SURVEILLANCE OF THE HEART RATE AND BODY TEMPERATURE USING WIRELESS TECHNOLOGY FOR REMOTE DOCTOR

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2017

DECLARATION

I hereby declare that the work in this thesis is my own except for quotations and summaries which have been duly acknowledged.

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Date : 26 MAY 2017

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ABSTRACT

The development of Surveillance of the Heart Rate and Body Temperature using Wireless Technology for Remote Doctor is a solution for non-facing interactions between personnel healthcare provider and patients. This device is upgrade from the existing system by implementing wireless technology for friendly monitoring. The project is specially designed to the patient who live in rural area or in heavily congested metropolitan city which facing a huge challenged to come to the hospital due to the insufficient of time. The developed project consists of two parts which are hardware and software. The hardware involved are heart rate sensor, body temperature sensor, LCD display, microcontroller (Arduino) and GSM module. Heart rate sensor is used to measure the heart rate in beat per minute (BPM). Temperature sensor is used to detect the body temperature of the patient. All the results will be displayed on LCD of the device and can be seeing on doctor and guardian smart phone. Global System for Mobile (GSM) is preferred choice for data transmission due to the established coverages, performances, and durability's. Easy to use make this device comfortable for self-measurement at home and the results goes to the doctor mobile phone instantly. An innovative and effective monitoring of heart rate and body temperature with wireless technology can be a great help for the people who are unluckily to have a consistent medical check-up. This device assists on improving and saving countless lives all around the world.

ABSTRAK

Pembangunan Alat Pemantauan kadar jantung dan suhu badan dengan menggunakan teknologi tanpa wayar untuk pengawasan doctor adalah penyelesaian untuk interaksi tidak bertemu antara pembekal kakitangan penjagaan kesihatan dan pesakit. Alat ini menaik taraf sistem yang sedia ada dengan melaksanakan teknologi tanpa wayar untuk pemantauan yang mesra pengguna.Projek ini direka khas untuk pesakit yang tinggal di kawasan luar bandar atau di bandar metropolitan sesak yang menghadapi banyak cabaran untuk datang ke hospital disebabkan kekangan masa. Projek yang dibangunkan terdiri daripada dua bahagian iaitu perkakasan dan perisian. Perkakasan yang terlibat adalah sensor kadar jantung, sensor suhu badan, paparan LCD, pengawal mikro (Arduino) dan modul GSM. Sensor kadar jantung digunakan untuk mengukur kadar jantung dalam denyutan seminit (BPM). Suhu sensor pula digunakan untuk mengesan suhu badan pesakit. Semua keputusan akan dipaparkan pada LCD peranti dan boleh dilihat oleh doktor dan penjaga pesakit melalui telefon pintar. Sistem Global Mudah Alih (GSM) dipilih sebagai penghantaran data kerana mempunyai ketahanan dan liutan yang meluas. Mudah untuk digunakan membuat alat ini selesa untuk dijadikan alat pengukuran kesihatan diri di rumah dan keputusan kesihatan akan dihantar ke telefon bimbit doktor dengan segera . Pemantauan yang inovatif dan berkesan bagi kadar jantung dan suhu badan dengan teknologi tanpa wayar boleh menjadi bantuan yang besar khasnya orang-orang yang kurang bernasib baik untuk mempunyai pemeriksaan kesihatan yang konsisten.Alat ini membantu untuk meningkatkan dan menyelamatkan nyawa yang tidak terkira banyaknya di seluruh dunia.

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LIST OF ABBREVIATIONS

SHRBT	Surveillance of the Heart Rate and Body Temperature Using Wireless Technology for Remote Doctor
LED	Light Emitting Diode
GND	Ground
BPM	Beats per minute
GSM	Global system module
SMS	Short massage service
ECG	Electrocardiogram
˚C	Celsius
%	Percentages
K	kilo

CHAPTER 1

INTRODUCTION

1.1 Background of study

Heart rate is the number of heartbeats per unit of time .which usually expressed as beats per minute (BPM). Heart rate can change as the body needs to retain oxygen and discharge carbon dioxide. The reading of heart rate will be different between people do exercise or at rest. The estimation of heart rate is generally utilized by medicinal experts as an essential test to help in the determination and following of the health conditions [1]. Human body temperature is a measurement of average body heat where comparison and reaction is made between the inner body part of the body and surrounding areas. The temperature differs depending on one's daily routines and activities. Heart rate and body temperatures are the most important parameters to maintain a vital life. These parameters can give some important indicator of the body health condition.

Surveillance of the heart rate and body temperature is a new device with advanced technology which calculates a sample of the heart rate signal and measures the beats per minute that allows utilization of the information for monitoring of heart condition became more easier. The devices employ electrical and optical methods as

means for detecting and achieving the heart signals. So, the wireless technology is utilized in order to meet the requirement of remote control and patient monitoring. The remote patient monitoring is a technology which provides us with the opportunity to monitor the patient outside the hospitals by reducing the need of visiting the patient. With the new advanced technology,it can saves the time and money of patient and doctor while increasing the efficiency along with the reliability of health services [2].

As an information, to ensure patients are in good stable condition is one of a difficult and crucial task. Monitoring of patient constantly is difficult because doctors are unable to monitor particular patient for total working hours. In a hospital either the nurse or the doctor has to move physically from one person to another for health check-up of patients, due to which it is not possible to monitor their conditions continuously [3]. The surveillance of the heart rate and body temperature using wireless technology by remote is a sophiscated device or development technology tools for monitoring the heart rate and body temperature of the patient. It monitors the heart rate and body temperature of a patient simultaneously and if the patients heartbeat rate or body temperature is abnormal, the system will send the massage to doctor or patient's family members for quickly examine or diagnose the patient's condition and take early precaution to save the patient's life [4].

With the existing of the new monitoring device, doctor still can monitor the heart rate and body temperature of the patient even they are not in the hospital. Monitoring of the patient data is important to save patient life and decrease the number of death. The remote heart rate and temperature monitoring system gives information of heart rate and body temperature simultaneously and sends results to the mobile phone when abnormal reading occur. From the mobile phone anyone can monitor the health status of the patient. Thus in this system development, the condition of the body can be monitored from remote places. This system development is equipped with several sensors such as heart rate and body temperature sensor which can measure several parameters. Arduino Uno are embedded at central and remote respectively to control the system [5]. The parameters of temperature sensor and heart rate are displayed on the LCD displays which are act as an output. The GSM-based technology is used to transmit and received data wirelessly among central and remote, so that the patients can be monitored continually from their home by doctors.

1.2 Problem Statement

For this time being, in a hospital doctor still use the manual operation to monitor the heart rate and body temperature of a patient. Doctor need to visit the patient at admitted ward for accessing their health condition [6]. Beside, patients also have to come to the hospital regularly to know their condition of health. With the implementation of the wireless technology, it contributes for continuous monitoring of the patient data at anywhere and anytime depends on to the doctor or nurses. The problems can be solve by using wireless system technology to ensure the patients can be monitor continuously by doctors and physician even though the patients stay at home [7]. So, it will be easier for patient especially for those who are in critical condition such as paralysed person and person who are suffering from critical disease.

1.3 Objective

The main purpose of our system is that the doctor can monitor the patient from remote area. Our device can also be used at home and help the doctors and to keep track the condition of heart rate and body temperature of their loved ones in the case of an abnormality in the health condition.

This project aims the specific goal to achieve several objectives:

I. To design and fabricate surveillance device for heart rate and body temperature for a remote doctor
II. To use appropriate sensor to measure the body temperature and heart rate of the patient
III. To display the measurement patient through LCD and send sms to mobile phone when abnormal reading occur.

1.4 Scope of project

The specific target for this project are suggest for elderly and disable person who are not be able to go to the hospital of such as paralysed patient and old folks. It also can be used as home monitoring device for patient at home. Hence, the development of this new system for heart rate and body temperature remote monitoring using wireless technology are built for the person who are not be able or

had a problem to go to the hospital for regularly medical check-up. The testing of this project have been run to 30 people from Bandar Tun Razak. The range age of the people is around 55 to 70 years old. Those respondents have been take their reading of heart rate and body temperature by using the actual device SHRBT device. It will test the accuracy between both device due to patient condition.

1.5 Significant of Project

This project is design to facilitate the work of doctor and physician in monitoring patient health condition. The system allowed person at home can highly monitor by doctor either they in normal condition or abnormal. Consequently, doctor and physician can take action as soon as possible if in emergency cases occur. Besides, can be used for home monitoring as private healthcare device [8]. With this development of device, it can reduce crowded patient in clinics or hospitals.

CHAPTER 2

LITERATURE REVIEW

2.0 Introduction

The idea of this project come from the problems that faced by the doctor which is to monitor the patient properly from far distance . This chapter also explains about the theory and basic concepts of electronic components that have been used in the project such as Arduino Uno board, GSM module sim 900, heart rate sensor,temperature sensor (LM 35), Arduino IDE software. All the related research papers and journals will be discussed in this chapter. Next, this chapter elaborates the recent research on the technology and emphasizes the use of GSM in various applications. Explanation will be focused on the related field of health care monitoring and wireless technology. Research and findings have been conducted in order to design and develop Surveillance of the heart rate and body temperature by using wireless technology that will suit the aims and objective in this project.

2.1 History of Patients Monitoring Devices

In medicine, monitoring is the observation of a disease, condition or one or several medical parameters over time. It can be performed by continuously measuring certain parameters by using a medical monitor (for example, by continuously measuring vital signs by a bedside monitor), and/or by repeatedly performing medical tests.

The invention of a patients monitoring system has been very important even to the fitness industry and as well as an aid to living a healthy lifestyle. Today, many treadmills and elliptical machines often have these monitors built in them to check the rate of the heartbeat at any given time. These monitoring devices are also very important to cyclists and athletes because it prevent them from over training or under training. The very first monitoring device with heartbeat rate (without a body temperature detector) was invented in 1975 by writer, lecturer and inventor Gregory Lekhtman. Lekhtman continues to design fitness electronic devices for his international award winning company, Biosig Instruments Incoporated. He has also collaborated with fitness equipment manufacturers such as Sony, Polar and Nordic Track. By 1977, improvements were made on the original heart rate monitor, and the Polar Electro Company produced the first wireless heart rate monitor. It was specifically used in training the Finnish National Cross Country Ski team. By the late 1970's and early 1980's, heart rate monitors were available in stores abroad for consumers. The current patient monitor of heart rate was shown in Figure 2.1.

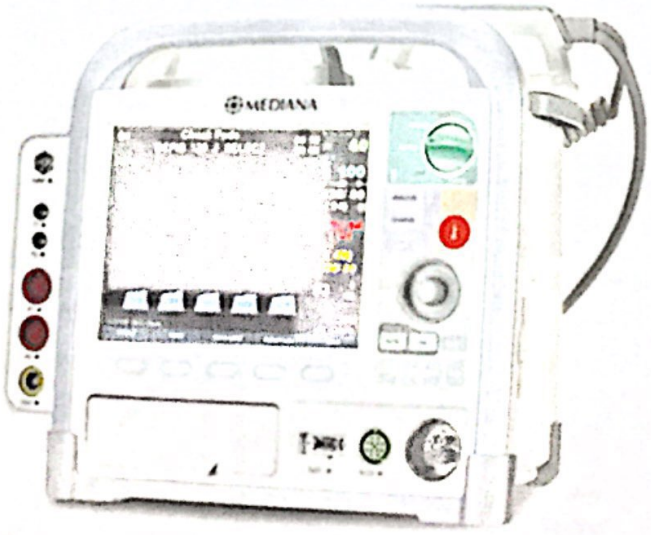


Figure 2.1 : Patient monitor for heart rate measurement

2.2 Research Conducted Related to the Patient Monitoring Devices

Current patient monitoring device is expanding by leaps and bounds in the last couple of decades for their considerable aim towards wireless and e-health monitoring systems providing remote monitoring of patients. But the tools used to deal with health conditions are tedious to maintain and limited to specific number of parameters. The systems being complex and laborious to operate also raise the cost of health care services and hospital expenses which is not affordable to economically challenged community.

Arun et al. introduced a remote patient monitor by using Bluetooth and enabled mobile of the doctor [9]. Every patient is will attach with a temperature sensor and parameters that are measured are interface with the system at the patient as shown in Figure 2.2. The patient system is connected with server and doctor mobile via Bluetooth. The server stores the central database of all the patients. If the status is normal, the parameter is transmitted to the server and entered in the database. Then, if the status is abnormal, the parameter is immediately intimated to the doctor end the data stored in the database of the server. The weaknesses of this project are the Bluetooth has a short-range communications where the range is limited and has high current consumption compared to GSM.

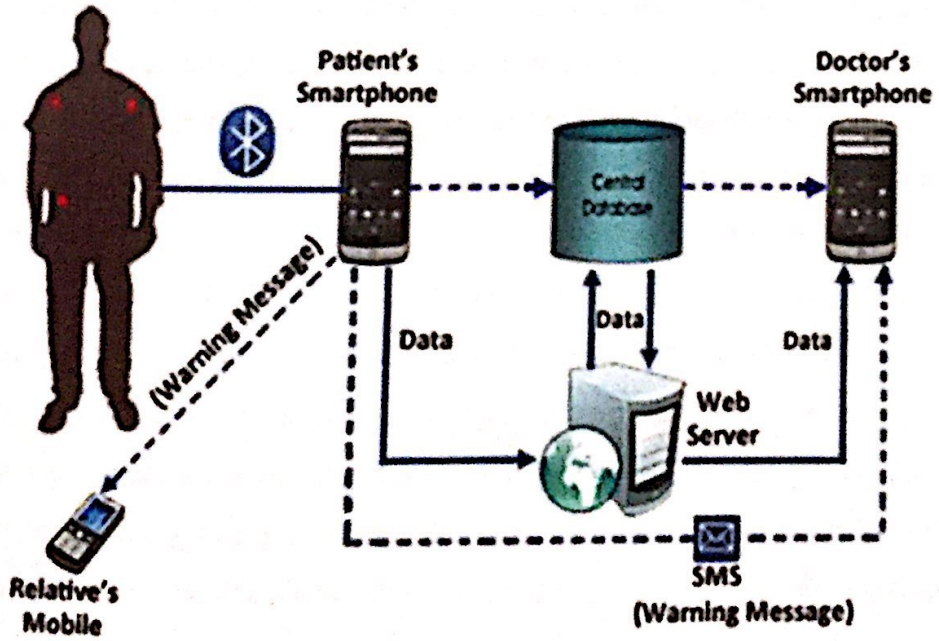


Figure 2.2 : The system process using bluetooth

Wan seri bahiyah [10] does a project where he uses Zigbee, Arduino Uno, and ECG circuit and temperature sensor. Lab View is use to process the signals. The problem is that this does not cover a wide are as compared to GSM. The flow of remote patient monitoring using bluetooth is shown in Figure 2.3.

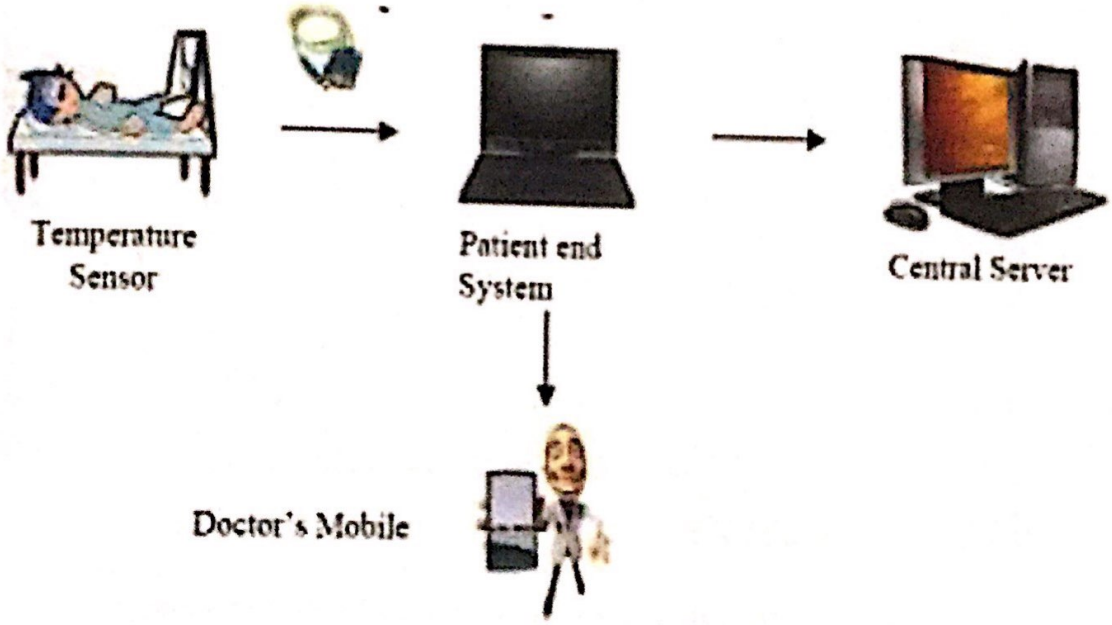


Figure 2.3 : The remote patient monitoring using bluetooth

Jacob et al [11], introduced the "Remote Patient Monitoring System. It provides the image based system which acquires the ECG signal via digital camera. This information is performed on the tool like MATLAB and data sending through the internet network and stored in database. Then the original image is then availed to the doctor via Android mobiles. The patient ECG waveform can view from doctors phone as shown in Figure 2.4. The purpose of this system is the vital sings and parameters from the ICU monitoring system and makes this data to be available to the doctor who may not be in the hospital and in the country. In case of any abnormality, the doctor will alert by sending a notification from C2DM server to his mobile. The drawback of this paper is that, due to the slow internet connection the data will not be send to the doctor which is located remotely. The image is captured through the camera, which must be HD which cost a lot.

