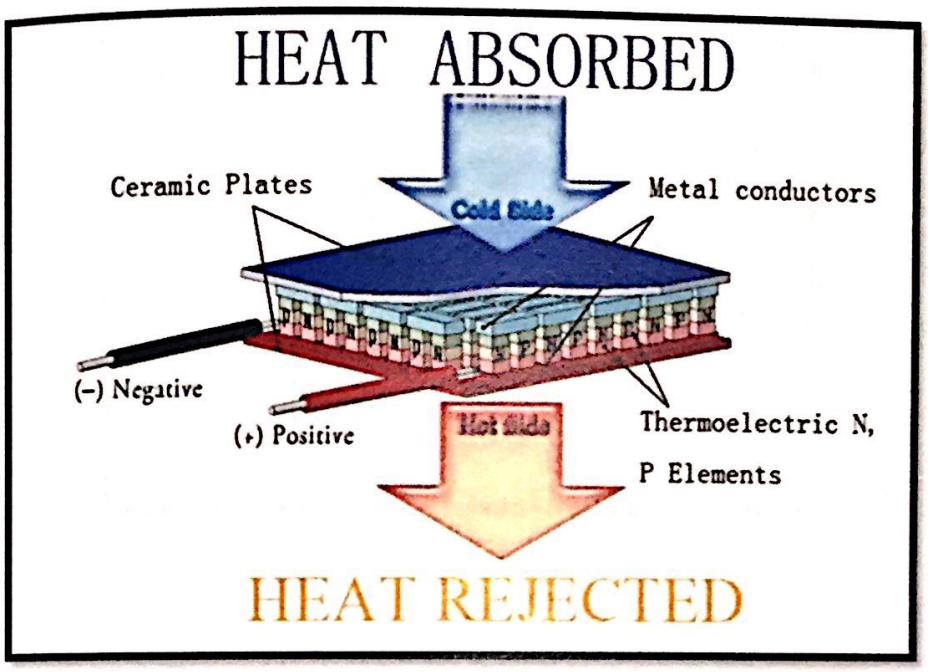


Figure 3.14: Thermoelectric device

Thermoelectric coolers are solid-state heat pumps that operate according to the Peltier effect: a theory that claims a heating or cooling effect occurs when electric current passes through two conductors. A voltage applied to the free ends of two dissimilar materials creates a temperature difference.

3.5.4 Temperature Sensor

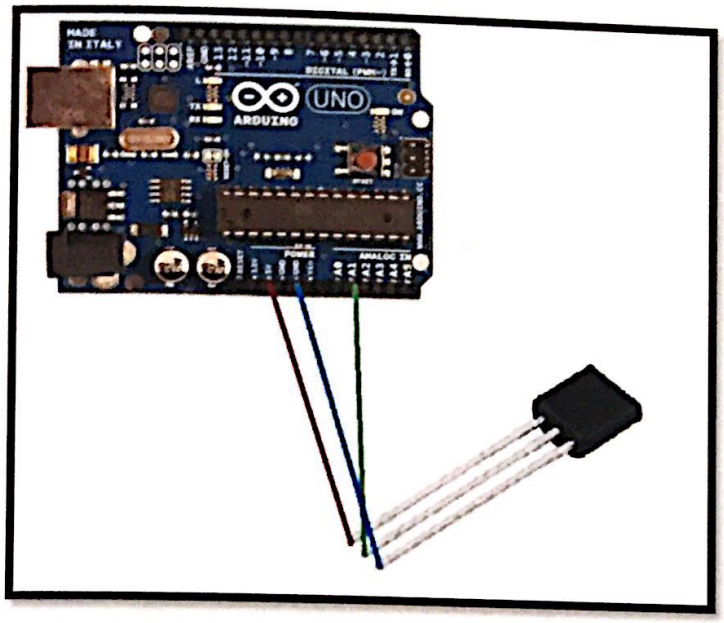


Figure 3.15: Temperature Sensor

Spicemen are biological products that can lose their potency if exposed to excessive heat or freezing. Different spicemen have different sensitivity to freezing and heat; it is because of this phenomenon that monitoring the temperature of vaccines during storage and transportation is vital. For the blood transport storage to be stored between +2°C and +10°C

3.6 SOFTWARE IMPLEMENTATION

3.6.1 Programming

Arduino Uno is used in this project, because it has ATmega328 running at 8MHz with external resonator, which the program that load into the arduino can be erased and rewrite. Arduino act as a CPU, which control all the activities on board and also the movement of device. The process of programming shown as the diagram below:

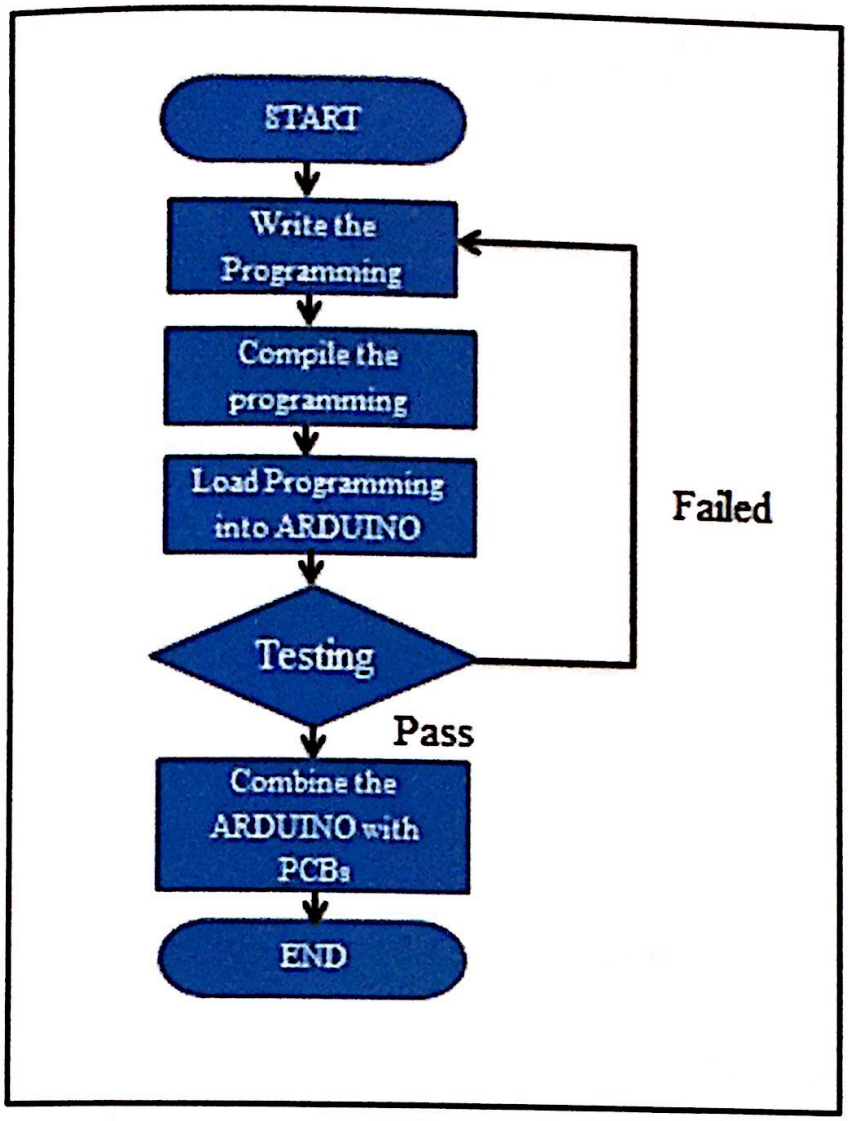


Figure 3.16: Process of Programming

To program the Arduino, Arduino IDE v8.56 was used to execute the programming. First, open the arduino board, and click tools and select the board which is Arduino Pro Mini. The next, will be click serial/com port that Arduino is attached. Once Arduino board is connected and the blink sketch open press the upload button. After a second, can see some LEDs flashing on Arduino, followed by the message 'Done Uploading' in the status bar of the Blink sketch. If everything worked, LED on Arduino board will be blinking.