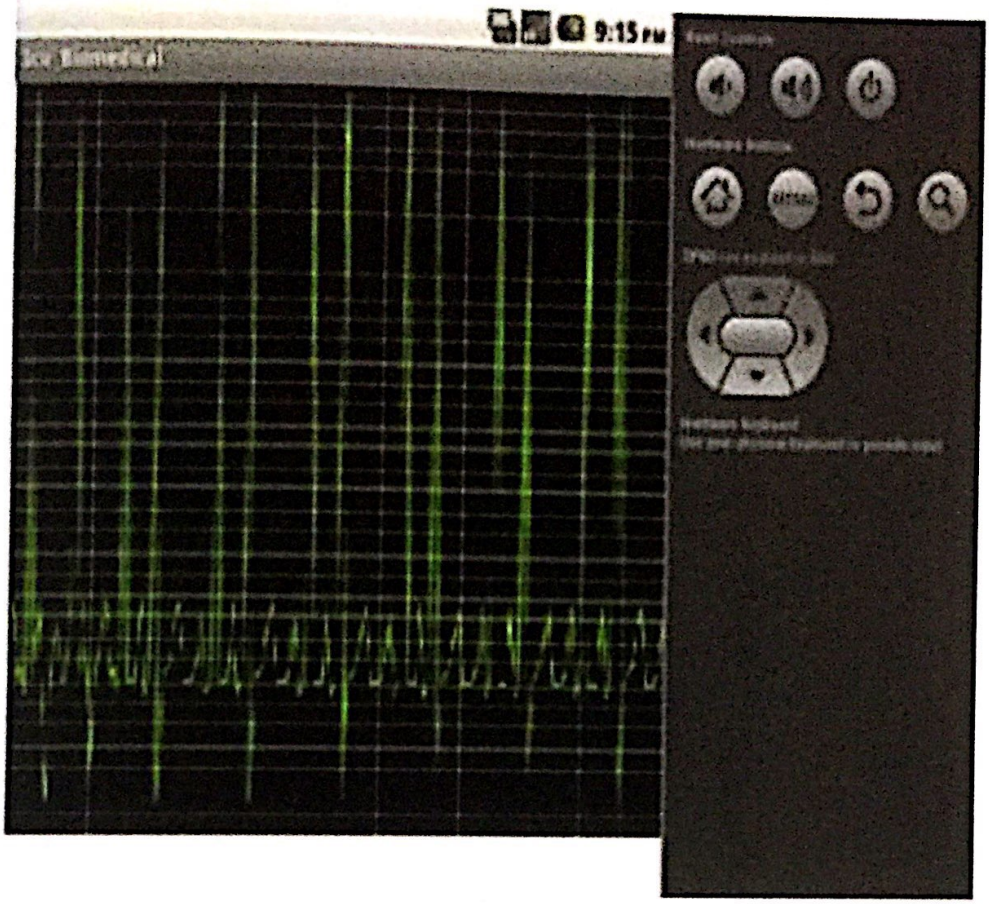


Figure 2.4 : Patient ECG waveform viewed in the doctor's phone

"Smart Elderly Home Monitoring System with an Android Phone" by Chuah Yea-Dat et al [12] said the project is considers or takes into account certain facts, which are heart attack and stroke as they are the major cause of hospitalization of the elder people. There is more chances of survival if the older people gets the treatment within an hour. SHEMS had also been developed. An android smart phone with accelerometer is used to detect a fall of the carrier, and this android device is known as healthcare device. The android phone is then connected to the monitoring system by using the TCP or IP protocol through WiFi. Due of this system, elderly and chronically ill patients can stay independently in their own home and secure in the knowledge that they are being monitored. The drawback of this system is that it only considers elder people as there is more chances of sudden (emergency situation) outbreak in them like heart attack and stroke. The block diagram of SEHMS is shown at Figure 2.5 below.

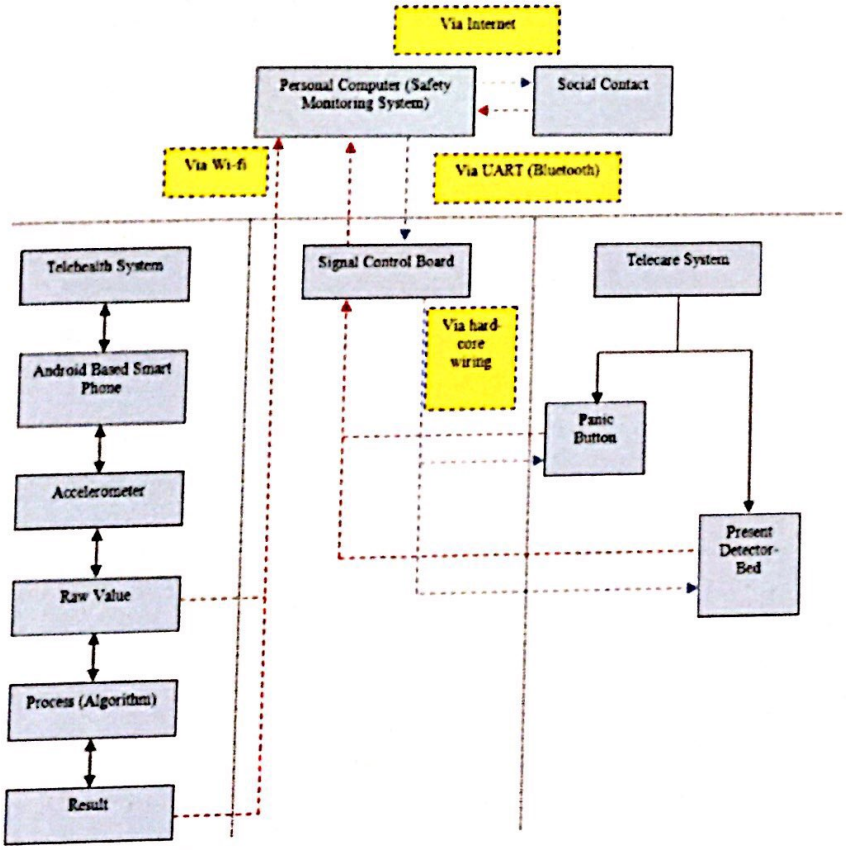


Figure 2.5 : Overall architecture block diagram of SEHMS

Shrenik Suresh Sarade et. al [13] proposed a project having a simple, microcontroller based heart beat rate & body temperature measuring device with display the information on LCD display. Heart rate of the body is measured from the index finger using IRD (Infra-Red Device) sensors. Also Saline Level is measured continuously for different levels. The device alarms when the heart beat & the body temperature exceed the provided threshold value. This threshold value is defined by the programmer at the time of programming of microcontroller. The threshold value is as 20 to 120 pulses per minute for heart beat indication & 18°C to 38°C for temperature. This information transmitted wirelessly to the doctor which is not in the vicinity of the patient through GSM technique. The problem with the use of infrared device is that the LED light must be very bright or it will not be sensed by the photodiode.

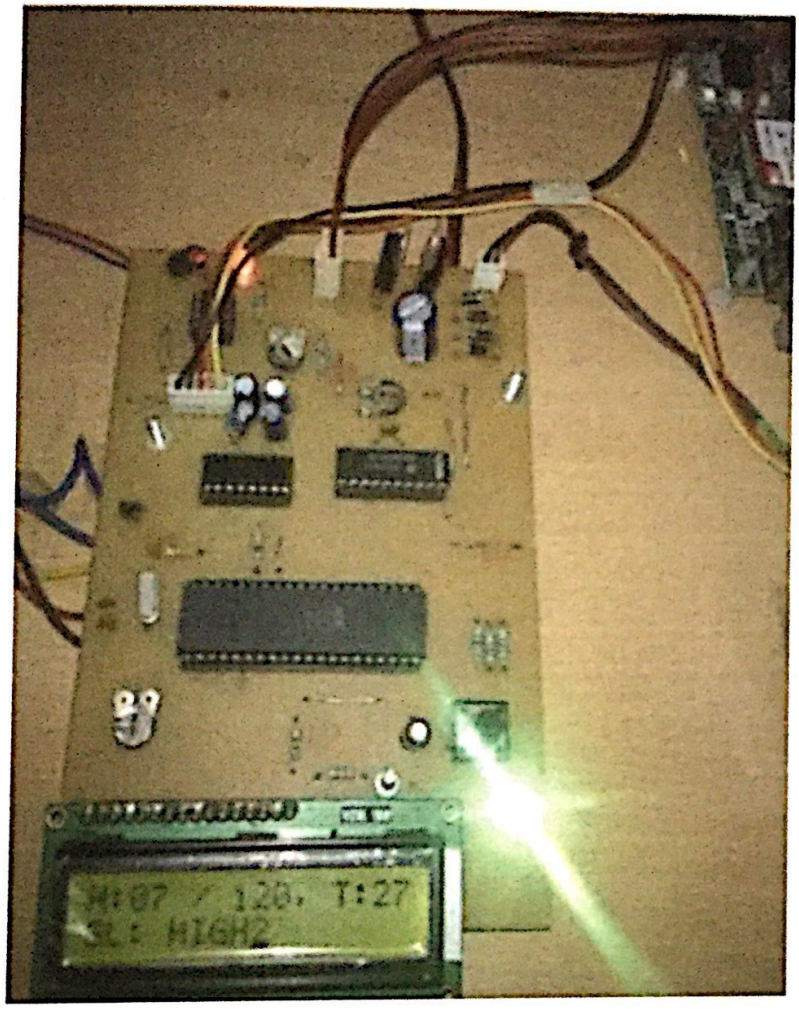


Figure 2.6 : Patient monitoring and alerting system by using GSM

Spanias et al, [14] proposed "Health Monitoring Laboratories by Interfacing Physiological Sensors to Mobile Android Devices". This paper describes, Android Java-DSP (AJDSP) as a mobile application that interfaces with sensors and enables simulation. This also helped in visualization of signal processing. In this system firstly there is creation of interface between both external sensors and on-board device sensors for monitoring the physiological parameter of human being. This paper also explored the trend of mobile sensing and adapted it towards improving digital signal processing (DSP), by building interfaces to medical sensor and external sensors. In this paper there is use of SHIMMER. It is a small wireless low-power sensor platform that can record and transmit physiological (Health related like ECG) and kinematic data in realtime. The drawback of this system is that it only monitors the patient which is admitted in the hospital. In this low power sensor are used.

Jaehong Choi et al proposed "Design and Implementation of Wearable ECG System. This project discuss and describes the design and implementation part of wearable ECG with the smart phone for the real time monitoring of health [15]. In this system smart shirt are developed with ECG sensors and can be worn by any type of patient for monitoring his or her health in real time and get required treatment or prescription. These systems are mainly developed considering elder people in mind as they live alone in their homes. Therefore this system basically monitors the elderly people for self-diagnosis purpose. The result of this system was the system could monitor and diagnose patients' heart conditions in real time, when they wear a sports-shirt with a ECG sensor in it. In addition to this, the system also provides graphical information with history management tools and an automatic emergency call system to the patient to get the required treatment in time. The drawback of the system is that it only concentrates on elder people and it includes shirt (ECG sensor) for wearing which cost a lot.

The paper describes the design and implementation part of wearable ECG with the smart phone for the real time monitoring of health. In this system smart shirt are developed with ECG sensors and can be worn by any type of patient for monitoring his or her health in real time and get required treatment or prescription. These systems are mainly developed considering elder people in mind as they live alone in their homes. Therefore this system basically monitors the elderly people for self-diagnosis purpose. The result of this system was the system could monitor and diagnose patients' heart conditions in real time, when they wear a sports-shirt with a ECG sensor in it. In addition to this, the system also provides graphical information with history management tools and an automatic emergency call system to the patient to get the required treatment in time. The drawback of the system is that it only concentrates on elder people and it includes shirt (ECG sensor) for wearing which cost a lot.

2.3 Monitoring and Function of Health Parameter

Monitor of health parameter devices are of integrated technology and are found in the area of medical electronics. It plays an important role in the medical or patient simulation system. With the help of the medical monitoring systems, a doctor can get an up to date information of a patient. In any modern society, the physical

condition and safety of patients has attracted more and more attention. Patients, who are merely over conscious of their health are easily susceptible to the unexpected situations, such as contraction of diseases or infections as well as some kind of sickness because they take their health issues for granted [14]. Thus, for a good guarantee of the patient's daily life, a monitor designed for this purpose is needed.

Patient heart rate monitors can perform many functions beyond tracking of heart rate in real time. One of the features is that when one enters an information and programming of choice within the machine, the monitor can average the person's heartbeat rate and estimate how many calories the person burns per hour. The information obtained can be downloaded into a computer for tracking purposes.

On cardiovascular machines like the treadmill or elliptical trainer, once information is entered like age and program, the machine can adjust the body resistance until it reaches the desired zone for the heartbeat rate. One of the existing patients monitoring system demonstrated below in this literature review is a technique that measures the heartbeat rate by sensing the change in blood volume in a finger artery (or mostly wrist artery) while the heart is pumping blood [15]. The system consists of an infrared LED that transmits an IR signal through the fingertip or wrist of the subject, a part of which is reflected by the blood cells. The reflected signal is detected by a photo diode sensor. The changing blood volume with heartbeat results in a train of pulses at the output of the photo diode, the magnitude of which is too small to be detected directly by a microcontroller.

Hospital Health Care Monitoring System using Wireless Sensors Network" was proposed by Naji HR Aminian et al. In this project, there is continuous observation of the patient's physiological parameters such as blood pressure of patient as well as heart rate. This system is mainly useful for pregnant women to measure the various parameters like blood pressure, heart beat and fatal movement to control the health issue [16]. This system has to monitoring more than one patient at a time and easily able to sense the blood pressure (BP) and heart rate of the patients. In this system, there is a sensor node attached to body of patient to measure signals from the wireless sensors and sends these signal to the database. This system can detect the abnormal conditions of the patient, raise an alarm to the patient and sends a

SMS/Email to the doctor for treatment. The main advantage of this system is to increase the freedom for enhancing patient's quality of life. The demerit of this system is that in this the patients need to get admitted in the hospital for continuous monitoring of the patient physiological parameters. This WSN gets complicated if number of patient is admitted in the hospital beyond the specified limit.

2.4 Temperature Monitoring/Thermometer for Body Temperature Measurement

The normal body temperature of a person varies depending on gender, recent activity, food and fluid consumption, time of day, and, in women, the stage of the menstrual cycle. Normal body temperature can range from 97.8 degrees F (or Fahrenheit, equivalent to 36.5 degrees C, or Celsius) to 99 degrees F (37.2 degrees C) for a healthy adult. A person's body temperature can be taken in any of the following ways:

- Orally
  - Temperature can be taken by mouth using either the classic glass thermometer, or the more modern digital thermometers that use an electronic probe to measure body temperature.
- Rectally
  - Temperatures taken rectally (using a glass or digital thermometer) tend to be 0.5 to 0.7 degrees F higher than when taken by mouth.
- Axillary
  - Temperatures can be taken under the arm using a glass or digital thermometer. Temperatures taken by this route tend to be 0.3 to 0.4 degrees F lower than those temperatures taken by mouth.

- Ear
  - A special thermometer can quickly measure the temperature of the ear drum, which reflects the body's core temperature (the temperature of the internal organs).
- By skin
  - A special thermometer can quickly measure the temperature of the skin on the forehead.

Table 2.1 shows the normal body temperature range for men and women. There are some differences between the genders. Table 2.2 shows the symptoms of irregular heart rhythm

TABLE 2.1 :The Normal Body Temperature Range For Men And Women[17]

Place	Normal range	Men	Women
Oral	33.2-38.2	35.7-37.7	33.2-38.1
Rectal	34.4-37.8	36.7-37.7	36.8-37.1
Tympiac	35.4-37.8	35.7-37.5	35.7-37.5
Axiallary	35.5-37.0	36.5-37.0	35-37.6

2.5 Heart rate/Patient monitor for Heart rate measurement

As the heart forces blood through the arteries, it feels the beats by firmly pressing on the arteries, which are located close to the surface of the skin at certain points of the body. The heart rate can be found on the side of the neck, on the inside of the elbow, or at the wrist [17]. For most people, it is easiest to take the heart rate at the wrist. If use the lower neck, be sure not to press too hard, and never press on the heart rate on both sides of the lower neck at the same time to prevent blocking blood flow to

the brain. Types of irregular heart rhythm is shown in Table 2.2 below. When taking your heart rate :

- Using the first and second fingertips, press firmly but gently on the arteries until you feel a pulse.
- Begin counting the heart rate when the clock's second hand is on the 12.
- Count your heart rate for 60 seconds (or for 15 seconds and then multiply by four to calculate beats per minute).
- When counting, do not watch the clock continuously, but concentrate on the beats of the pulse.
- If unsure about your results, ask another person to count for you.

TABLE 2.2: The Symptoms of Irregular Heart Rhythm[[18]]

Symptom	Effect
Palpitation-skipped beat	• Seem like heart missed a beat but actually had an early heartbeat
Fluttering	• Due to extra "skipped beats" that occurs right after another-caused by abnormal heart rhythm
Brandycardia-slow heartbeat	• Too slow than 60 beats per minute-not enough blood carrying oxygen to the body • Symptoms: ▪ Fatigue ▪ Dizziness ▪ Lightheaded ▪ Fainting or near fainting
Tachycardia	• Too quickly (above 100 beats per minute) – lower chambers, or verticals do not have enough time to fill with blood, cannot pump to

	the rest of body. • Symptoms: ▪ Skipping a beat ▪ Beating out of rhythm ▪ Palpitations ▪ Fast heart beat ▪ Shortness of heart breath ▪ Chest pain ▪ Dizziness ▪ Lightheadness ▪ Fainting or near fainting

2.6 Wireless Monitoring system.

Purnima et al proposed health monitoring systems based on GSM & Zigbee technology. In this ECG, temperature & heart beat signals are continuously transmitted & monitored through Zigbee [19]. A Zigbee node was connected to every patient monitoring system. The data are transmitted to the doctors PC via Zigbee as well as GSM technology is used to send data to doctor's mobile. It also remotely monitor patient's vital parameters through messages sent by GSM along with date & time, patient's location, name of the patient. The research on biomedical wireless monitoring systems is show in Table 2.3.

TABLE 2.3 : The Research on Biomedical Wireless Monitoring Systems[20].