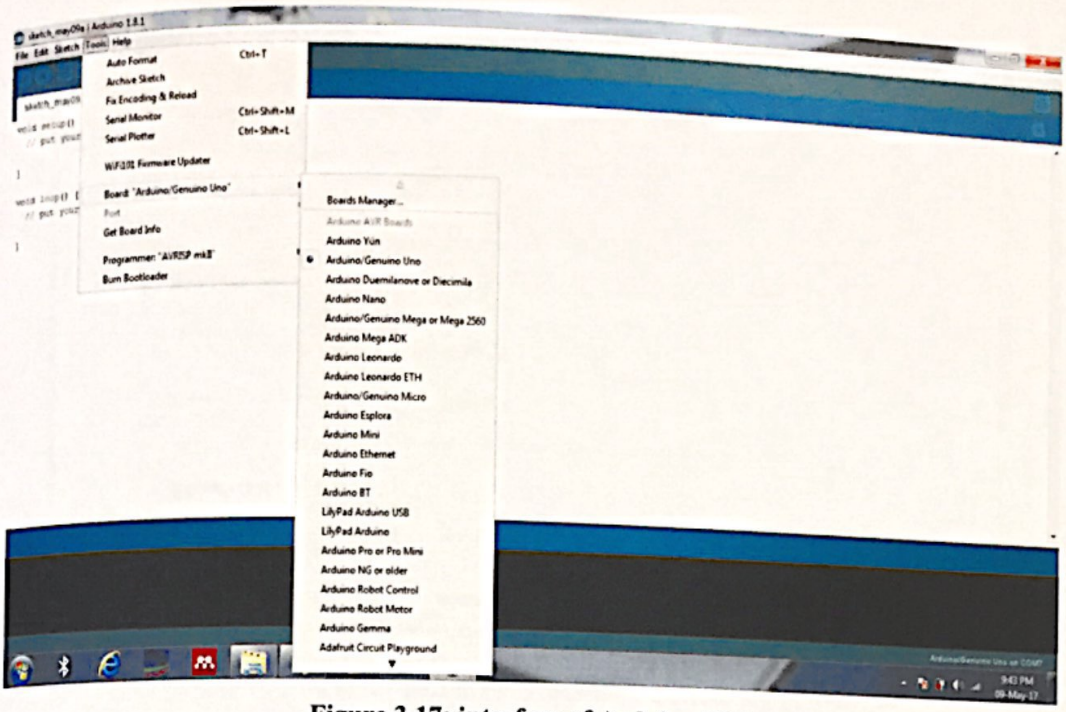


Figure 3.17: interface of Arduino IDE

3.6.2 Programming Code of Device

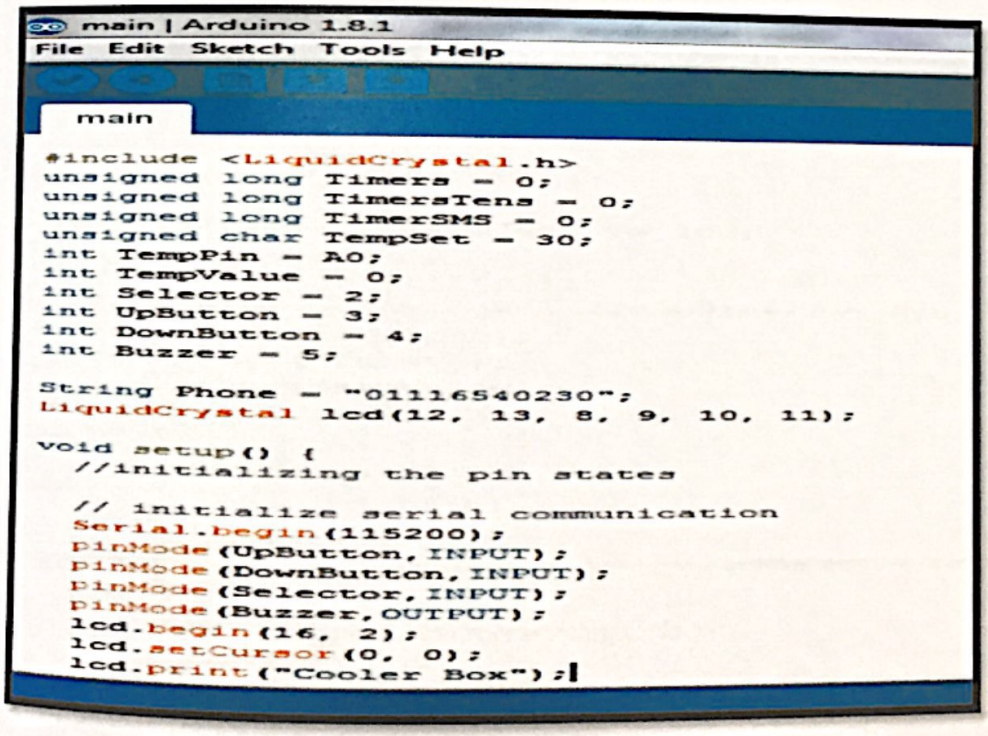


Figure 3.18: Programming Code 1

```
  lcd.print("Cooler Box");
  lcd.setCursor(0, 1);
  lcd.print("For Blood");
  delay(2000);
  lcd.clear();
}
void loop()
{
  if(millis() - TimerSMS >= 500)
  {
    TimerSMS = millis();
    lcd.setCursor(0, 1);
    lcd.print("Set:");
    if (digitalRead(UpButton))
    {
      TempSet++;;
    }
    else if(digitalRead(DownButton))
    {
      TempSet--;
    }
    lcd.setCursor(5, 1);
    lcd.print(TempSet);

    if ((TempValue > TempSet) && digitalRead(Selecto
```

Figure 3.18: Programming Code 2

```
      lcd.setCursor(12, 0);
      lcd.print("Send:");
      lcd.setCursor(12, 1);
      lcd.print("SMS:");
      digitalWrite(Buzzer,HIGH);
      SendSMS();
      lcd.clear();
      digitalWrite(Buzzer,LOW);
    }


  }

  if(millis() - TimersTens >= 100)
  {
    TimersTens = millis();
    TempValue = analogRead(TempPin)/2 - 2;
    lcd.setCursor(0, 0);
    lcd.print("Temp:");
    lcd.print(TempValue);
  }

}


void SendSMS(void)
```

Figure 3.19: Programming Code 3

```
void SendSMS(void)
{
  Serial.println("AT+CPOWD=1");                    //
  Serial.write(0x0D);
  delay(1000);
  Serial.println("AT+CMGF=1");                     //
  Serial.write(0x0D);
  delay(1000);
  Serial.print("AT+CMGS=");
  Serial.write(0x22);
  Serial.print(Phone);
  Serial.write(0x22);
  Serial.write(0x0D);
  delay(1000);
  Serial.print("Over Temperature");
  Serial.print(" ");
  Serial.print(TempValue);
  Serial.print("'C");
  Serial.write(0x1A);
  delay(5000);
}
```

Figure 3.20: Programming Code 4

CHAPTER 4

RESULT AND DISCUSSION

4.1 INTRODUCTION

This chapter shown the result from our collected data such as questionnaire and the data is analyzed and generated graph by using Microsoft Excel. And then the result that analyzed is discussed in this chapter.

4.2 DESIGN OF BLOOD COOLER TRANSPORTATION BOX WITH GSM TECHNOLOGY

Figure 4.1: Prototype of Blood Cooler Transportation Box with GSM Technology

Blood Cooler Transportation Box device is developed using GSM Technology services to monitor temperature range of Cooler Box. This device can maintain the temperature inside the box much better than the conventional cooler box. This device is provided with screen display to ease the monitoring temperature range of cooler box to preventing from being contaminated. This device will send information through mobile when the limit of temperature is over the range as set. The peltier cooler is attached on the box to remain the cooling of the box. The overall design also protect the blood from excessive vibration or damage as it will absorb the pressure to keep the internal storage of the box remain safe.

4.2.1 Structure of Blood Cooler Transportation Box With GSM Technology Device

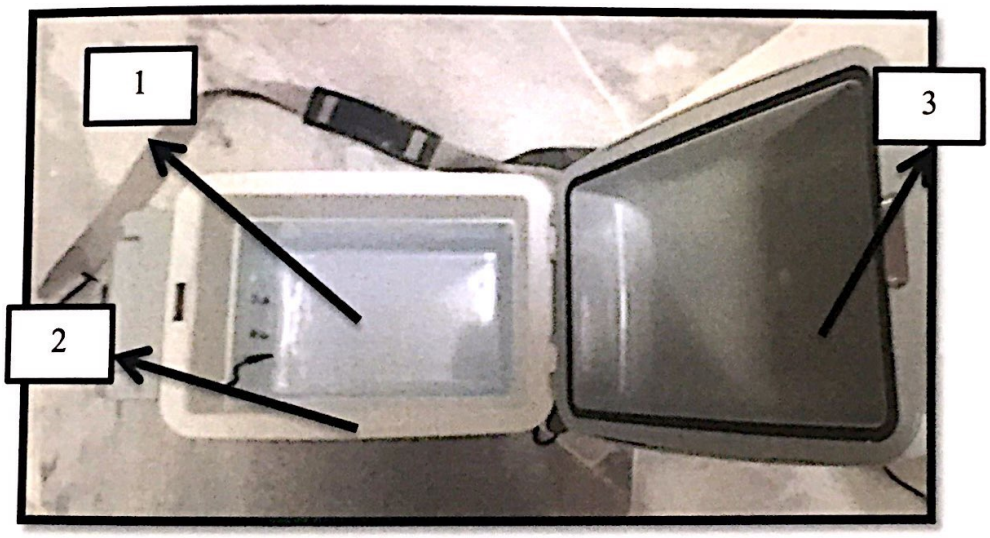


Figure 4.2: Blood Cooler Transportation Box with GSM Technology (Top View)

Figure 4.3: Polystyrene

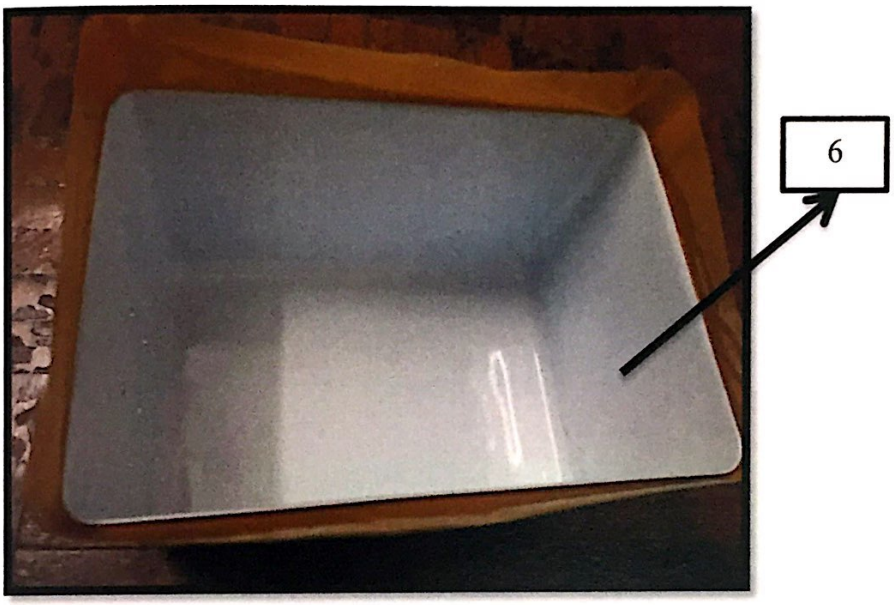


Figure 4.4: Stainless Steel

Table 4.1: Function of the Inner Parts of Device

NO	PARTS	FUNCTION
1	Box	To keep blood
2	Sensor	To detect temperature inside Box
3	Magnet cover	To remain cooling

4	Polystyrene	To remain the cooling
5	PVC insulated	Box insulated
6	Stainless Steel	To make more cooling

4.2.2 Frontal View

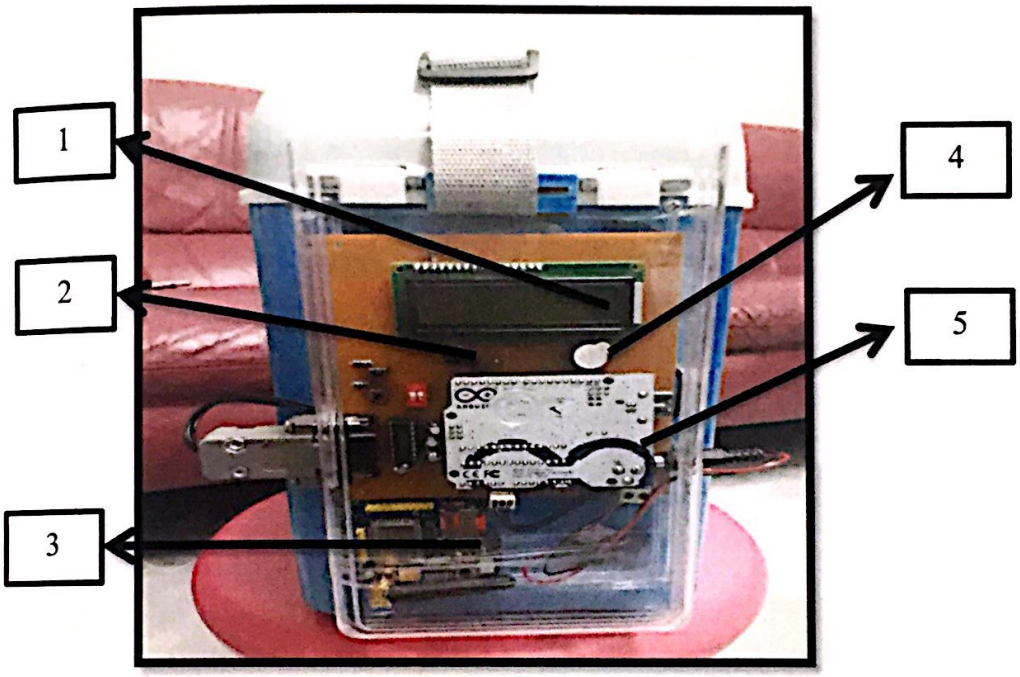


Figure 4.5: Frontal Part

Table 4.2: Function of the Control Panel Parts of Device

NO	PARTS	FUNCTION
1	LCD	To display temperature
2	Switch	To switch On/Off
3	GSM module	To send SMS when temperature high