Author	Application	Variables	Technology	Sensor	Benefits
Dagtas et al,2007	Patient monitoring in a smart home	Cardiac activity	Zigbee	ECG	Communicatio n with home server via ZigBee, incoming data stored for future reference
Curtis et al,2008	Ambulatory patient monitoring system	Vital signs, position of patient	Wifi	GPS,ECG, Acoelemeter	Open platform,low cost, geo-positioning

Abbate et al,2011	Monitoring system for eldery	Acceleration and tilt angle	Zigbee, bluetooth	Accelerometers, gyroscope	Mobility of nodes
Gomez et al,2011	Cardiac condition monitoring system	Cardiac activity, pressure and volume	Zigbee	Conductance catheter	Management of multiple signal
Cancela et al,2011	Parkinson's disease monitoring system	Gait,posture , leg and hand movement	Zigbee	Accelerometer, gyroscope, microphone	Focused on one disease
Vijayalakshmi et al	General patient monitoring system	Cardiac activity, respiration, muscle activity	Zigbee, Bluetooth, Wifi	EMG,EEG, EKG	Communication medical server through internet

2.7 Analog to Digital Conversion (ADC)

Microcontroller understands only digital language. The inputs available from the environment to the microcontroller are mostly analog in nature. In order to understand the inputs by the digital processor, a device called Analog to Digital Converter (ADC) is used. As the name suggests this peripheral gathers the analog information supplied from the environment and converts it to the controller understandable digital format. Microcontroller processes the information and provides the desired result at the output. Figure 2.7 shows the process of conversion of analog to digital signal.

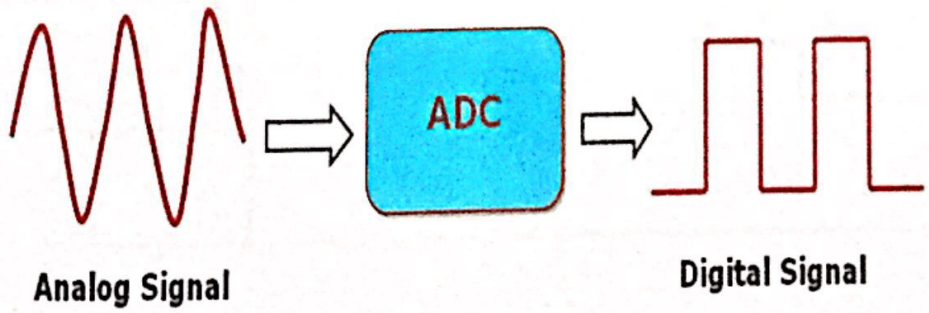


Figure 2.7 : Analog to digital conversion

2.8 Analysis of LM35

There are two transistors in the centre of this circuit. One has ten times the emitter area of the other. This means it has one tenth of the current density, since the same current is going through both transistors. This causes a voltage across the resistor R1 that is proportional to the absolute temperature, and is almost linear across the range we care about. A special circuit straightens out the slightly curved graph of voltage versus temperature.

The amplifier at the top ensures that the voltage at the base of the left transistor (Q1) is proportional to absolute temperature (PTAT) by comparing the output of the two transistors. The amplifier at the right converts absolute temperature (measured in Kelvin) into Celsius. The little circle with the "i" in it is a constant current source circuit. The two resistors are calibrated in the factory to produce a highly accurate temperature sensor. The integrated circuit has many transistors in the middle, some in each amplifier, some in the constant current source, and some in the curvature compensation circuit. All of that is fit into the tiny package with three leads. The circuit diagram of LM35 is shows at Figure 2.8.

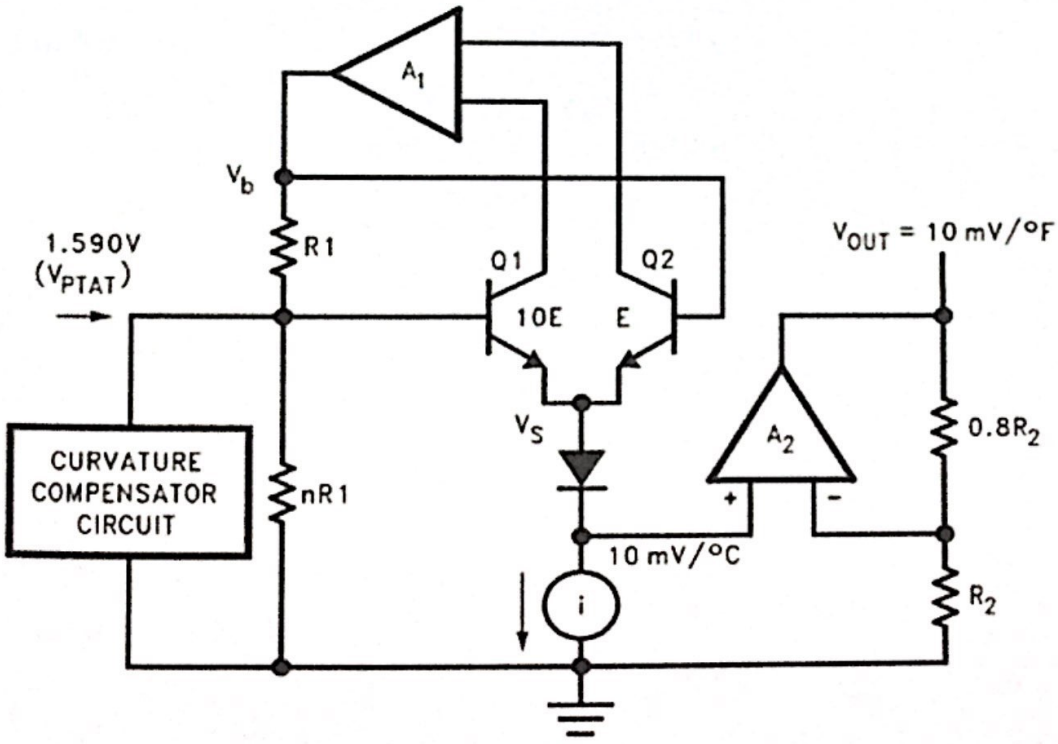


Figure 2.8 : The circuit diagram of LM35

CHAPTER 3

METHODOLOGY

3.1 Introduction

This chapter describes the method which has been implemented in this project.This project is divided into two main parts which are hardware design and software design. For the hardware design, it is focus on the main controller hardware, Arduino Uno board which connected to the heart rate sensor and temperature sensor (LM 35). Meanwhile, for the software design, Arduino IDE software and GSM wireless technology is use.

3.2 Hardware Connecction Set Up

In hardware connection set up, two sensors which is heart rate sensor and temperature sensor(LM35), microcontroller, a GSM modem and LCD display to show the reading of both parameter. The device will be attached to a patient's finger and the measurement for heart rate and body temperature measurement will be sent to the LCD display. It can be configured in such a way that it sends data after a time period. The discussion is based on the overview of the components used in the system.

3.3 Block Diagram for Surveillance of the Heart Rate and Body Temperature Using Wireless Technology for Remote Doctor

The block diagram in Figure 3.1 shows the block diagram of Surveillance of The Heart Rate and Body Temperature using Wireless Technology for Remote Doctor. The hardware implementation flow can be seen through this block diagram.

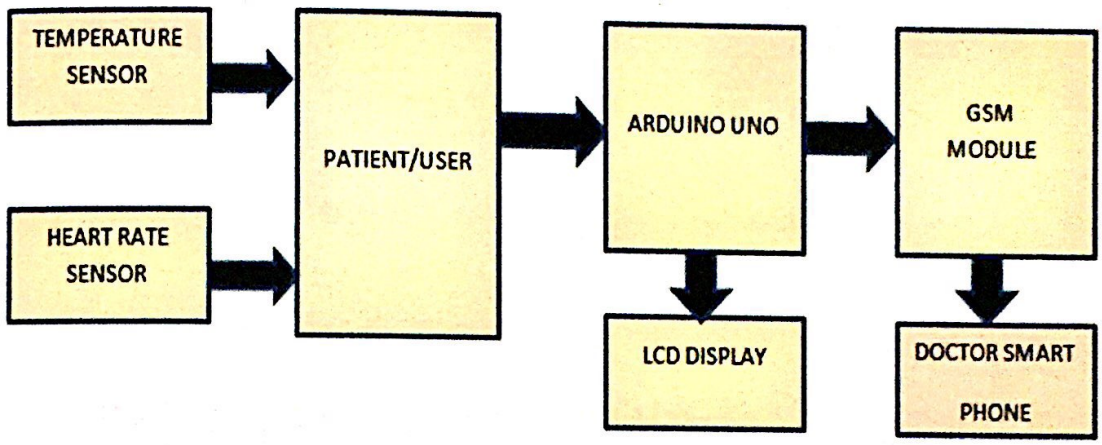


Figure 3.1 : The block diagram of surveillance of the heart rate and body temperature using wireless technology for remote doctor

3.4 Microcontroller/Arduino Uno

Arduino Uno board is the main function system in this project because it reads and interprets the data from the heart rate and the temperature sensor outputs. Arduino software is downloaded directly through the internet from the Arduino main page in order to build a specific programmed. Arduino needs a USB cable to power up the board in 5V. Excess power will cause irreparable damage to the Arduino board. Arduino can be connected to a PC or Laptop and get its power from that.

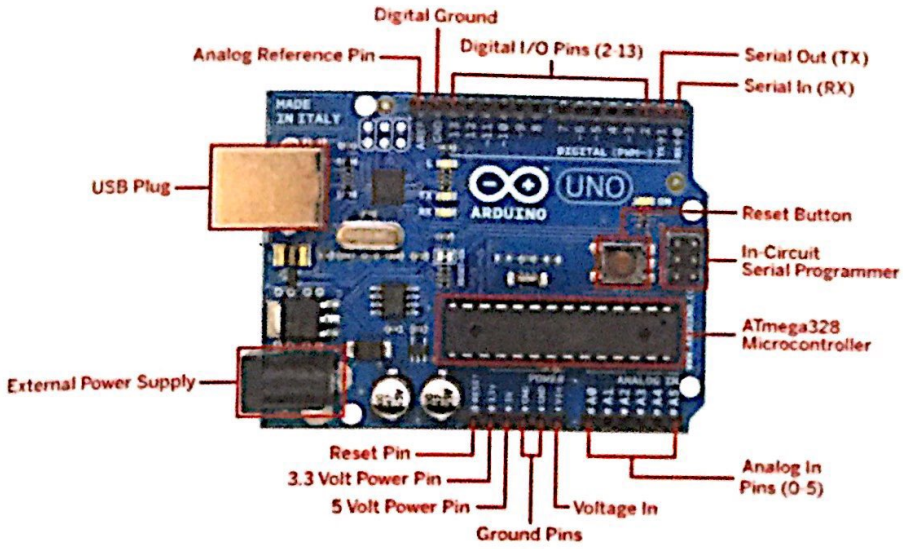


Figure 3.2 : Arduino UNO with label function

3.5 Heart Rate Sensor

Heart rate sensor gives digital output of heart rate when a finger is placed on it. The beat LED on sensor is flashes with each heartbeat, when the heart beat detector is working. The output of sensor is then connected to microcontroller directly to measure the Beats per Minute (BPM) rate. It works on the principle of light modulation by blood flow through finger at each pulse.Figure 3.3 shows the heart rate sensor that use in this project.

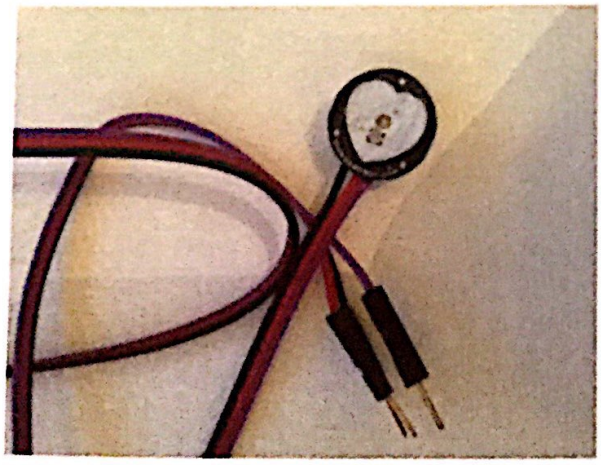


Figure 3.3 : Heart rate sensor

Specifications:-

- Operating voltage is +5V DC regulated.
- Operating current is 100 mA.
- Output data levels are 5V TTL level.
- LED is use to Heart beat detection and Output High Pulse.
- Light source are 660nm Super Red LED[21] .

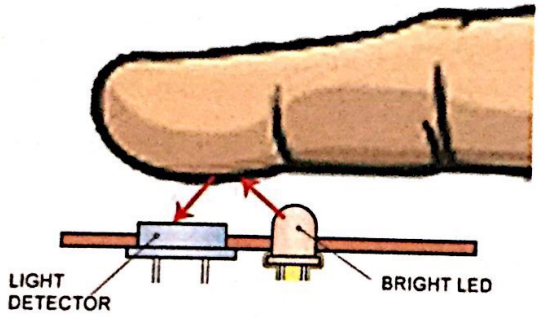


Figure 3.4 : Heart Rate Sensor Placement

3.6 Temperature sensor

LM35 used as a temperature sensor which gives output voltage linearly proportional to Celsius temperature. Temperature sensor senses the temperature from body and sends the data to microprocessor. The processor converts the data in digital form and displays it on LCD screen. It has higher accuracy and wider range from its counterparts. LM35 used as a temperature sensor which gives output voltage linearly proportional to Celsius temperature [22]. Figure 3.5 show the temperature sensor while Figure 3.6 shows the temperature sensor placement.

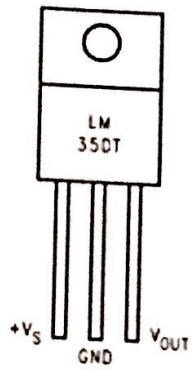


Figure 3.5 : the temperature sensor

Specifications:-

- Calibrated Directly in °Celsius (Centigrade).
- Linear + 10 mV/°C Scale Factor.
- 0.5°C Ensured Accuracy (at +25°C).
- Rated for Full −55°C to +150°C Range.

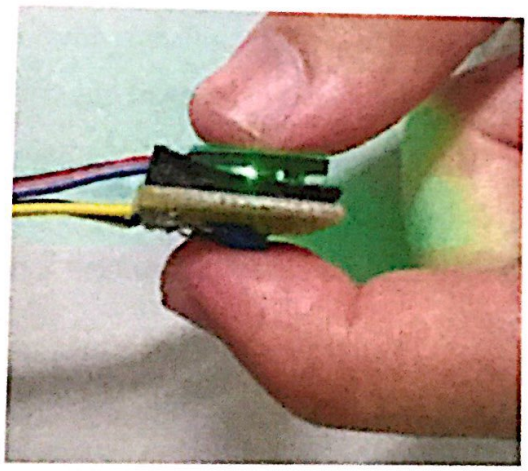


Figure 3.6 : The temperature sensor replacement

3.7 LCD display

The LCD is used to display the digital parameters on the hardware circuit device. A 16x2 LCD means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. This LCD has two registers, namely, Command and Data. The command register stores the command instructions given to the LCD. A command is an instruction given to LCD to do a predefined task like initializing it, clearing its screen, setting the cursor position,

controlling display etc. The data register stores the data to be displayed on the LCD. The LCD displays is shown in Figure 3.7.

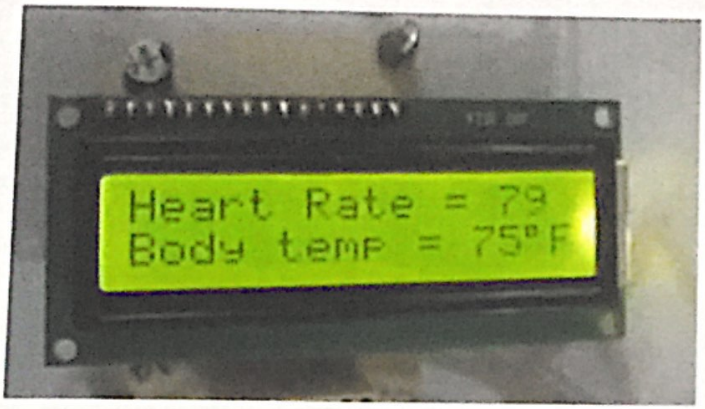


Figure 3.7 : LCD will display the parameter of patient

3.8 Buzzer

A buzzer or beeper is an audio signalling device, which may be mechanical, electromechanical, or piezoelectric and finds extensive use in electronics circuits and designs especially to trigger an alarm or as a system alert device. In the event of any abnormalities, if the patient or person presses any emergency switch, buzzer is used to alert the people around and to seek help from them. Figure 3.8 shows the buzzer that use as alert if emergency occur.

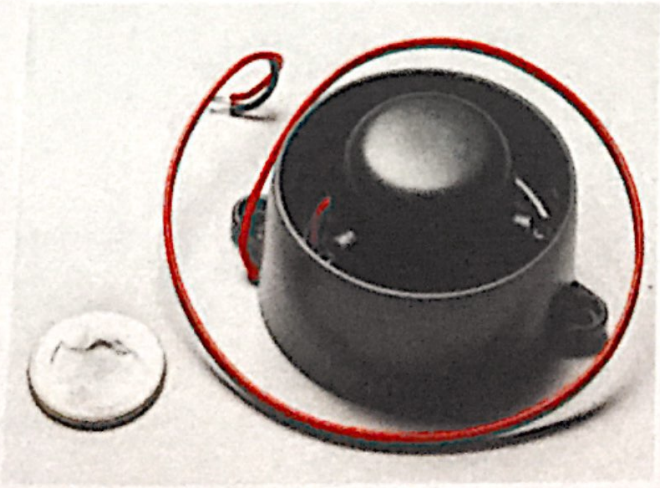


Figure 3.8 : Buzzer

3.9 GSM Modules

GSM (Global System for Mobile communications) is the most popular standard for mobile phones in the world. Figure 3.9 shows the GSM modules that used for this project. The GSM Association estimates that 80% of the global mobile market uses the standard. GSM is used by over 3billion people across more than 212 countries and territories. Its ubiquity makes international roaming very common between mobile phone operators, enabling subscribers to use their phones in many parts of the world. GSM differs from its predecessors in that both signalling and speech channels are digital, and thus is considered a second generation (2G) mobile phone system. GSM need an adapter to give power source to it module

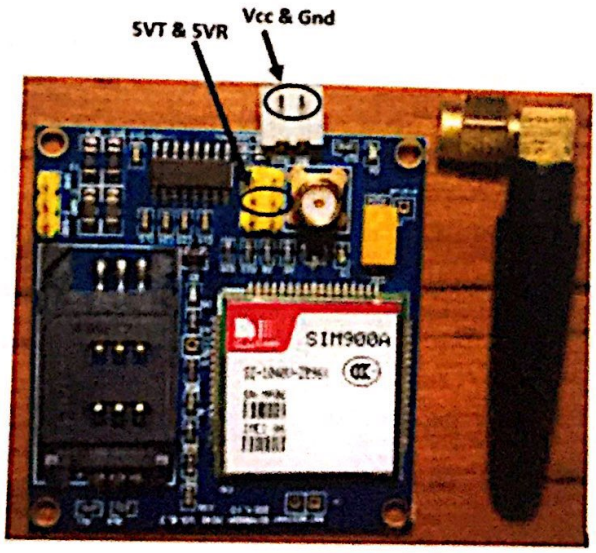


Figure 3.9. : The GSM modules

3.10 SIM card

Figure 3.10 shows the sim card that must be insert in GSM and doctor mobile phone. Others than that, SIM card also used to identify and authenticate subscribers on mobile telephony devices (such as mobile phones and computers). It is also possible to store contact information of doctor and guardians of patient. The sim card will save all the data before it send the sms to doctor smartphone when the device detect abnormal reading of the patient.