4	Buzzer	While sending SMS the buzzer will On
5	Arduino Uno	To running the project

4.2.3 Back View

Figure 4.6: Back View of Device

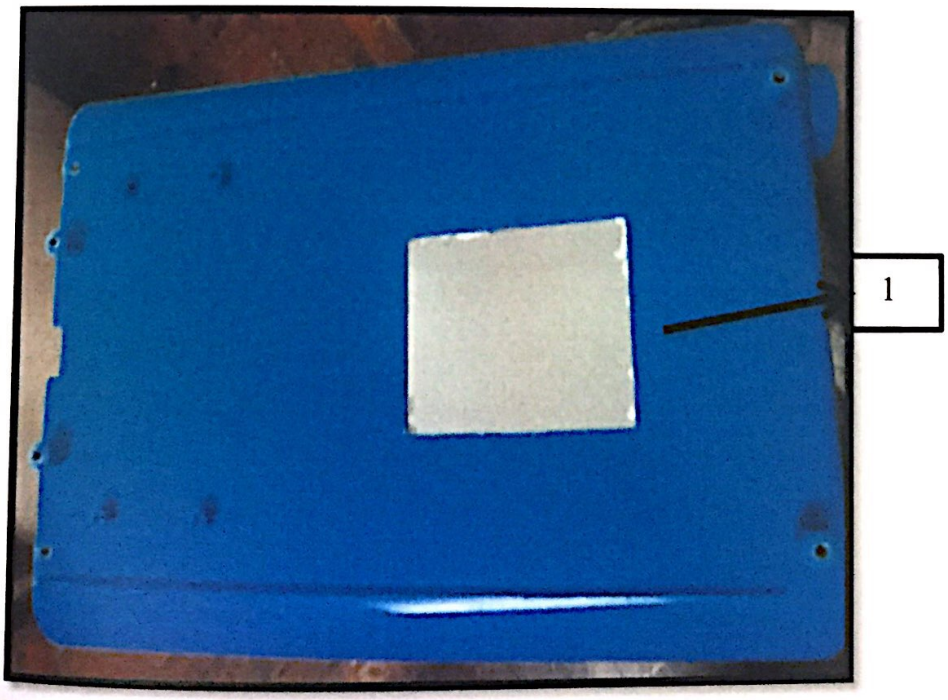


Figure 4.7: Hole for Place Peltier Effect

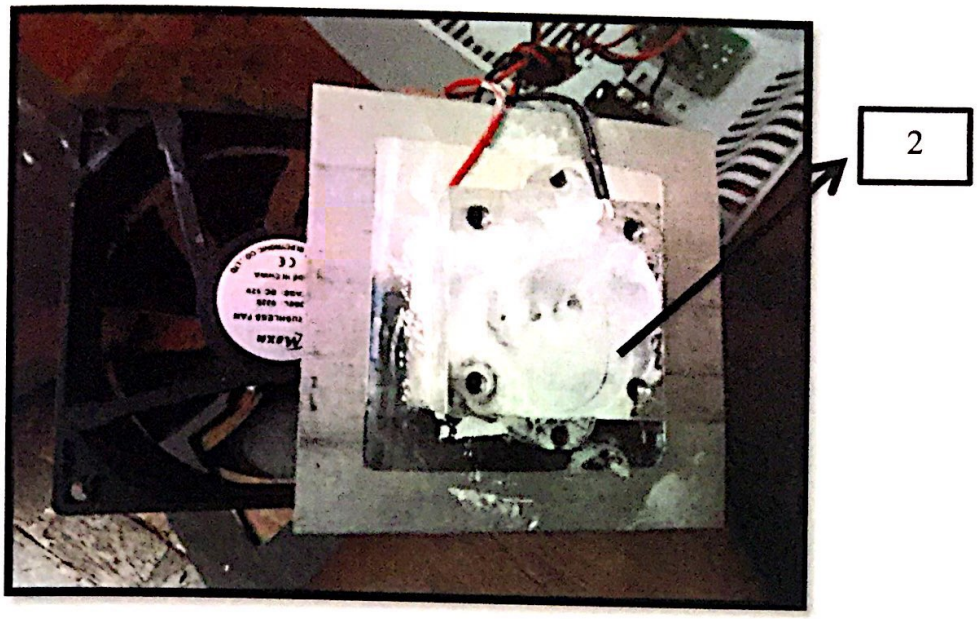


Figure 4.8: Peltier Effect

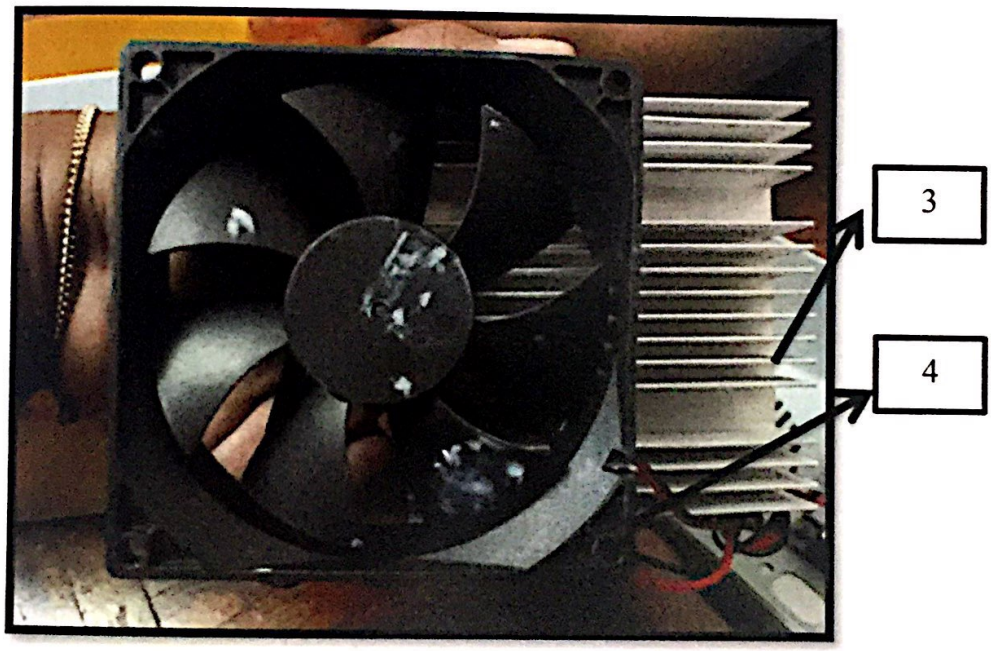


Figure 4.9: Fan

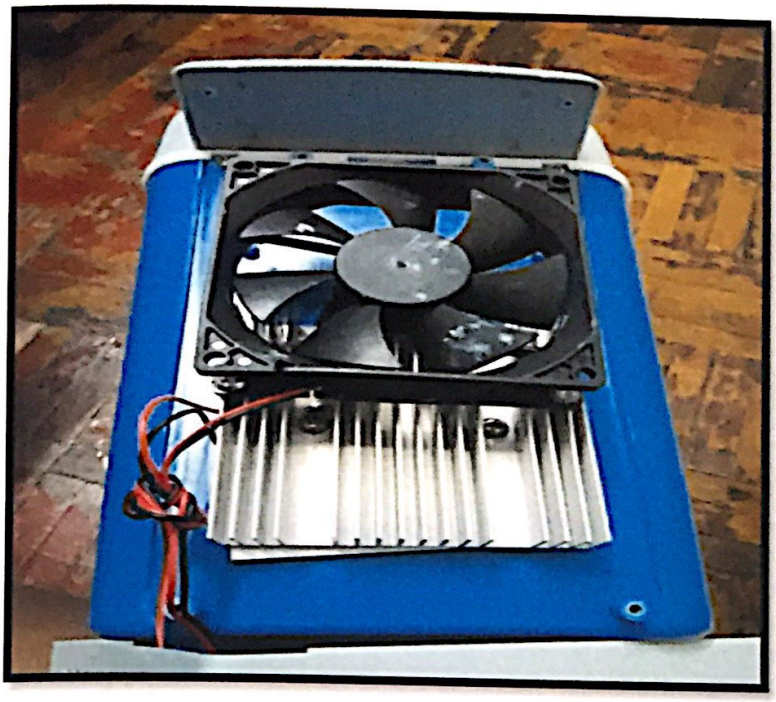


Figure 4.10: After Install Peltier Effect and Fan

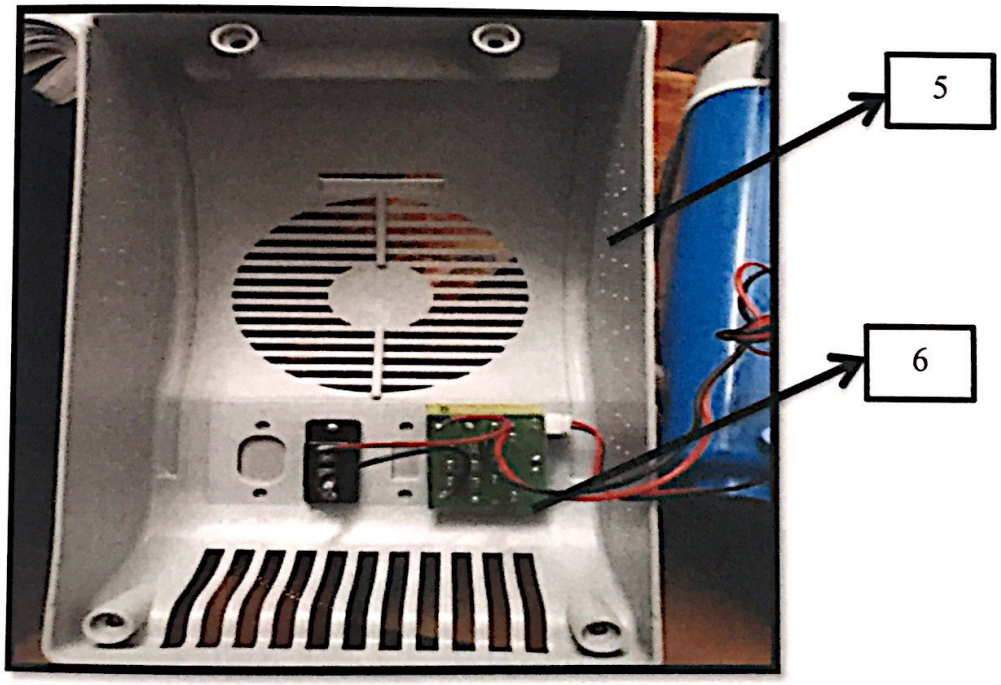


Figure 4.11: Cover of Installed Device

Table 4.3: Function of the Back Parts of Device

NO	PARTS	FUNCTION
1	PVC insulated Box	Make a hole for peltier cooler
2	Peltier cooler	It can be used to cooling
3	Heat sink	Heat exchanger
4	Fan	Used to cool the peltier effcet
5	Cover	Cover for devices
6	Switch	On/Off button for box

4.3 QUESTIONNAIRE

Throughout the distributed questionnaire, all the data survey have done both pre questionnaire and post questionnaire, can see positive feedback from subjects.

4.3.1 Pre Questionnaire

Through this part, the questionnaire is conducted among hospital's staff at Hospital Kuala Lumpur. A part from that, all the data in the survey form is tabulated in graph bar below. As overall, through the data collection almost of the staff nurse has showed positive feedback on improving of cooler box

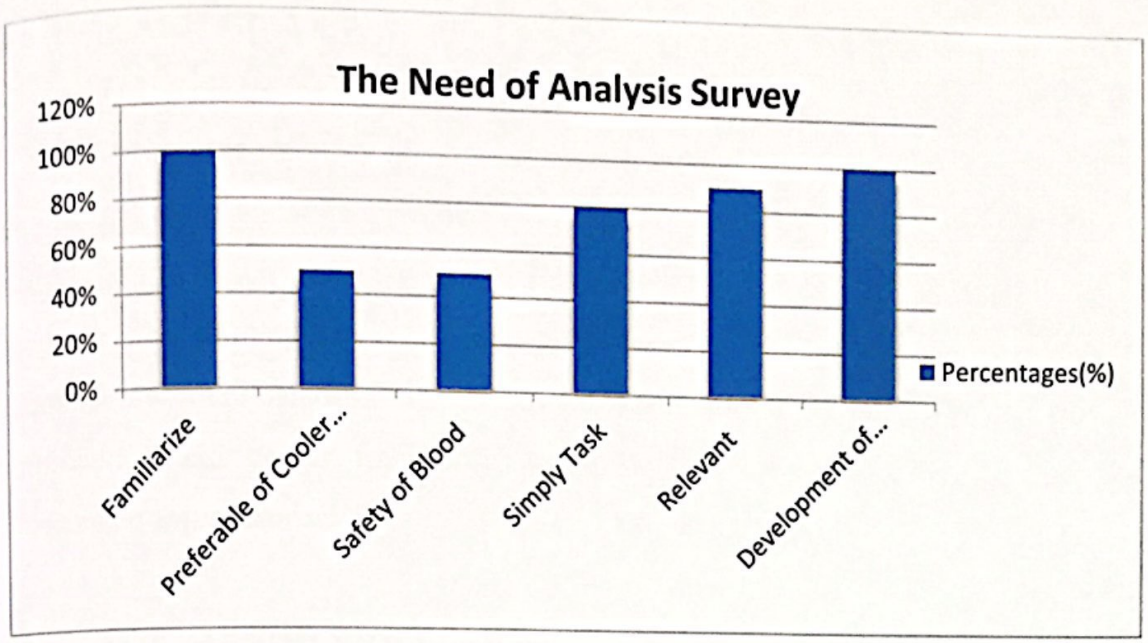


Figure 4.12: The Need of Analysis Survey

From the graph, as can see familiarize and development of product has the highest percentage with 100%, while preferable of cooler box and safety of blood has dropped to 50%.

4.3.2 Post Questionnaire

4.4 USABILITY TEST

During this usability testing, 20 respondent are tested which 10 Nurse and 10 public, and questionnaires were distributed to them. Usability testing has consisted of 4 main items which are analysis on survey question, sustainability to monitor the range or level of temperature, Reliability of device and comfortability, These are the items data was collected through the usability test, which the subject have tested the improved Blood cooler transportation box with GSM technology Device, then answered questionnaire.

4.4.1 Analysis Survey on Blood Cooler Box

This survey is done based on blood box users, from the data collection as we see that response from pathology unit staffs.

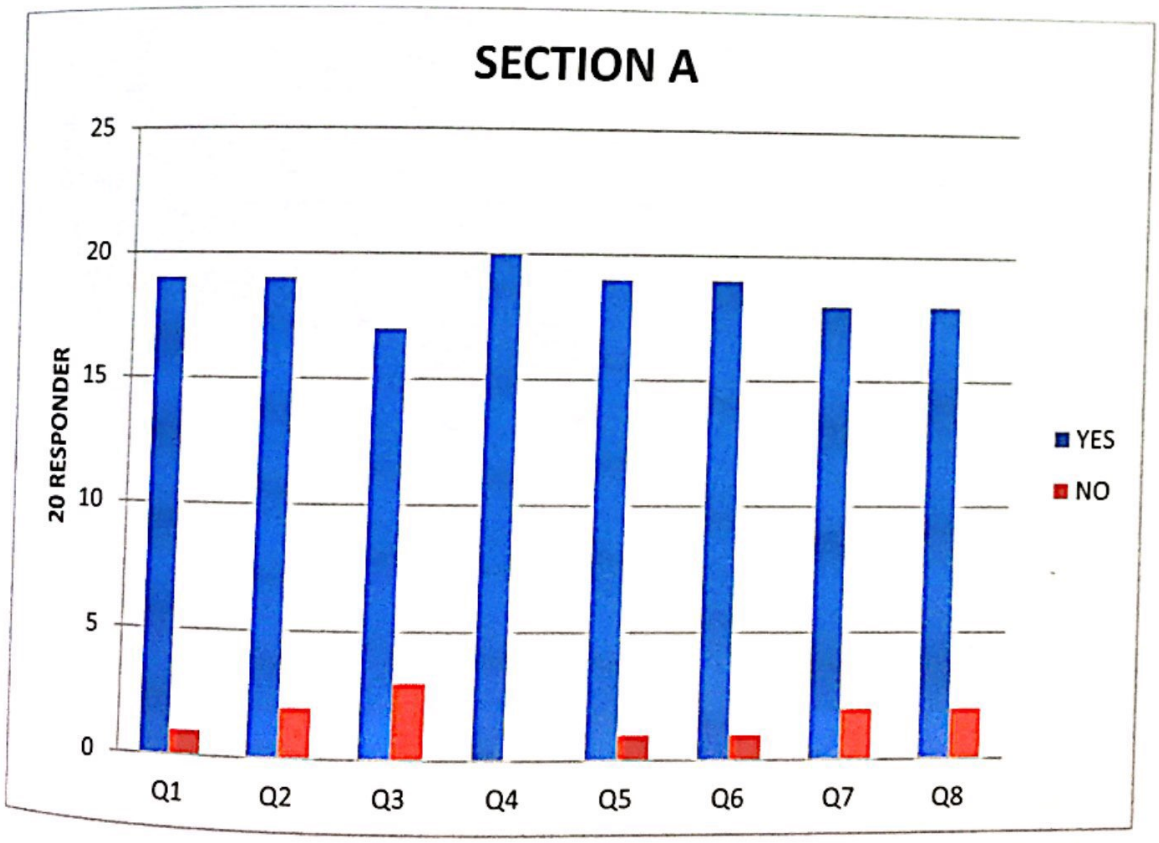


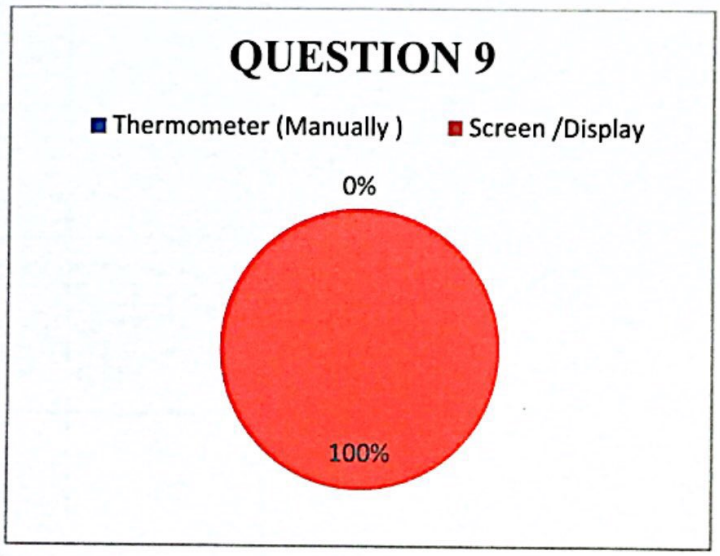
Figure 4.13: Analysis Survey

From the graph 2, through this part the questionnaire is conducted among pathology unit staff's and ordinary. A part from that, all the data in the

survey form is tabulated on bar chart. As overall, through the data collection almost the subject has showed positive feedback on development of Blood cooler box.

4.4.2 Sustainability of Blood cooler box

Throughout the sustainability survey majority of them were preferred to monitor through displayed screen and receiving alert/alarm message on mobile phone.



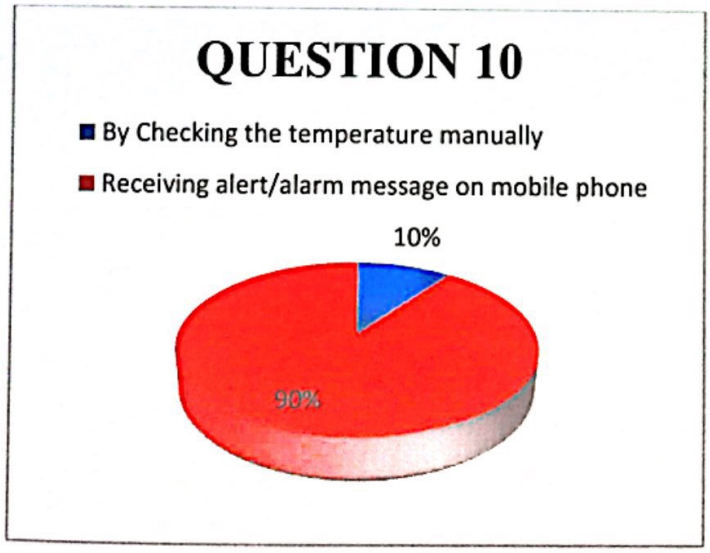


Figure 4.14: Shows the Sustainability of Device

4.5 RELIABILITY OF BLOOD COOLER BOX

Table 4.4: Data of Reliability Blood Cooler Box

STATEMENTS	Very Dissatisfied	Dissatisfied	Neutral	Satisfied	Very Satisfied
Easy/comfortable to use	0	0	0	11	9
Accuracy of temperature reading	0	0	1	14	5
Reliability during usage	0	0	0	15	5
Safety, secure and user friendly	0	0	1	7	12
Productiveness to daily routine/tasks	0	0	0	5	15