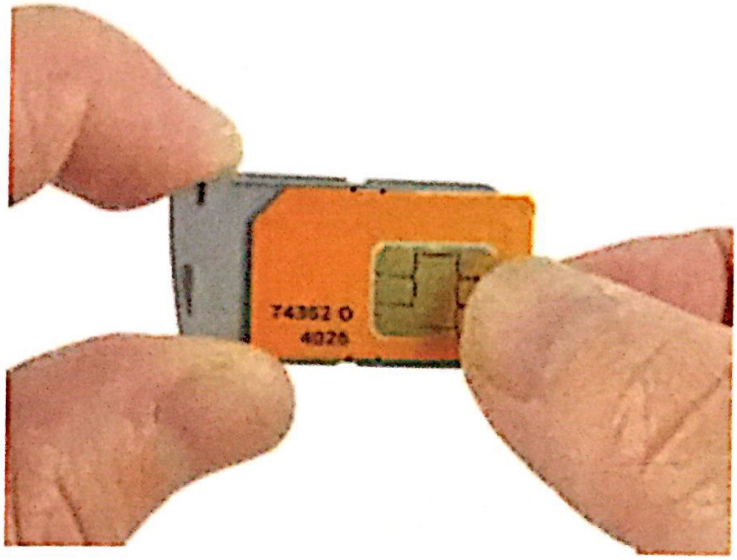


Figure 3.10 : The sim card

3.11 Doctor smartphone

In order to access the data from the sensors through GSM there has to be a medium. There can be multiple mediums in this world full of assistive technology devices but smart phone is the best choice because of its size and easy to bring anywhere. Smart phone will receive the alert sms when the patient are not in abnormal reading measurement.

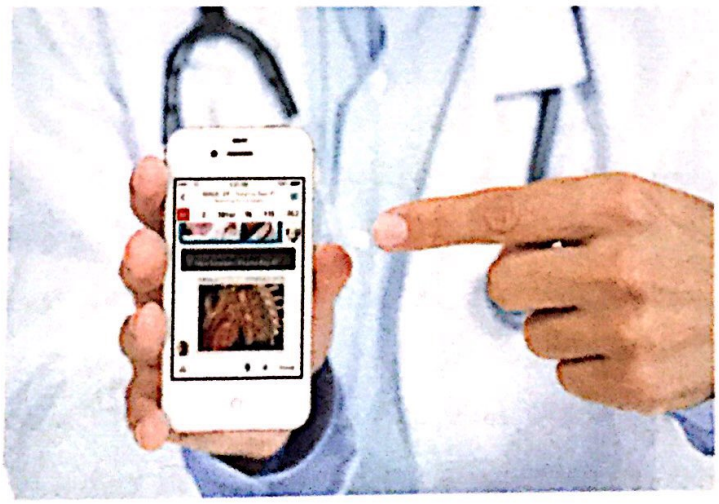


Figure 3.11 : The doctor smartphone

3.12 Circuit diagram of Surveillance of the Heart Rate and Body Temperature using Wireless Technology for Remote Doctor

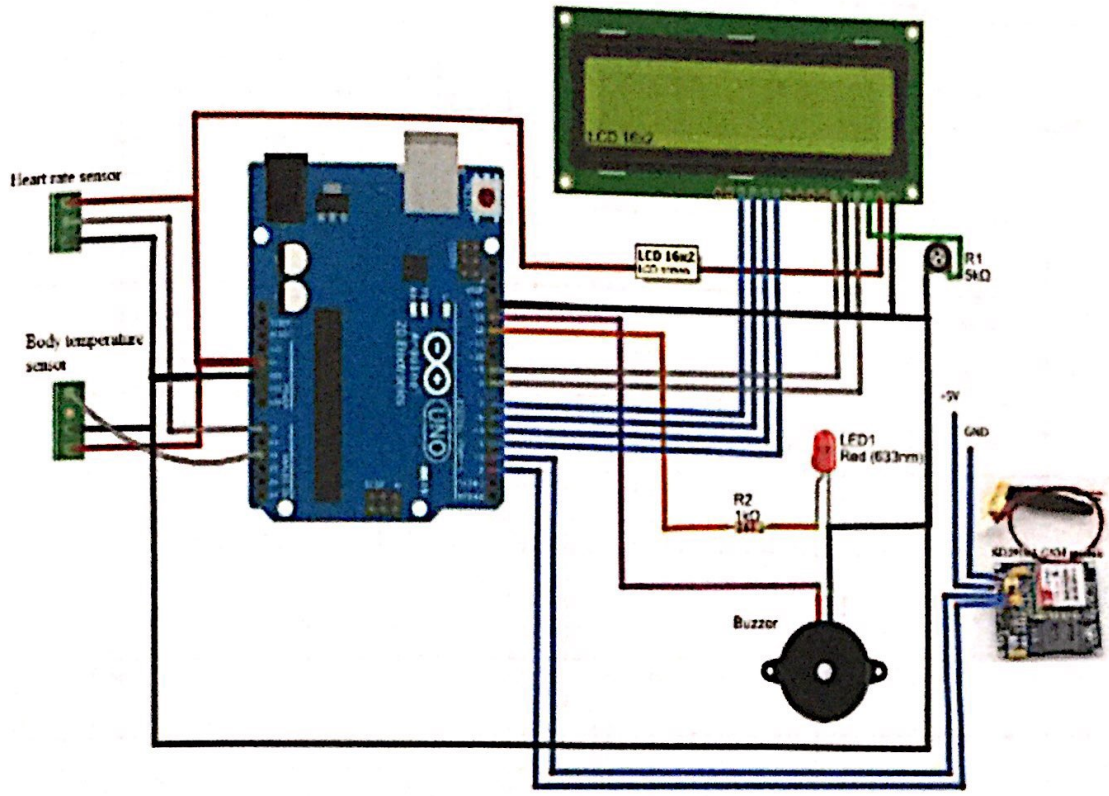


Figure 3.12 : Circuit diagram

3.13 Arduino Uno connection set up

The temperature sensor and the pulse sensor are first configured with the Arduino Uno Board in order to get these two vital measurements from a patient.The temperature sensor has three pins, the first pin is connected with the ground, the second pin is connected with a 4.7K ohm.Then with the output pin in the Arduino board which basically gives the temperature result. The last pin is connected with the 5volt pin in the arduino. Temperature sensor requires one wire and temperature libraries in the arduino library folder as well.The configuration between arduino and temperature sensor is shown in Figure 3.13.

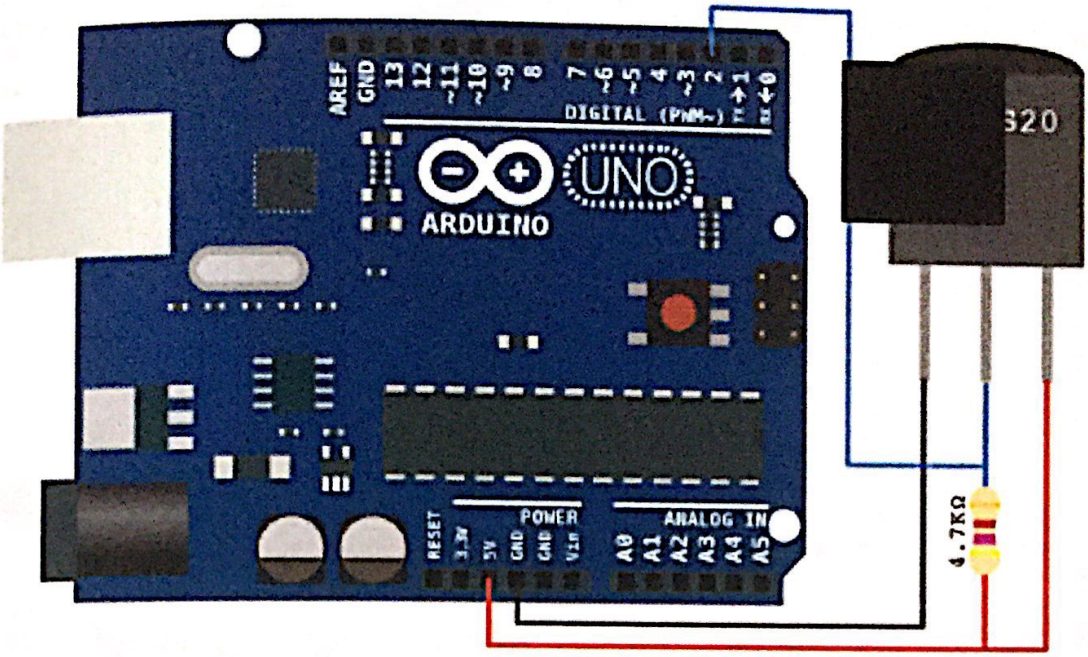


Figure 3.13 : Arduino Uno configured with temperature sensor

Since the pulse sensor is simply a plug and play sensor it does not require much calculation after the data is received. The pulse sensor has three pins as well. One pin is for the signal coming from the sensed data and the other two pins are 5volts and Ground.The configuration of arduino with pulse sensor is shown in Figure 3.14

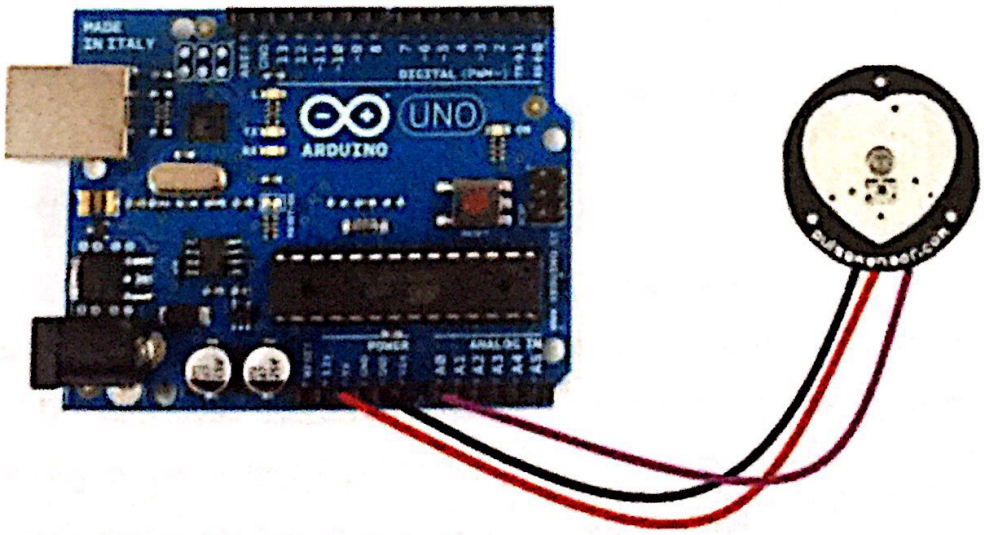


Figure 3.14 : Arduino configured with Pulse Sensor

The GSM modem, SIM900A is used in this project It configured first with the arduino to make it able to send data over the GSM connectivity. The arduino connection set up is shown in Figure 3.15.

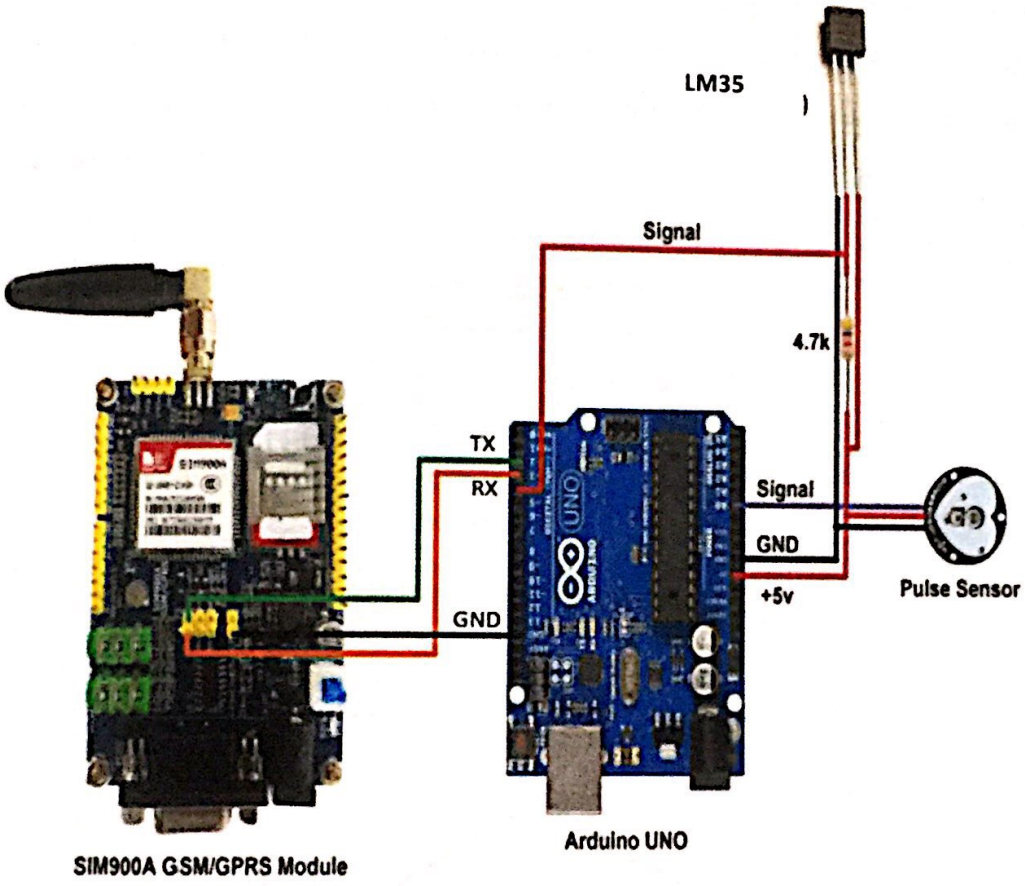


Figure 3.15 : Arduino connection set up

3.14 Software Implementation

This chapter was discussing about the implementation of the software for Surveillance of the Heart Rate and Body Temperature using Wireless Technology for Remote Doctor.In this project,Arduino Uno software are used control all the programming of the project.GSM wireless monitoring system are take position as receiver and transmit the data from the patient to smart phone

3.15 Flowchart of software development system for Surveillance of the Heart Rate and Body Temperature using Wireless Technology for Remote Doctor

Surveillance of the Heart Rate and Body Temperature using Wireless Technology for Remote Doctor has it own software. The software system is important to make it run and can be used by others. Figure 3.16 shows the flowchart of software development system for this project,

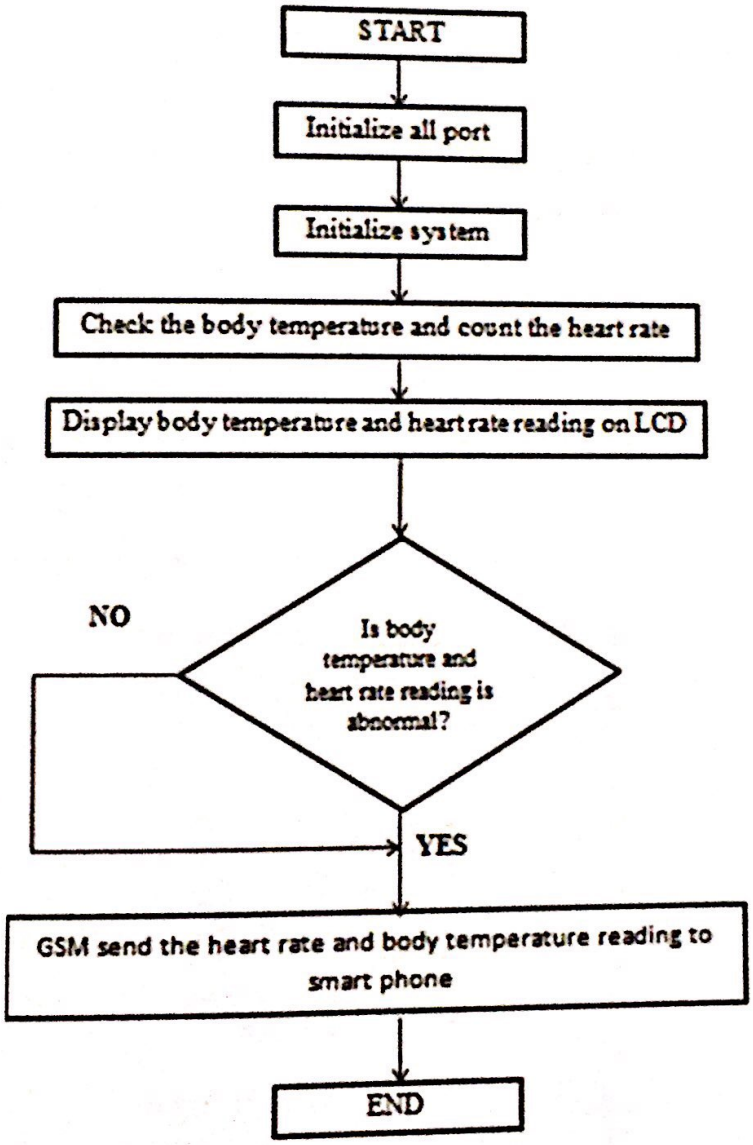


Figure 3.16 : Flowchart of software development system for Surveillance of the Heart Rate and Body Temperature using Wireless Technology for Remote Doctor

3.16 Arduino IDE software

The Arduino Integrated Development Environment or Arduino Software (IDE) contains a text editor for writing code, a message area, a text console, a toolbar with buttons for common functions and a series of menus. It connects to the Arduino and Genuino hardware to upload programs and communicate with the device. Arduino also simplifies the process of working with microcontrollers. Figure 3.17 shows the Arduino Ide System that is used as software system in this project.