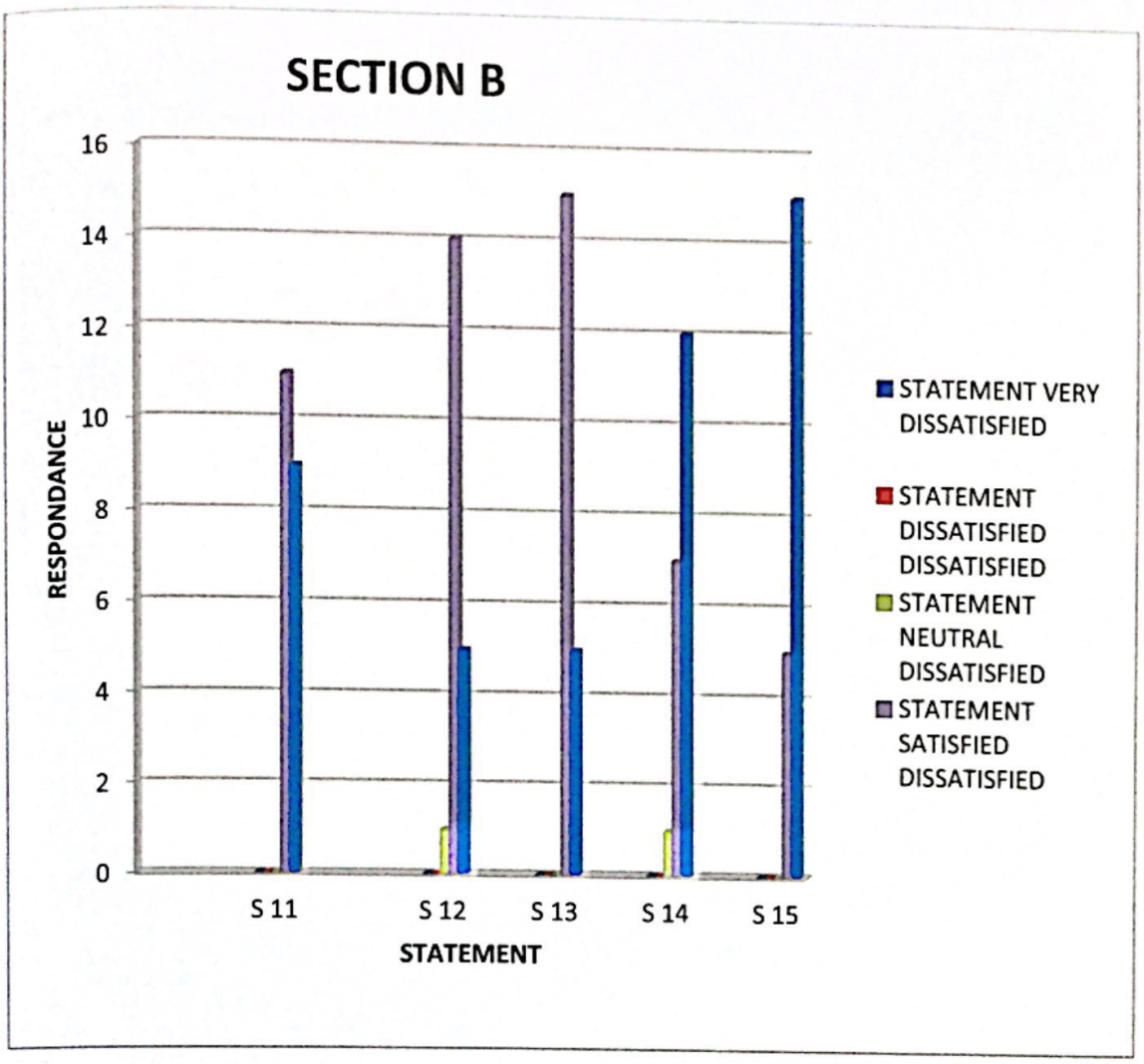


Figure 4.15: Shows Reliability of Device

4.6 COMFORTABILITY

The data of comfortability about the developed devices was takes. 5 questions are consisted in this part, below is the table of the

Table 4.5: Data of Comfortability

STATEMENTS	STRONGLY DISAGREE	DISAGREE	NEUTRAL	AGREE	STRONGLY AGREE
I enjoy using/operating this device	0	1	1	12	7

I would recommend this device to others	0	0	1	6	13
This device is eligible for transportation	0	0	2	7	11
This device should be available in the market	0	0	2	8	10
This device preferred at medical facilities	0	1	0	7	12

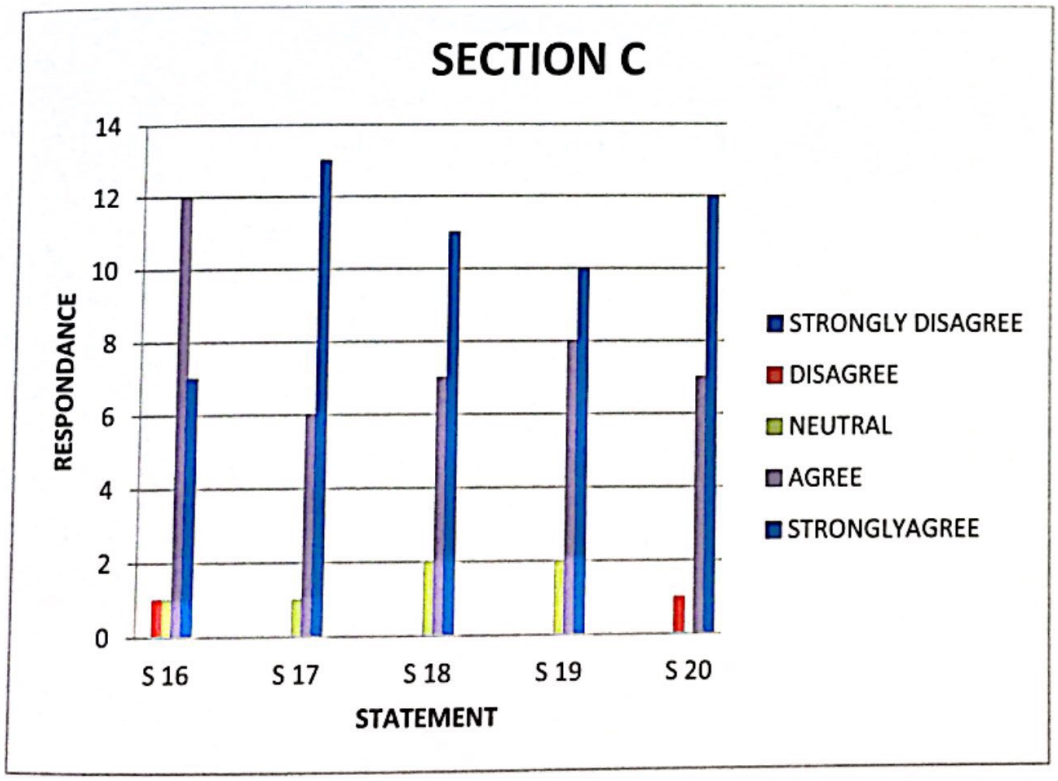


Figure 4.16: Comfortability of Device

From the graph 4, 12 subjects are agree that this device is enjoyable to be used, 7 subjects are strongly agree with that, and only 1 subject is disagree with it. After that, 6 subjects were agree recommend this device to others, 11subjects are strongly agreed with it and only 1 subject was neutral.

Based on the third question, 7 subjects were agreed eligible for transportation device,11 subjects are strongly agree with that, 2 subjects were neutral with it. Besides that, 10 subjects were strongly agreed that the device should available in market and 8 subjects were slightly agreed with the statement. 2 subjects were neither agreed nor neutral.

CHAPTER 5

CONCLUSION AND RECOMMENDATION

5.1 CONCLUSION

As a conclusion, Blood Cooler Transportation Box with Global System for Mobile Communications (GSM) technology, which is to display the internal temperature of cooler box through LCD screen. The purpose of developing this device to assist the regular monitoring of temperature and preventing it from being contaminated . Besides, staff nurse can monitor internal temperature range of blood through LCD that is fixed at outside of cooler box. In contrast, existing cooler box have to handle manually to monitor temperature. GSM technology is a modem where can slot sim as mobile phone, this will send information to user. The function of this modem is to monitor internal temperature of blood if its high it will send a message to nurse who holding the box. It will make them to be alert.

From the usability test that has done, 10 subjects of staff nurse and 10 ordinary subjects were volunteer to answer the distributed questionnaire based on effectiveness of device. Once the data is collected and it has analyzed and generated by using Microsoft Excel. From the result, the device is comfortable and safe to be used.

5.2 RECOMMENDATION

Here are the suggestions from staff nurse of Salam Hospital for Blood Cooler Transportation Box with Global System for Mobile Communications (GSM)

technology which are productive device and this device can reduce the manpower and it will be better if used rechargeable battery.

Besides, there is recommendation among the 10 subjects, this device would better if the device can be used up for 4 hours which can be useful for patients that will able to travel for long journey. This problem will be solved for the future research or study.

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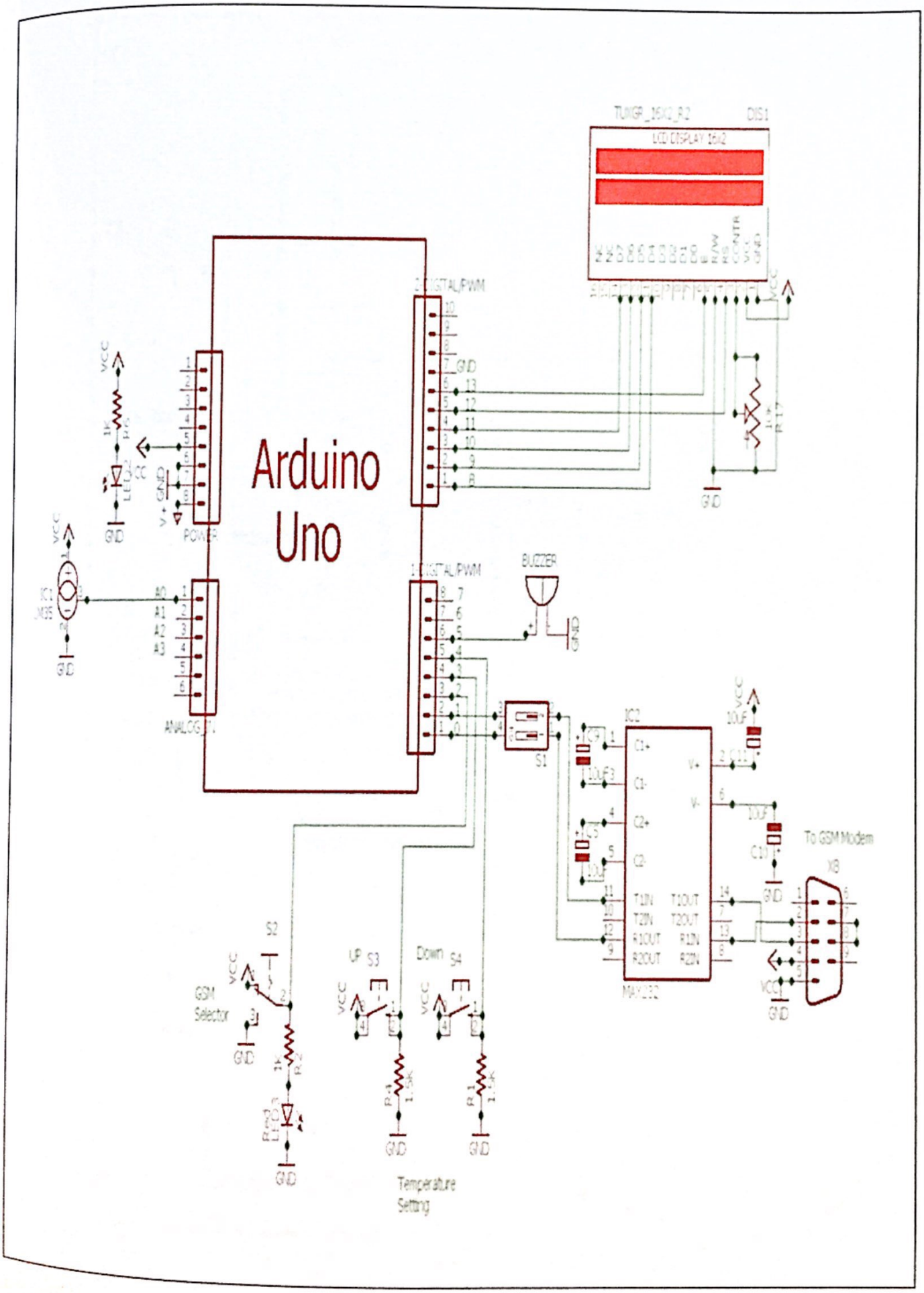
```
#include <LiquidCrystal.h>
unsigned long Timers = 0;
unsigned long TimersTens = 0;
unsigned long TimerSMS = 0;
unsigned char TempSet = 30;
int TempPin = A0;
int TempValue = 0;
int Selector = 2;
int UpButton = 3;
int DownButton = 4;
int Buzzer = 5;

String Phone = "01116540230";
LiquidCrystal lcd(12, 13, 8, 9, 10, 11);
void setup() {
 //initializing the pin states
 // initialize serial communication
 Serial.begin(115200);
 pinMode(UpButton,INPUT);
 pinMode(DownButton,INPUT);
 pinMode(Selector,INPUT);
 pinMode(Buzzer,OUTPUT);
 lcd.begin(16, 2);
 lcd.setCursor(0, 0);
 lcd.print("Cooler Box");
 lcd.setCursor(0, 1);
 lcd.print("For Blood");
 delay(2000);
 lcd.clear();
```

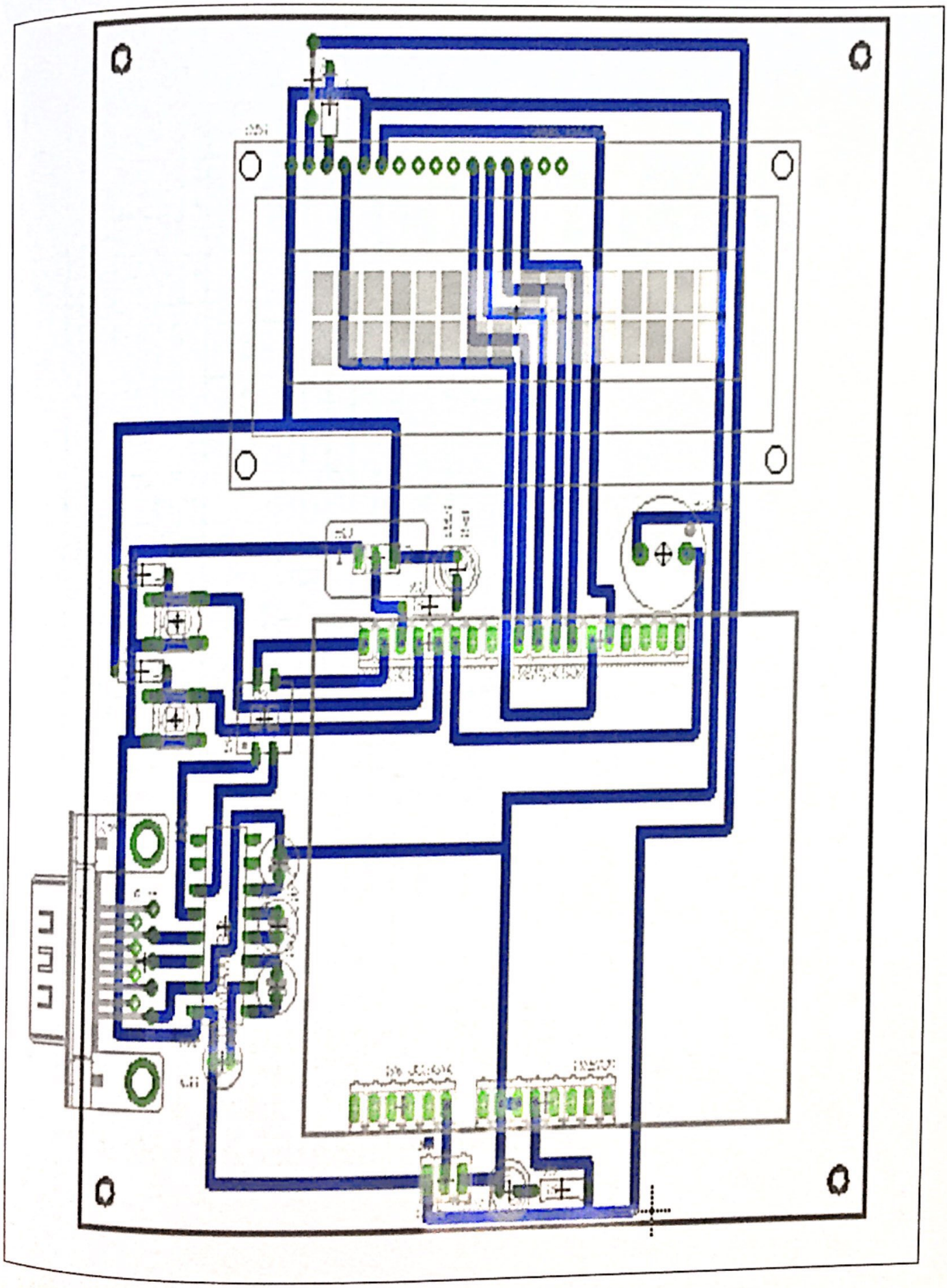
```
}
void loop()
{
 if(millis() - TimerSMS >= 500)
 {
  TimerSMS = millis();
  lcd.setCursor(0, 1);
  lcd.print("Set:");
  if (digitalRead(UpButton))
  {
   TempSet++;;
  }
  else if(digitalRead(DownButton))
  {
   TempSet--;
  }
  lcd.setCursor(5, 1);
  lcd.print(TempSet);
  if ((TempValue > TempSet) && digitalRead(Selector))
  {
   lcd.setCursor(12, 0);
   lcd.print("Send:");
   lcd.setCursor(12, 1);
   lcd.print("SMS:");
   digitalWrite(Buzzer,HIGH);
   SendSMS();
   lcd.clear();
   digitalWrite(Buzzer,LOW);
  }
 }
if(millis() - TimersTens >= 100)
```

```
 {
  TimersTens = millis();
  TempValue = analogRead(TempPin)/2 - 2;
  lcd.setCursor(0, 0);
  lcd.print("Temp:");
  lcd.print(TempValue);
 }
}
void SendSMS(void)
{
 Serial.println("AT+CPOWD=1");      //
 Serial.write(0x0D);
 delay(1000);
 Serial.println("AT+CMGF=1");      //
 Serial.write(0x0D);
 delay(1000);
 Serial.print("AT+CMGS=");
 Serial.write(0x22);
 Serial.print(Phone);
 Serial.write(0x22);
 Serial.write(0x0D);
 delay(1000);
 Serial.print("Over Temperature");
 Serial.print(" ");
 Serial.print(TempValue);
 Serial.print("'C");
 Serial.write(0x1A);
 delay(5000);
}
```