The advatntages of Arduino IDE software :

- Inexpensive - Arduino boards are relatively inexpensive compared to other microcontroller platforms.
- Cross-platform - The Arduino Software (IDE) runs on Windows, Macintosh OSX, and Linux operating systems. Most microcontroller systems are limited to Windows.
- Simple, clear programming environment - The Arduino Software (IDE) is easy-to-use and yet flexible enough for advanced users to take advantage of as well.It is conveniently based on the Processing programming environment, Open source and extensible software .
- The Arduino software -Published as open source tools

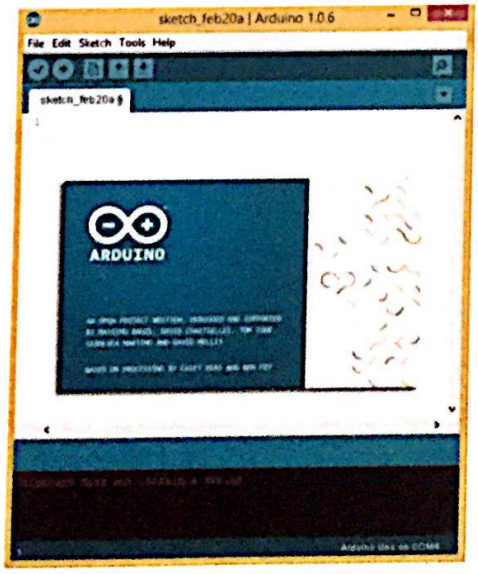


Figure 3.17 : Arduino Ide System

3.17 GSM wireless technology

GSM is the best choice of wireless technology system. It is because it cover more large area than other technology. The GSM will receive and transmit data to mobile phone ever the range of the receiver are far. Figure 3.18 shows the working process of GSM wireless technology while Figure 3.18 shows the block diagram of GSM wireless technology system. Table 3.1 shows the advantages of the GSM wireless technology.

Figure 3.18 : GSM wireless technology

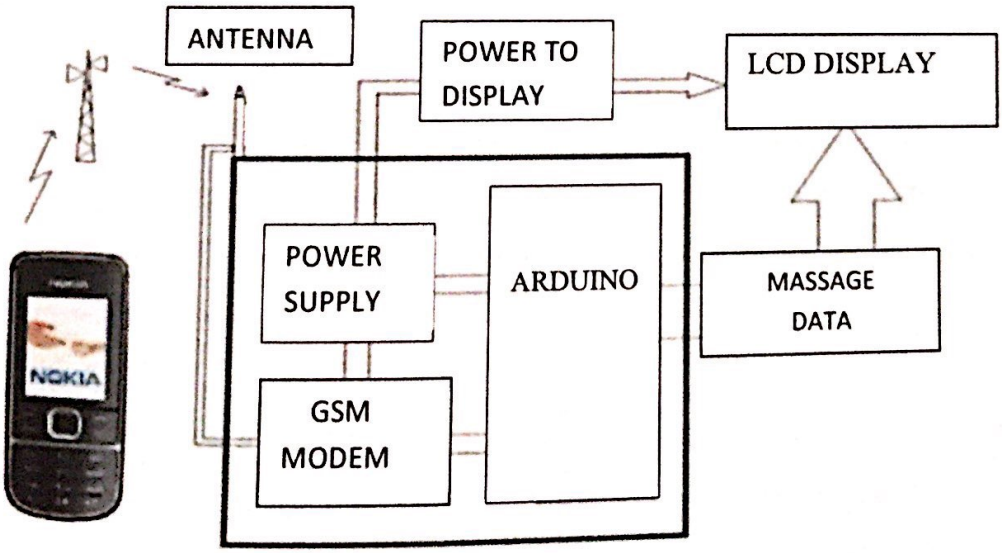


Figure 3.19 : The block diagram of GSM wireless technology system.

There are some features and characteristics of GSM wireless technology :

- Frequency Band :
  The frequency range specified for GSM is 1,850 to 1,990 MHz (mobile station to base station).
- Duplex distance :
  The duplex distance is 80 MHz. Duplex distance is the distance between the uplink and downlink frequencies. A channel has two frequencies, 80 MHz apart.
- Channel separation :
  The separation between adjacent carrier frequencies. In GSM, this is 200 kHz.
- Modulation :
  Modulation is the process of sending a signal by changing the characteristics of a carrier frequency. This is done in GSM via Gaussian minimum shift keying (GMSK).
- Transmission rate :
  GSM is a digital system with an over-the-air bit rate of 270 kbps.
- Access method
  GSM utilizes the time division multiple access (TDMA) concept. TDMA is a technique in which several different calls may share the same carrier. Each call is assigned a particular time slot.
- Speech coder :
  GSM uses linear predictive coding (LPC). The purpose of LPC is to reduce the bit rate. The LPC provides parameters for a filter that mimics the vocal tract. The signal passes through this filter, leaving behind a residual signal. Speech is encoded at 13 kbps
- Short message services :
  A convenient facility of the GSM network is the short message service. A message consisting of a maximum of 160 alphanumeric characters can be sent to or from GSM station. This service can be viewed as an advanced form of alphanumeric paging with a number of advantages. If the subscriber's mobile

unit is powered off or has left the coverage area, the message is stored and offered back to the subscriber when the mobile is powered on or has re-entered the coverage area of the network. This function ensures that the message will be received.

TABLE 3.2 : The advantages and characteristic of GSM wireless technology

System	P-GSM 900	E-GSM 900	GSM(DCS) 1800	GSM(PCS) 1900
Uplink (MS → BS) Downlink(BS→ MS)	890 - 915 MHz 935 - 960 MHz	880 - 915 MHz 925 - 960 MHz	1710 - 1785 MHz 1805 - 1880 MHz	1850 - 1910 MHz 1930 - 1990 MHz
Wavelength	≅ 33 cm	≅ 33 cm	≅ 17 cm	≅ 16 cm
Bandwidth	25 MHz	35 MHz	75 MHz	60 MHz
Duplex distance	45 MHz	45 MHz	95 MHz	80 MHz
Carrier separation	200 kHz	200 kHz	200 kHz	200 kHz
No. of carriers	124	174	374	299
Channel rate	270.8 kbps	270.8 kbps	270.8 kbps	270.8 kbps

CHAPTER 4

RESULT AND DISCUSSION

4.1 Introduction

In this chapter, the result and the discussion of the project will be discussed.. This section also cover the result of data collection of patient measurement for both parameter. Others than that, the analysis that have been made about the accuracy also will be covered in this chapter. The accuracy is is compared between two device which is standard device and designed device. The thermometer is used to compare the measurement result of patient body temperature. Then, patient monitor is use to measure the heart rate of the patient. After the comparison done, the percentage of error is obtained.

4.2 Project Design

The project is design with the small sizes to make patient easy to bring everywhere. If the patient does not felling well , the device will attached to the patient body and act as a primary check- up before waiting the doctor to come and see the patient . Figure 4.1 shows the front view of the project while Figure 4.2 shows the side view of the project. The device is labelled to make the patient understand the function of each component

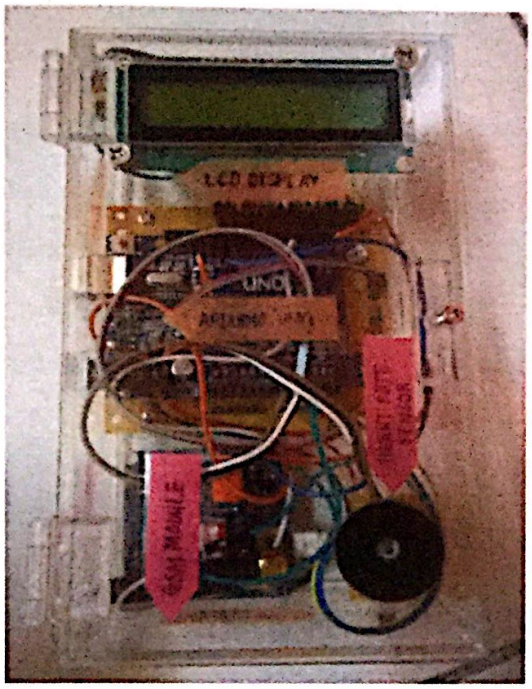
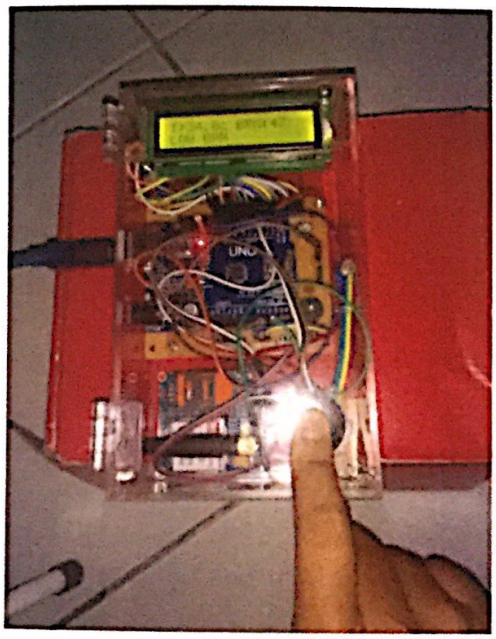
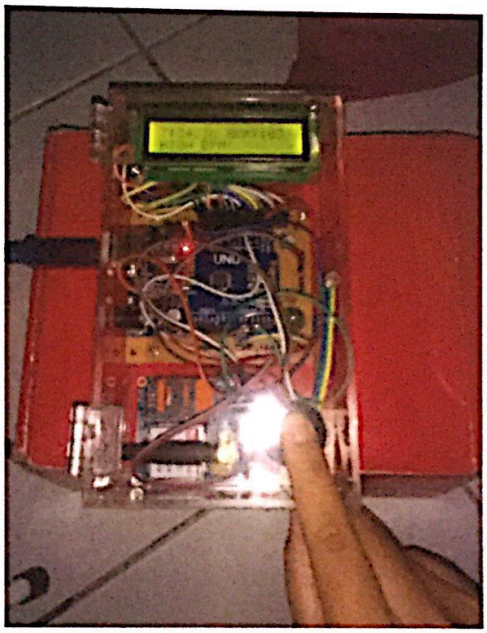
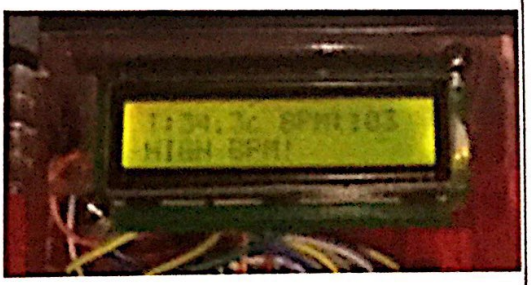


Figure 4.1 : Front view of the project

Figure 4.2 : Side view of the project

4.3 GSM Module Result for Surveillance of the Heart Rate And Body Temperature using Wireless Technology for Remote Doctor

The result for GSM module operation is shown in Figure 4.3. The device will send the data of the patient to the doctor if the measurement of heart rate and body temperature is in abnormal condition.

LOW BPM AND BODY TEMPERATURE SMS ALERT	HIGH BPM AND BODY TEMPERATURE SMS ALERT
	
	

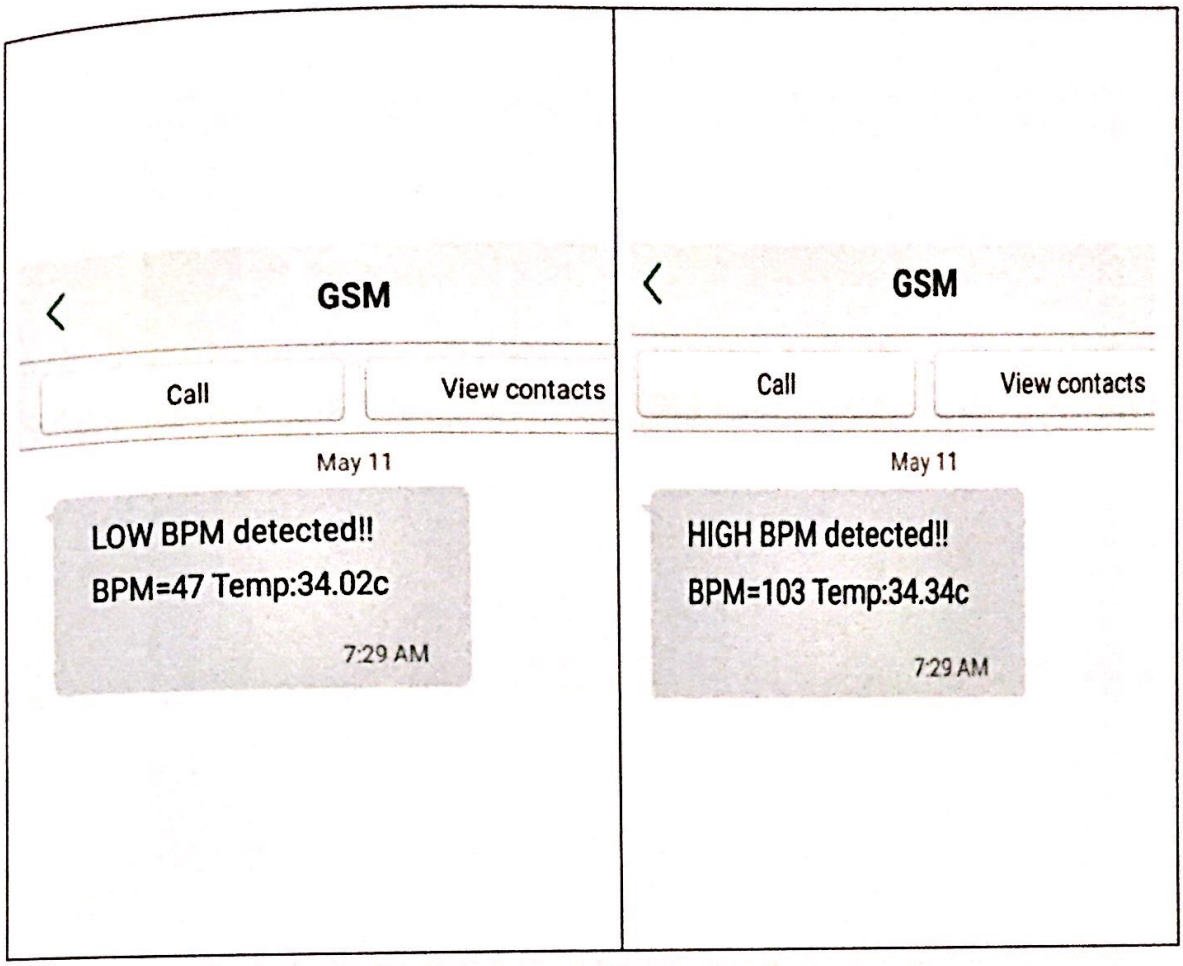


Figure 4.3: Result display from GSM

4.5 Arduino Display Result of Heart Rate and Body Temperature Sensor

It takes around one minute to get data from sensors through microcontroller when the sensor is attach to the patient. After that, the GSM module is turn on. Usually it takes 5 to 10 seconds to get the connection. Right after turning the GSM module on, it starts to blink. When it starts to blink slowly, means connection has been established and ready to be used. The output can be displayed where it shows whether connection is good or weak . It also shows the status level of heart rate and body temperature. Finally, the confirmation will occur by getting a message of data receiving. Figure 4.4 shows the result of temperature sensor and pulse sensor in arduino serial monitor while Figure 4.5 shows the data sent by the GSM modem is received with confirmation message.

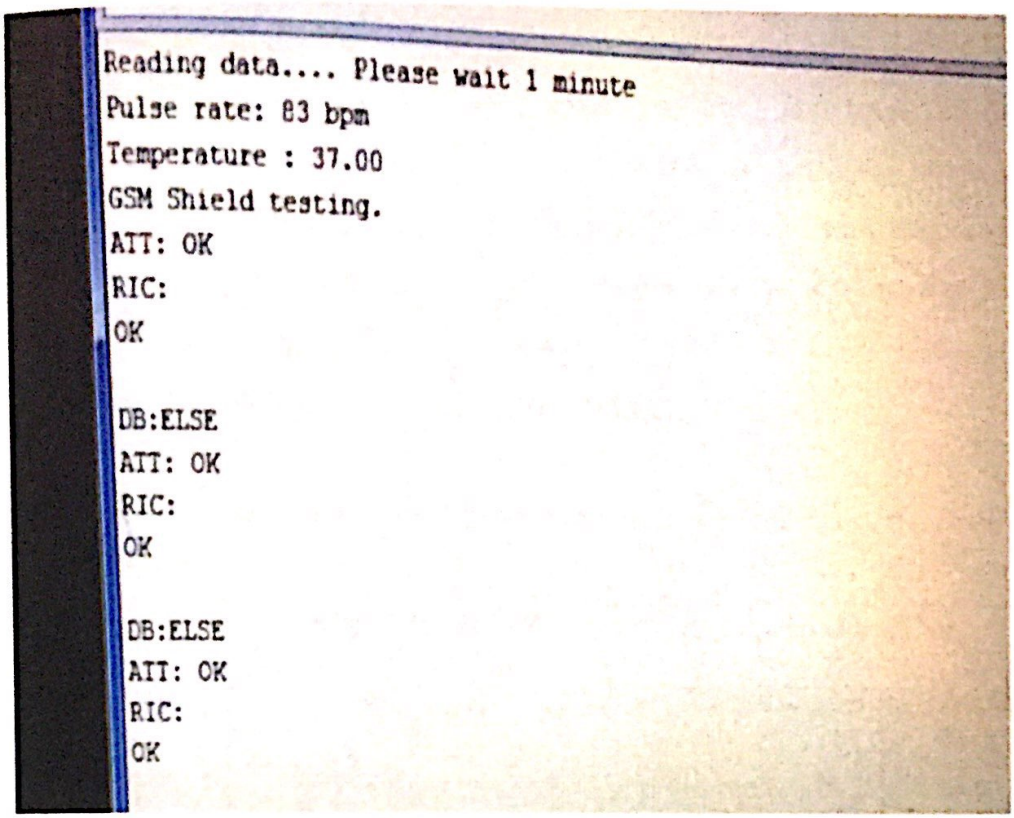


Figure 4.4 : Result of temperature sensor and pulse sensor in arduino serial monitor

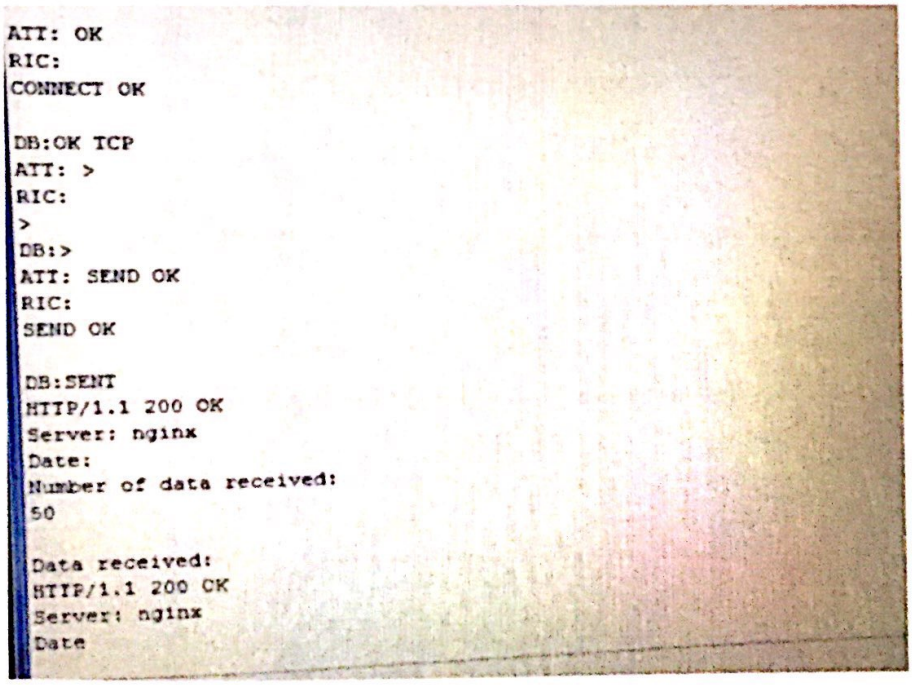


Figure 4.5 : Data sent by the GSM modem is received with confirmation message

4.6 Data collection

To verify whether the device is giving a better output or not, the result of heart rate will be compared with the result from patient monitor. The result of body temperature will be compared with thermometer to identify the accuracy when it is used by patient. As the main things are taking temperature and heart rate, this devices must be sure produces an almost accurate output for both parameter when it used by patient. Table 4.1 shows the result of the data collection of heart rate output measurement between standard device and designed device.

TABLE 4.1 : The Data Collection of Heart Rate Output between the Standard Device and Designed Device.

Bil no	Standard device (BPM)	Designed Device (BPM)	Percentage error (A-B/A*100)	Accuracy(%) (100-percentage error)
1	72	76	5.6	94.4
2	110	113	2.7	97.3
3	70	68	2.9	97.1
4	72	76	5.6	94.4
5	68	65	4.4	95.6
6	65	69	6.2	93.8
7	72	68	.5.6	94.4
8	82	85	3.7	96.3
9	86	85	1.2	98.8
10	78	78	0	100
11	98	95	3.2	96.8
12	81	86	5.8	94.2

13	63	65	3.2	96.8
14	84	86	2.4	97.6
15	96	93	3.1	96.9
16	89	85	4.5	95.5
17	73	71	2.3	97.7
18	66	62	6.5	93.5
19	81	82	1.2	98.8
20	62	58	6.4	92.4
21	100	105	5.0	95.0
22	55	59	7.3	92.7
23	93	98	5.4	94.6
24	85	88	3.5	96.5
25	66	65	1.5	98.5
26	79	82	3.8	96.2
27	97	98	1.0	99
28	63	66	4.76	95.2
29	60	57	5	95
30	82	86	4.8	95.2

The data collection of heart rate output between standard device and designed device for 30 respondent is shown in table 4.1. The table also shows the percentage error and and the accuracy percentage of heart rate output for each respondent. Almost all the respondet achieve 90 % and above of the accuracy test between standard and designed output. For the 100 % accuracy,it was showed by respondent

number 10. The minumum accuracy was shown by respondent number 20 which is the percentage accuracy is 92.4%.

Figure 4.6 shows the comparison of heart rate output between standard device (BPM).

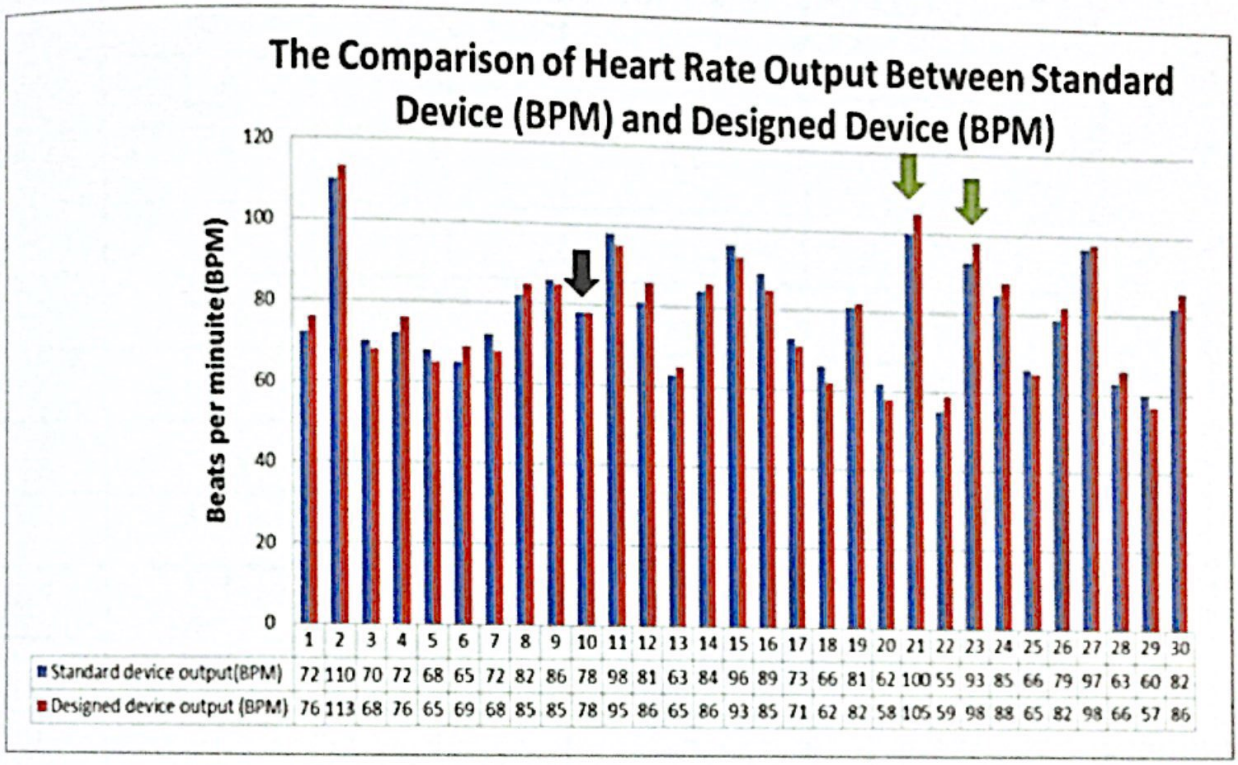


Figure 4.6 : The comparison of heart rate output between standard device (BPM)

The comparison of 30 respondents for heart rate between standard output and designed output are shown in Figure 4.6. Each of them shows the different reading of heart rate measurement. From the graph, the large differentiation of the reading is represent by respondent 21 and respondent 23 which is marked with green arrow. The same reading measurement of heart rate for both devices has been showed by respondent 9 which is 78 beats per minute which is represent by black arrow.

Table 4.2 shows the data collection of body temperature measurement of heart rate output between standard device and designed device. Each repondent have different measurement of output

TABLE 4.2 : Data collection of body temperature measurement of heart rate output between standard device and designed device.

Bil no	Standard device output	Designed device output	Percentage error (A-B/A*100)	Accuracy(%) (100-percentage error)
1	37.6	36.5	2.9	97.1
2	36.8	35	4.9	95.1
3	37.2	35.8	3.8	96.2
4	35.5	34.9	1.7	98.3
5	37.5	36.3	1.7	98.3
6	37	35	5.4	94.6
7	35.8	33.3	6.7	93.3
8	37.6	34.3	8.7	91.3
9	36.5	33.9	7.1	92.9
10	37	37	0	100
11	38.5	35	9.09	90.9
12	36.9	34.6	6.2	93.8
13	39	36.4	6.7	93.3
14	37.5	34.7	7.5	92.5
15	35.5	32	9.9	90.1
16	37.8	35	7.4	92.6
17	35.5	33.4	5.9	94.1
18	36.6	35.8	2.2	97.8
19	36	37	2.7	97.3
20	33	30	9.1	90.0

21	36	36	0	100
22	37	35.6	3.8	96.2
23	35.6	34	4.5	95.5
24	36	38	5.5	94.5
25	41	37	8.8	91.2
26	35.5	36.9	3.9	96.1
27	37.3	38	1.9	98.1
28	36	36.6	1.7	98.3
29	35.9	33.6	6.4	93.6
30	37	40	8.1	91.9

Table 4.2 shows the data collection of body temperature measurement for 30 between both devices. It also shows the percentage error and the accuracy percentage for each respondent. The 100% frequency was showed by 2 respondents which is respondent 10 and respondent 21. The low accuracy is shown at respondent 20 which is 90%.

Figure 4.7 shows the comparison of body temperature output between standard output device and designed device output for each respondent. The blue colour represent output for standard device while the red colour of bar graph cover for device designed output.

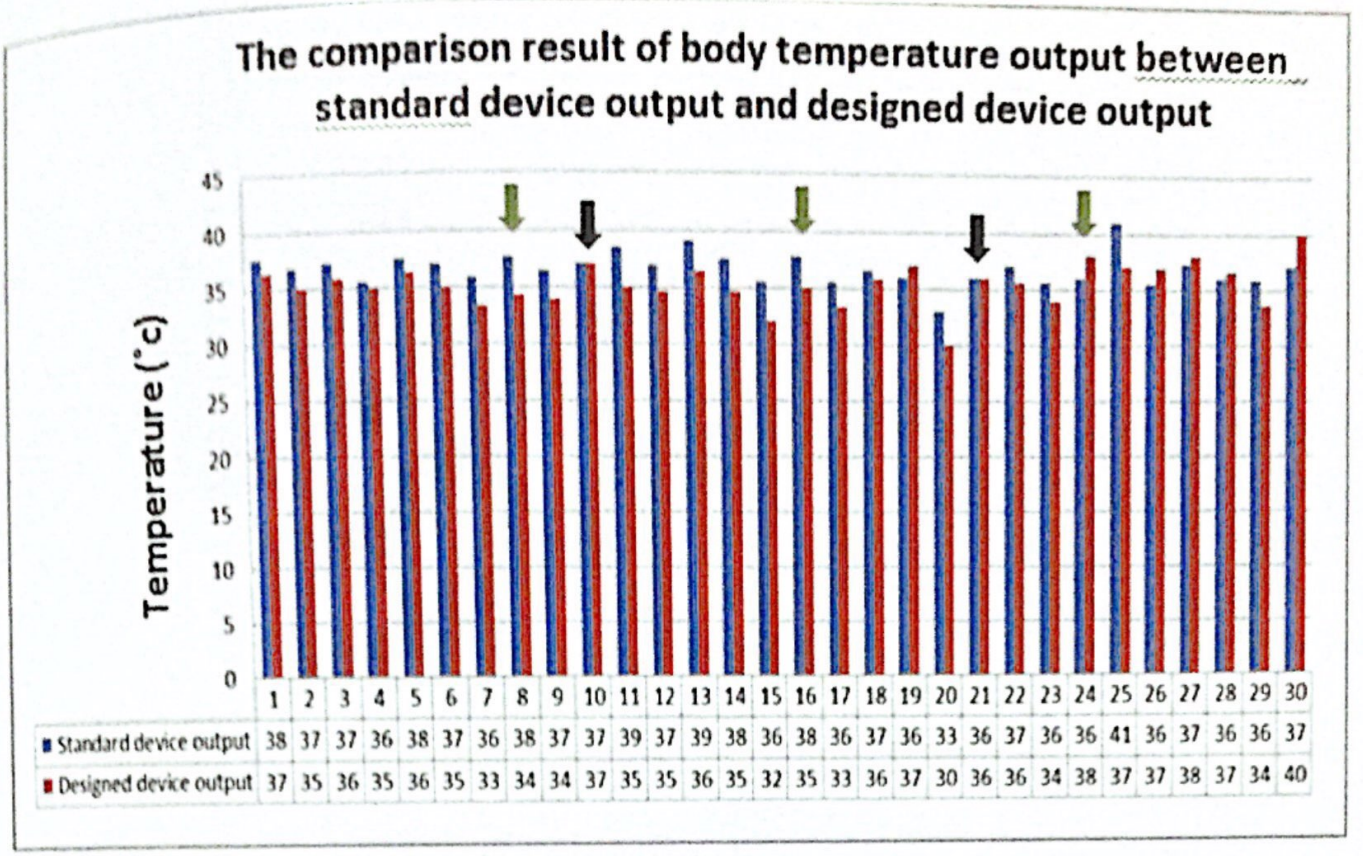


Figure 4.7 : The comparison result of body temperature output between standard device output and designed device output

Figure 4.7 shows the comparison result of body temperature output between standard device output and designed output. The black arrow show the respondent 10 and 21 have a same reading measurement for both device which is 36 °C. Respondent 8, 16 and 24 with green arrow shows the large different measurement between standard device output and designed device output which is the comparison is 4 °C.

In this chapter, the level of heart rate output between standard and designed is shown at Figure 4.8. The blue bar in the graph represent the standard output devices while the red is for designed device output.

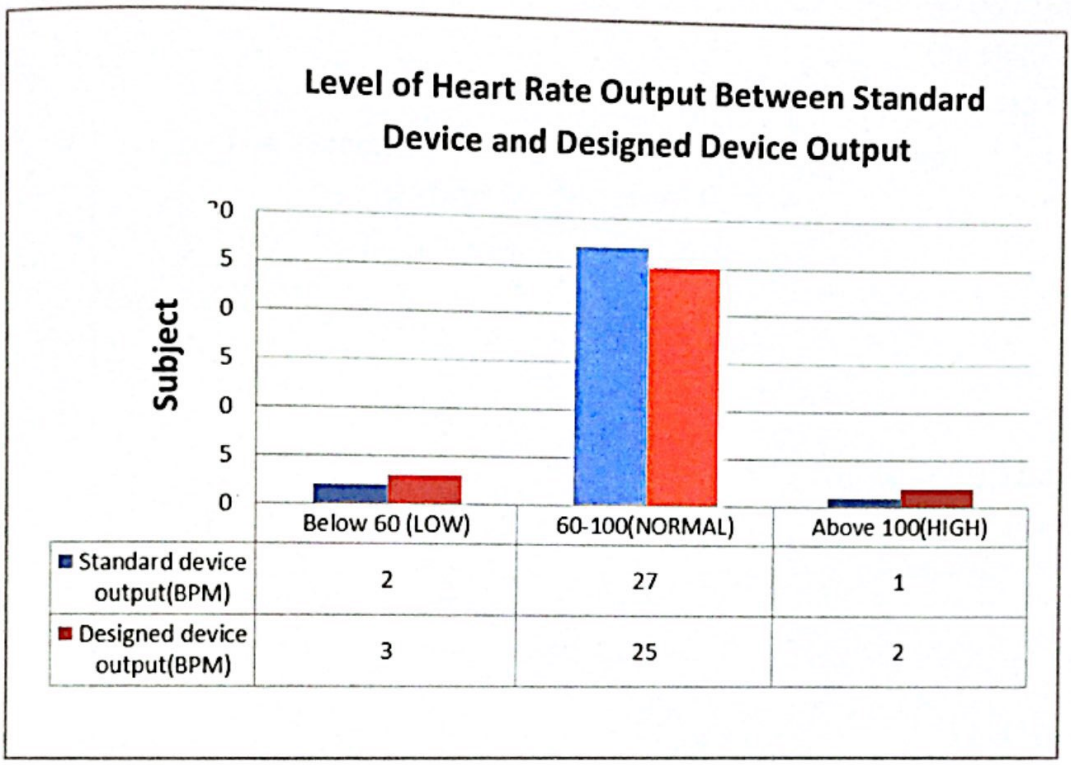


Figure 4.8 : The result of heart rate (BPM) level between design output and standard output device

The graph at figure 4.8 shows the reading for heart rate level between standard and design output. According to the America Heart Associates, there are 3 parts conditions of the heart rate which is low, high and normal. The range for low reading heart rate is below 60 bpm while for normal reading is 60-100 bpm. If the patient heart rate reached above 100 bpm,it will categorized as high measurement.

Figure 4.9 shows the percentages the level of heart rate output of respondent for standard device. The pie chart is represent the research that cover percentages for 30 respondent according to level of bpm.