APPENDIX B: SCHEMATIC DIAGRAM



APPENDIX C: PCB BOARD



APPENDIX D: GANTT CHART

YEAR	SESI 1 2016/2017														SEM 2 2016/2017													
MONTH	SEPT				OCT				NOV				DEC		FEB	MARCH					APRIL				MAY			
WEEK	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
RESEARCH PROPOSAL	X	X	X	X	X	X	X	X	X	X	X	X	X	X														
• Title declaration	X	X	X	X	X	X																						
• Finalize research proposal					X	X	X	X	X	X																		
LITERATURE REVIEW																												
• Blood warmer	X	X	X	X	X	X	X	X	X	X	X	X	X	X														
• Gsm technology	X	X	X	X	X	X	X	X	X	X	X	X	X	X														
• Fabricate cooler box	X	X	X	X	X	X	X	X	X	X	X	X	X	X														
• Blood Temperature	X	X	X	X	X	X	X	X	X	X	X	X	X	X														
DATA COLLECTION / DESIGN PHASE																												
• Distributing questionnaire	X	X	X	X	X	X																						
• Interview (Nurse)	X	X	X	X	X	X																						
ANALYSIS /TESTING SIMULATION																												
• Product testing generally															X	X	X	X	X	X	X							
• Product testing on patient															X	X	X	X	X	X	X							
• Interpret data																					X	X	X	X	X			
PUBLICATION																												
• Journal /Conference Proceeding																								X				
• Review Paper											X																	
THESIS WRITING																												
• CHAPTER 1 – Introduction	X	X	X	X																								
• CHAPTER 2 – Literature Review					X	X	X	X																				
• CHAPTER 3 – Methodology									X	X	X	X	X	X	X	X	X	X	X	X	X	X						
• CHAPTER 4 – Data analysis / finding															X	X	X	X	X	X	X	X	X	X				
• CHAPTER 5 – Conclusion																								X	X	X		
• Submit final draft																							X					
• Submit thesis																										X		
ASSESSMENT																												
• VIVA																											X	
• Thesis (Chapter 1 – 5)																												

APPENDIX E: COST ESTIMATION

ITEMS	PRICE	UNIT	TOTAL
Temperature sensor	RM 70.00	1	RM 70.00
GSM Module	RM 350.00	1	RM 350.00
Arduino Uno	RM 80.00	1	RM 80.00
Circuitboard and component	RM 200.00	-	RM 200.00
LCD	RM150.00	1	RM 150.00
Peltier cooler	RM150.00	1	RM150.00
Heat sink	RM 100.00	1	RM 100.00
Cooler box	RM150.00	1	RM150.00
Thesis	RM80.00	-	RM80.00
Present Paper	RM1500.00	-	RM1500.00
TOTAL			RM 2830.00

KEMENTERIAN PENDIDIKAN TINGGI

POLITEKNIK MALAYSIA
SULTAN SALAHUDDIN ABDUL AZIZ SHAH

POLITEKNIK SULTAN SALAHUDDIN ABDUL AZIZ SHAH

SURVEY QUESTIONNAIRE

BLOOD COOLER TRANSPORTATION BOX WITH GSM TECHNOLOGY

DISCLAIMER:

The survey is based on a final year Bachelor of Engineering Technology (Medical Electronic) project device, the Blood Cooler Transportation Box with GSM Technology. The aim of this survey is to understand and evaluate the application of the device. This will be helpful in order to improve and to enhance the device in the future. Participation of this survey is completely voluntary and anonymous. You may choose to discontinue with this survey at any time. No harm will fall to any participants. All the data collected will be recorded and analysed.

CONSENT:

I have read and understood all the information mentioned above. My participation in this survey is voluntary and I am willing to share necessary information needed for this survey.

This survey is divided into three sections. Section A, B and C.

SECTION A

**Please read and answer (√) these questions below*

1. Have you heard about this device before?

   ☐ Yes
   ☐ No

2. Are you familiar with this device?

   ☐ Yes
   ☐ No

3. Do you understand the function/operation of this device?

- [ ] Yes
- [ ] No

4. Is it easy to use/operate this device?

- [ ] Yes
- [ ] No

5. Is this device user-friendly?

- [ ] Yes
- [ ] No

6. Is this device safe to be used?

- [ ] Yes
- [ ] No

7. Do you prefer to use this device at your workplace?

- [ ] Yes
- [ ] No

8. Does this innovation help in monitoring the internal temperature of the box?

- [ ] Yes
- [ ] No

9. How do you prefer to check the internal temperature of the box?

- [ ] Thermometer (Manually)
- [ ] Screen/Display

10. How do you prefer to stay alert on the internal temperature changes inside the box?

- [ ] By checking the temperature manually
- [ ] Receiving alert/alarm message on mobile phone

SECTION B

**Please rate (√) on how much you satisfied or dissatisfied with each of these statements below*

NO.	STATEMENTS	VERY DISSATISFIED	DISSATISFIED	NEUTRAL	SATISFIED	VERY SATISFIED
11.	Easy/comfortable to use					
12.	Accuracy of temperature reading					
13.	Reliability during usage					
14.	Safety, secure and user friendly					
15.	Productiveness to daily routine/tasks					

SECTION C

**Please rate (√) on how strongly you agree or disagree with each of these statements below*

NO.	STATEMENTS	STRONGLY DISAGREE	DISAGREE	NEUTRAL	AGREE	STRONGLY AGREE
16.	I enjoy using/operating this device					
17.	This device preferred at medical facilities					
18.	This device is eligible for transportation					
19.	This device should be available in the market					
20.	I would recommend this device to others					

Signature,

_____

(Doctor /Nurse/User)

RECOMMENDATION/SUGGESTION/COMMENT

_____

_____

THANK YOU

APPENDIX G: CERTIFICATION OF SAFETY TEST

Biomedical Calibration Laboratory
Centre for Medical Electronic Technology
Politeknik Sultan Salahuddin Abdul Aziz Shah,
Persiaran Usahawan, Seksyen U1, 40150 Shah Alam, Selangor, Malaysia
Tel : +603-5163 4000
Fax : +603-5569 1903   Email : cmetcalab@psa.edu.my

PAGE 1 OF 1 PAGES

VERIFICATION CERTIFICATE

Issued Date : 11 May 2017

Verification Date : 9 May 2017

Issued To : **Jothi A/P Balakirushnan**
Bachelor of Electronic Engineering (Medical Electronic),
Department of Electrical Engineering
Politeknik Sultan Salahuddin Abdul Aziz Shah

Requested Verification Due Date : N/A

Instrument : Blood Cooler Transportation Box with GSM Technology

Model No. : N/A

Manufacturer : N/A

Serial No. : N/A

Condition Received : Good physical condition

Condition Returned : Planned Preventive Maintenance (PPM) has been performed in accordance to the checklist and the equipment is functioning to the intended purpose

Reference (s) : IEC 61010 standard requirements.

Result (s) : As per attachment -
i) Planned Preventive Maintenance Checklist (BMCL PPM CHECKLIST 30)

Verified by

Kamil Bin Jinan
Technical Head

CMET

Scanned with CamScanner

BLOOD COOLER TRANSPORTATION BOX WITH GSM TECHNOLOGY

(Estimated Time: 60 minutes)

EQUIPMENT INFORMATION

Job No:	N/A		
Manufacturer:	N/A	Customer:	Johti A/P Balakirushnan
Serial No:	N/A	Model:	N/A
Frequency:	6 monthly ☐ 12 monthly ☐	Location:	N/A

TEST INFORMATION

Test equipment needed: **Electrical Safety Analyzer**

		TEST RESULT			
		Measured Value	Pass	Fail	Not Applicable
PHYSICAL CONDITION					
Device is clean and decontaminated			√		
No physical damage to case, display, mounts, cart or components			√		
Switches and controls operable and correctly aligned			√		
Display intensity adequate for daytime use			√		
Control numbers, labelling and warnings present and legible			√		
Inlets and hoses			√		
Power cord, accesory cables, charger					√
Filters and vents clean			√		
ELECTRICAL SAFETY					√
Ground wire resistance	< 0.3 Ω				√
Mains Voltage					
	Live to Neutral	234.3 VAC	√		
	Neutral to Earth	0.4 VAC	√		
	Live to Earth	234.3 VAC	√		
Accessible Voltage (Normal Condition)		0.1 VAC	√		
Accessible Voltage (Reverse Condition)		0.1 VAC	√		
Accessible Voltage (OFF Condition)		0.0 VAC	√		
Accessible Leakage (AC + DC)	< 500 µA NC	0.2 µA	√		
Equipment Current		0.3 AAC	√		
PREVENTIVE MAINTENANCE					
Complete model-specific preventive maintenance					√
PERFORMANCE TESTING					
LCD display function			√		
GSM with ARDUINO UNO board function			√		
Temperature Sensor function			√		
Complete model-specific performance testing					√

REMARK

1. *Electrical Safety test passed according to the safety Standard for Measurement, Control and Laboratory Equipment (IEC61010-1).*
2. *PPM has been performed in accordance to the checklist and the equipment is functioning to the intended purpose.*

COMPLETED BY: _____ DATE: _____