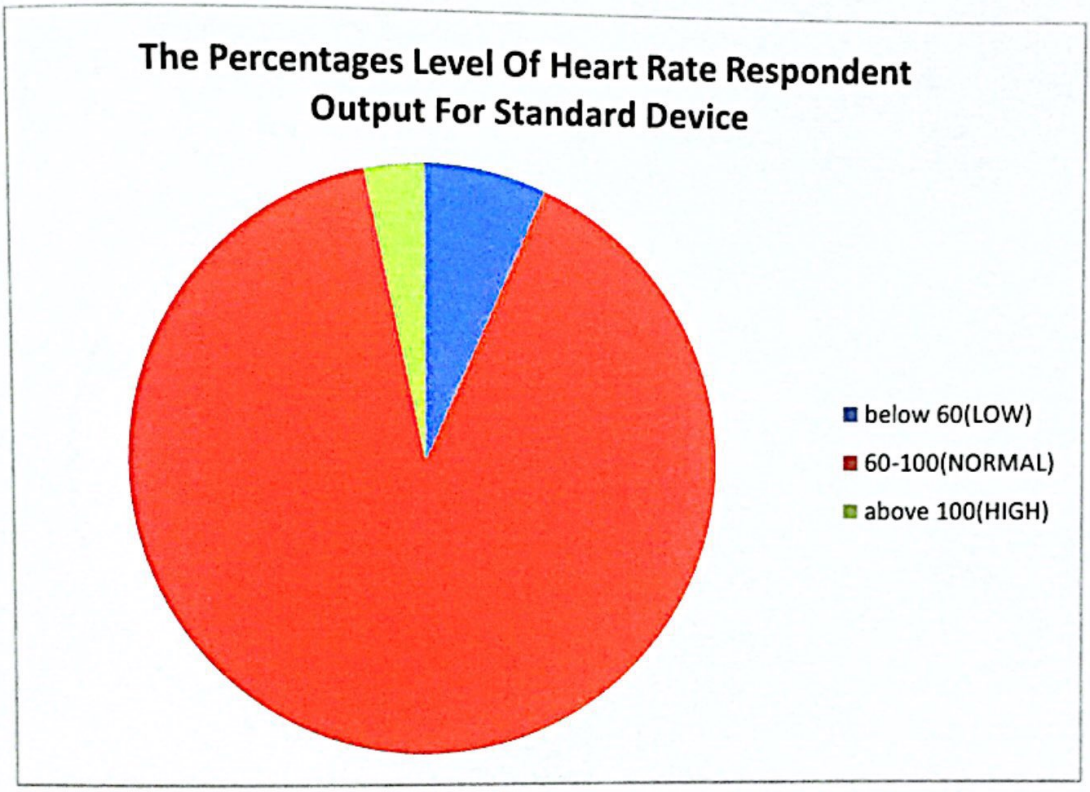


Figure 4.9 : Percentages the level heart rate output of respondent for standard device

From figure 4.9, the percentages level of heart rate respondent output for standard device is divided by 3 .The three level is low with blue colour, normal with red and high with green colour. The highest percentage was represent by respondent with the normal heart rate which is 90%. Respondent with the low bpm is in the middle level which the quantitiy is 6.7 %. Heart rate level above 100 bpm which is considered as high bpm represent 3.3 %.

The percentages level of heart rate output of the respondent for each level for designed device is shown in Figure 4.10 .

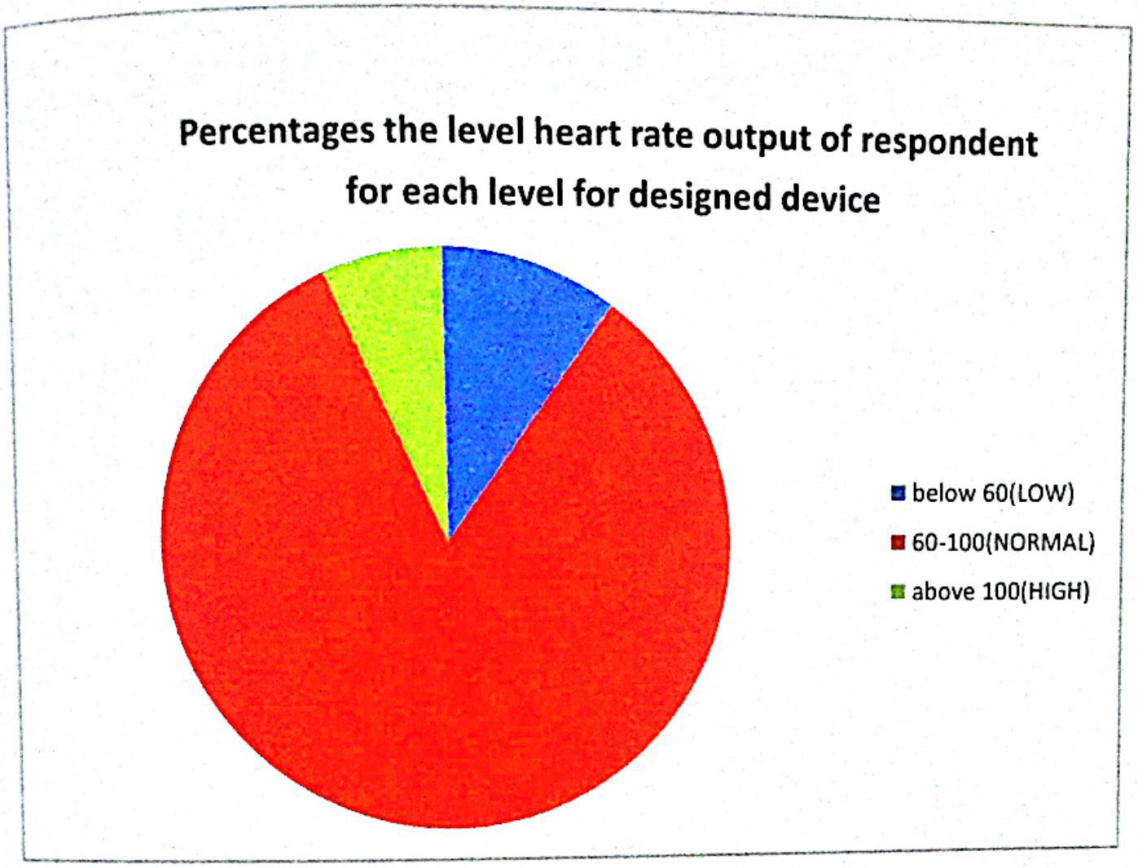


Figure 4.10 : Percentages the level heart rate output of respondent for each level for designed device

Figure 4.10 shows the percentages the level heart rate output of respondent for each level for designed device. As showed, the highest level of heart rate is headed by normal level which is 83.3 % and followed by low bpm which is 10 %.Respondent that had heart rate level above 100 is covered 6.7 %.

The temperature level between standard and design output device is shown in Figure 4.11. The temperature level is important to identify the measurement of the patient body temperature using both device which is standard device and design device

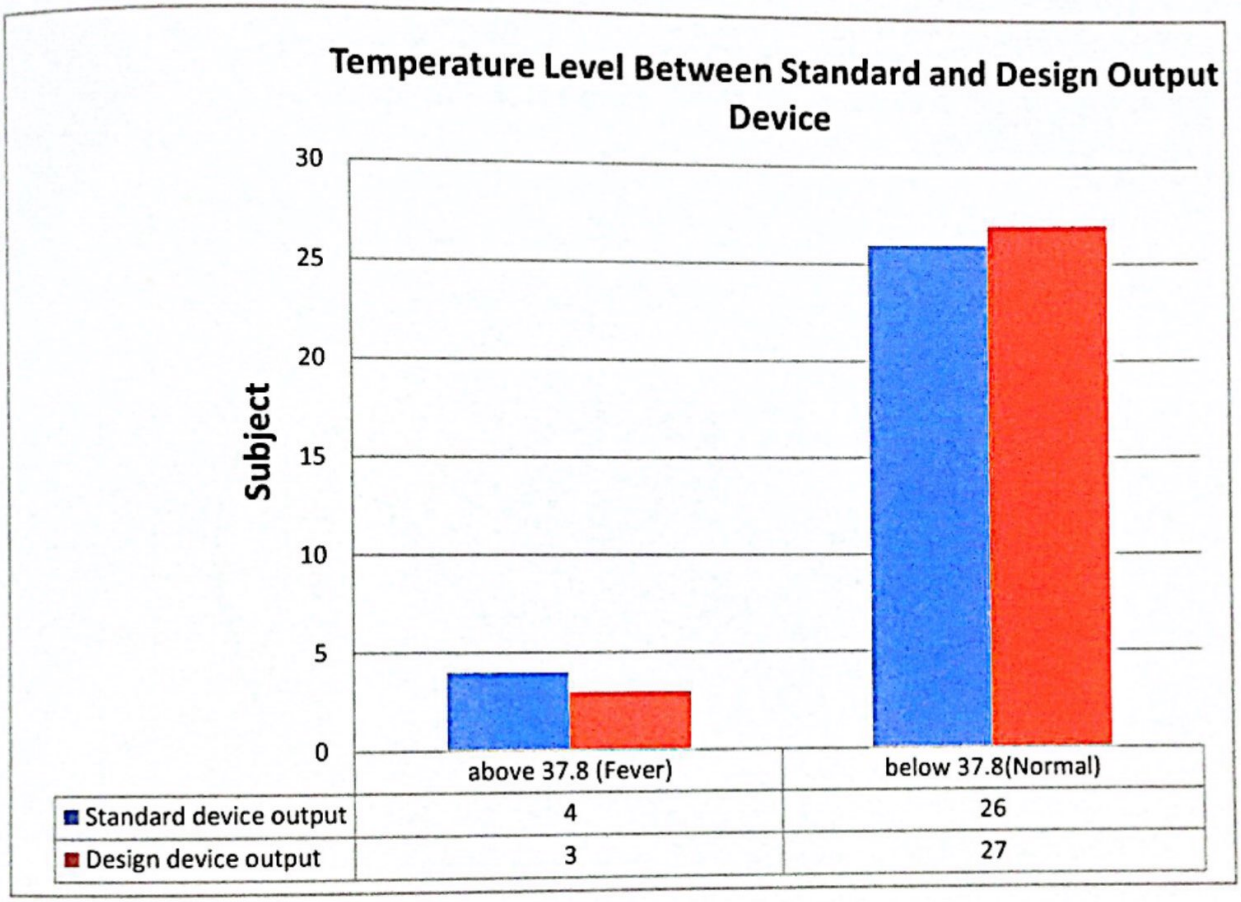


Figure 4.11 shows the temperature level between standard and designed output device

Figure 4.11 shows the temperature level between standard and designed output device.There are two level range of body temperature. From the graph we can see,the blue bar is represent standard device output and red bar represent designed device output.For standard device,4 respondent that have above 37.8°C reading is assume as fever while 26 respondent that have below 37.8 is categorized as normal level.3 respondent from designed device output have fever and 27 person hace the normal body temperature.

Figure 4.12 shows the percentages of body temperature each level output of standard device. The percentages of the measurement is important to identify the level of patient condition.

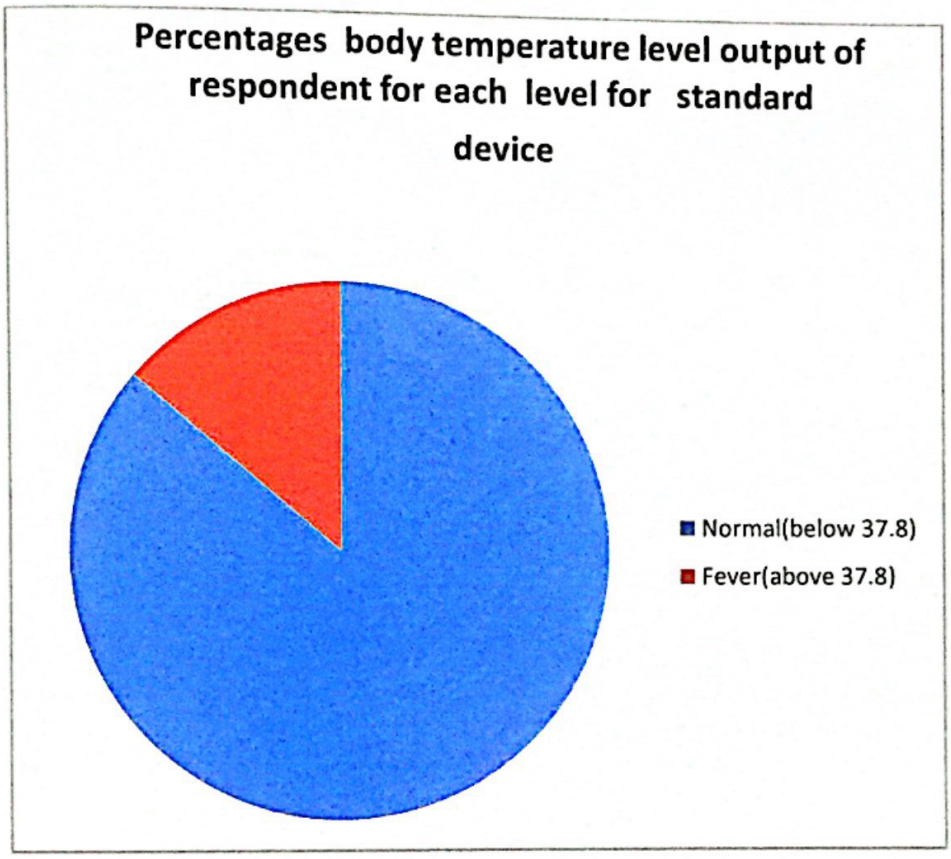


Figure 4.12 : The percentages body temperature level output of respondent for each level for standard device output

Figure 4.12 shows the percentages body temperature level output of respondent for each level for standard device output. Blue colour represent the normal range percentages which is 86.7% .The normal body temperature for people is 37.6 or below form it. Next, the red colour in the pie graph represent fever level with the percentages is 13.3%. Range for the fever level is above 37.6

Besides, the body temperature level output also have been dicussed in this chapter. Figure 4.13 shows the percentages body temperature each level output of respondent for designed device.

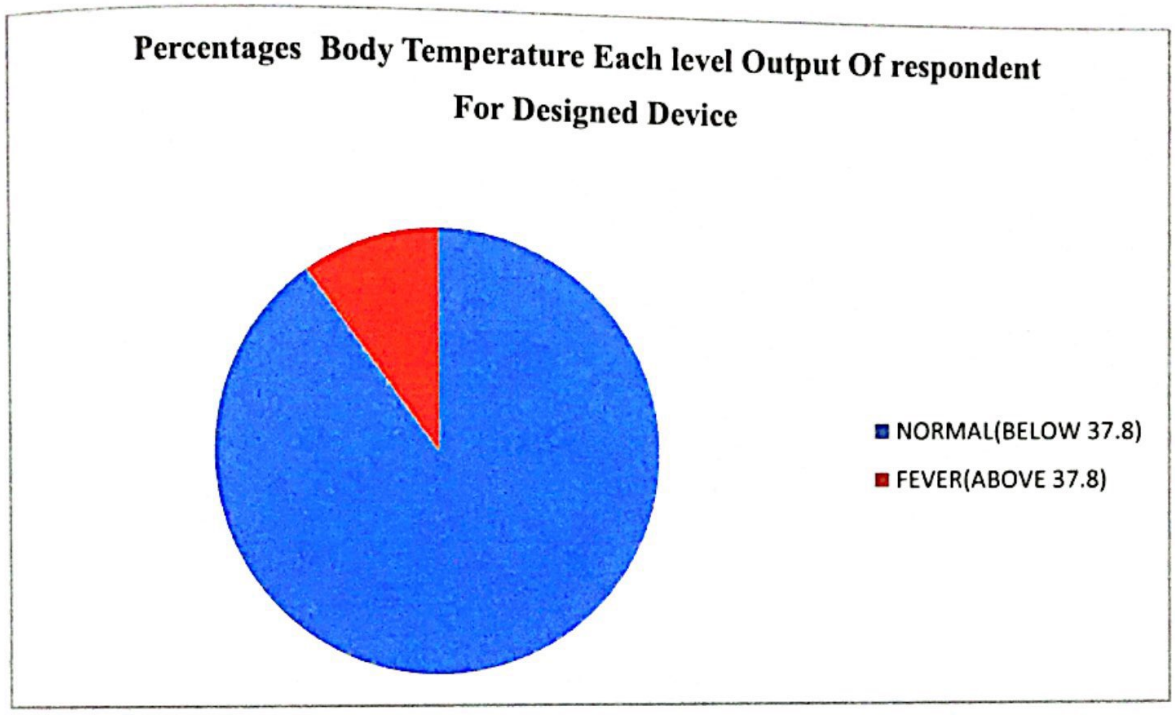
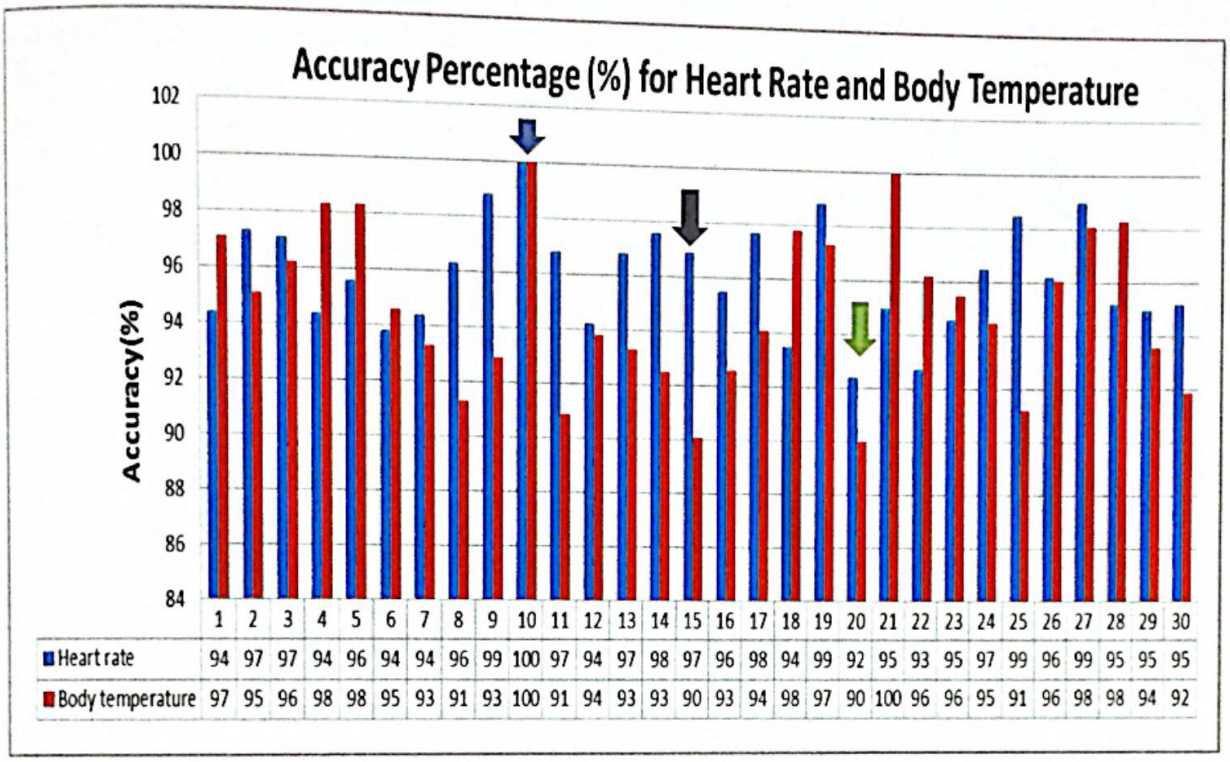


Figure 4.13 : Percentages body temperature level output of respondent for each level for designed device

Figure 4.13 shows the percentages body temperature level output of respondent for each level for designed device output. Blue colour represents the normal range percentages which is 90% and 27 person is discovered by the percentages. The red colour represent fever level with the percentages is 10% and it cover for 3 person.

Figure 4.14 shows the result of accuracy percentage for heart rate and body temperature measurement between standard device and designed device.



	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	29	30
Heart rate	94	97	97	94	96	94	94	96	99	100	97	94	97	98	97	96	98	94	99	92	95	93	95	97	99	96	99	95	95	95
Body temperature	97	95	96	98	98	95	93	91	93	100	91	94	93	93	90	93	94	98	97	90	100	96	96	95	91	96	98	98	94	92

Figure 4.14 : The result of accuracy percentage for heart rate and body temperature

Figure 4.14 shows the result of accuracy percentage for heart rate and body temperature between standard and designed device. For both parameter, mostly every respondent achieve 90 % and above of accuracy. Respondent 10 shows the 100% of accuracy for heart rate and body temperature measurement. The respondent also shown the maximum range for both parameter. It has been marked by blue error. The minimum range for heart rate measurement accuracy had been showed at respondent 20 that had been marked with green arrow. Others than that, for the body temperature minimum accuracy is shown by respondent 15 and it had been marked by black arrow.

4.15 Analysis of Survey Questionnaire

This survey is distributed to 30 people who are live in Bandar Tun Razak.The age of respondet is between 20-65 years old.Aim of the survey is to understand the usage of the device to people.It can be helpful to improve and to enhance the device in future.It also to analyse the getting the correct reading and measurement.The survey was divided by 3 part which is section A,B and C. Figure 4.15 shows the needed of surverillance of the heart rate and body temperature using wireless technology for remote doctor (Section A).

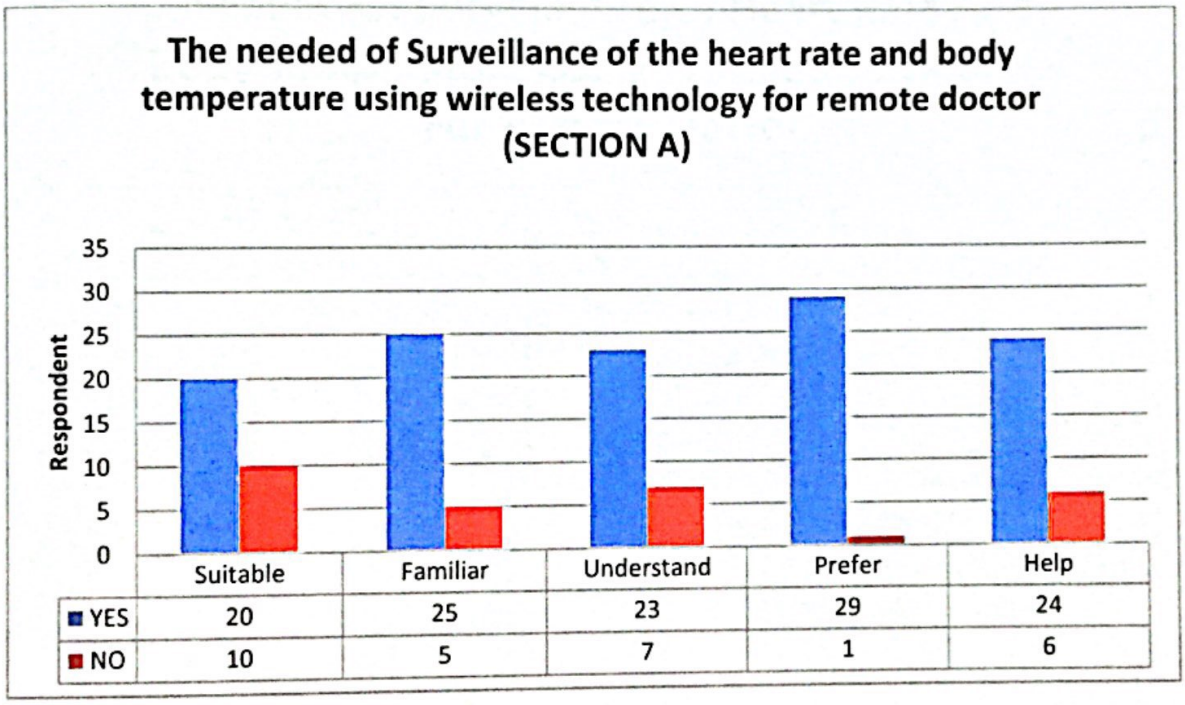


Figure 4.15 : The need of survey analysis(Section A)

Figure 4.15 shows the analysis the needed of Surveillance of heart rate and body temperature using wireless technology for remote doctor. Most of the respondent are familiar with this device. Most of the respondent also confident this device is suitable to use at home. Besides, many of respondent understand the function of the

device and prefer the device compared to patient monitor. From the observation, the respondent agree that the device help in determining the condition of heart rate and body temperature.

The need of surveillance of heart rate and body temperature using wireless technology for remote doctor for section B is shown in Figure 4.16. This section made up to identify the important of this project.

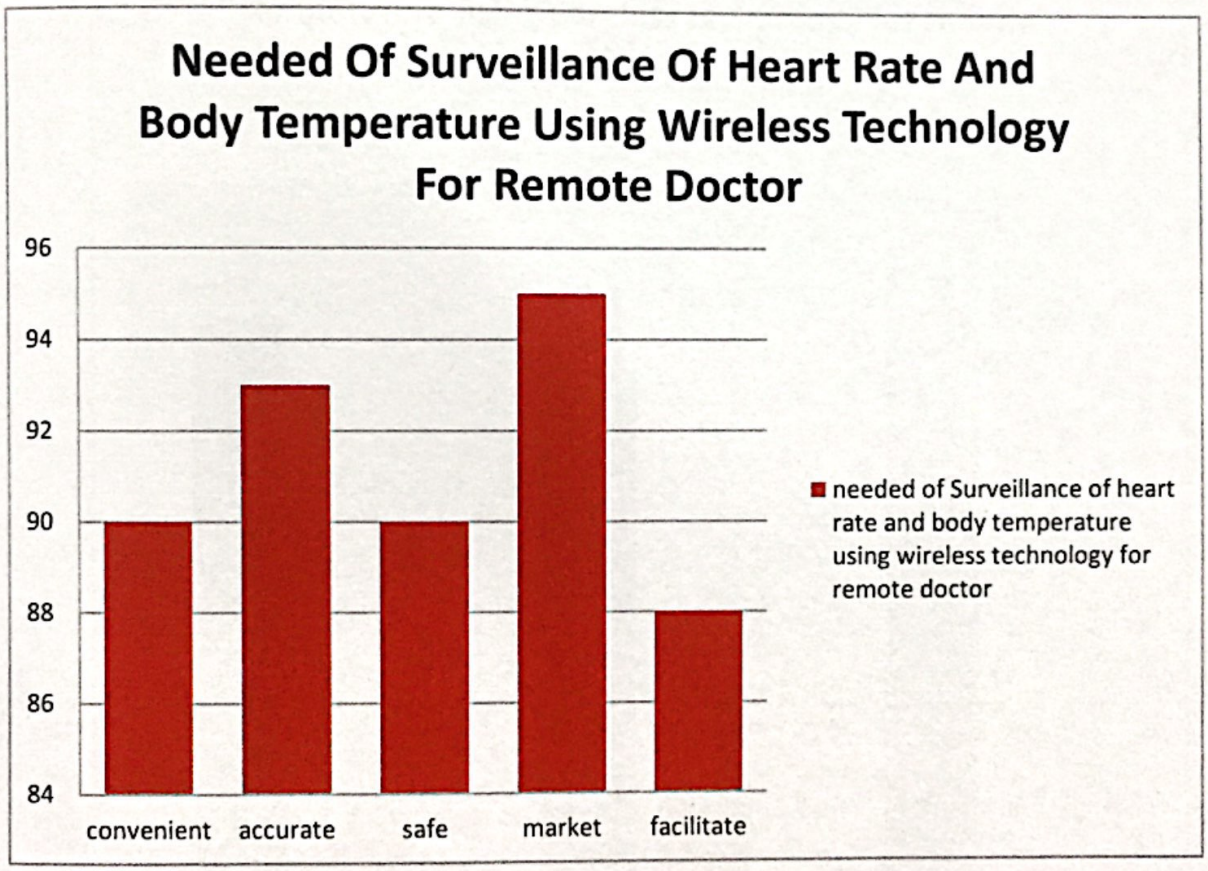


Figure 4.16 : Survey analysis (section B)

Figure 4.16 shows the analysis survey for section B. The questionnaire was distributed to 30 respondent, 90% agree this device is convenient to use. Then, 92% of the measurement give accurate reading to respondent. Most of the respondent with the 90% felt this device is safe to use. Others than that, respondent choose to have this in

market with the population 95 %. Last but not least, 88% of the respondent said with this kind of device, it will facilitate to both side which are doctor and user.

Figure 4.17 shows the needed of surveillance of the heart rate and body temperature using wireless technology for remote doctor (Section C).

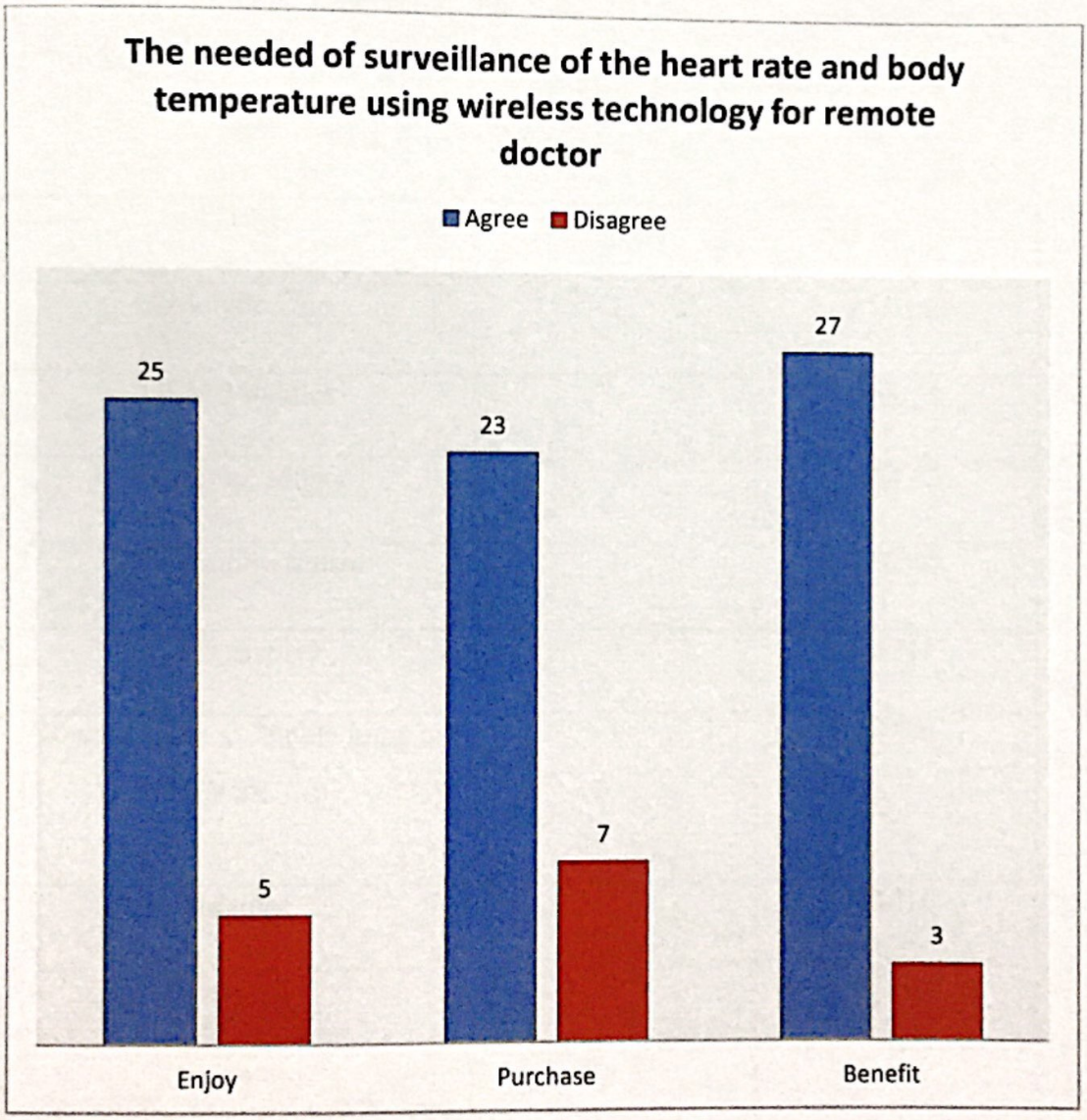


Figure 4.17: Survey analysis (section C)

Figure 4.17 shows the analysis survey for section C. The analysis the needed of Surveillance of heart rate and body temperature using wireless technology for remote doctor show that most of the respondent enjoy use this device. Only a few of

them are not disagreeing with the statement. Other than that, 23 over 30 respondent agree to purchase this product if the product is sell at the market. Besides, 27 out of 30 user said this device give more benefit to user compared the standard device.

4.16 Costing of project

Table 4.3 shows the costing of Surveillance of the Heart Rate and Body Temperature using Wireless Technology for Remote Doctor. The speciality of this device is built with low cost price

TABLE 4.3 : Project costing

Bil	ITEM	PCS	PRICE
1	Arduicno Uno	1	RM 150
2	GSM Modules	1	RM250
3	Heart rate sensor	1	RM 50
4	Temperature sensor	1	RM 50
5	LCD display	1	RM45
6	40ways male to female jumper wire	1	RM20
7	Adapter	1	RM10
8	Batery 16V	1	RM 15
7	Casing box	1	Rm50
8	Sim card	1	Rm10
		TOTAL	RM 650

CHAPTER 5

CONCLUSION AND RECOMMENDATION

As a conclusion, surveillance of the heart rate and body temperature using wireless technology for remote doctor has been successfully developed. There are many advantages with this equipment and new development of the system. Doctor and nurses can monitor the temperature and heart rate remotely for far distance.. It suits with the main propose which is the doctor and guardians can keep track the condition of heart rate and body temperature even the patient at home.

Others than that, the device come with the new design which is small and does not need power supply to use it. Due to the new design , patient will easy to bring the device anywhere .At the hospital doctor still use the patient monitor with big size to check the condition of the patient. With this kind of device, it achieve the first objective which is to design and fabricate surveillance device for heart rate and body temperature for a remote doctor.

Based on the results obtained from the project, it showed that the project achieved the second objective of the implementation. The sensor that applied in this project is successfully detect the body temperature and heart rate measurement of the patient. The reading was shows after the sensor was touched by patient.

Lastly, this device also success to alert medical advisory about patient health condition of via SMS. It fulfils the third objectives which is the short massage service (sms) will send to mobile phone when abnormal reading occur.

RECOMMENDATION

In order to commercialize the device to the public usage, some improvements and recommendation need to be considered. Therefore, for the future works, there are some suggestion and improvement can be added such as :

- more vitals parameters should be added to make it more valuable to the patients. For example, pulse oximeter and blood pressure are added to monitor oxygen concentration and blood pressure of patients.
- Another improvement that can be made in this project is replacing LM35 with the specific temperature sensor of body measurement like thermistor. This might help to make it more functional to the users.
- Besides, an alarm sensor can be implemented to the monitor device to give a warning to the users that condition is critical and dangerous to the health.
- Others than that,use the small arduino to make the pin and wireless in the circuit. Last but not least,add GPS to the device. The function of the GPS is when emergency occur, the doctor will know the location of patient

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APPENDIX

A

APPENDIX A

DATA SHEET OF TEMPERATURE SENSOR

ANALOG DEVICES

Low Voltage Temperature Sensors

TMP35/TMP36/TMP37

FEATURES

Low voltage operation (2.7 V to 5.5 V)
Calibrated directly in °C
10 mV/°C scale factor (20 mV/°C on TMP37)
±2°C accuracy over temperature (typ)
±0.5°C linearity (typ)
Stable with large capacitive loads
Specified −40°C to +125°C, operation to +150°C
Less than 50 µA quiescent current
Shutdown current 0.5 µA max
Low self-heating

APPLICATIONS

Environmental control systems
Thermal protection
Industrial process control
Fire alarms
Power system monitors
CPU thermal management

GENERAL DESCRIPTION

The TMP35/TMP36/TMP37 are low voltage, precision centigrade temperature sensors. They provide a voltage output that is linearly proportional to the Celsius (centigrade) temperature. The TMP35/ TMP36/TMP37 do not require any external calibration to provide typical accuracies of ±1°C at +25°C and ±2°C over the −0°C to +125°C temperature range.

The low output impedance of the TMP35/TMP36/TMP37 and its linear output and precise calibration simplify interfacing to temperature control circuitry and ADCs. All three devices are intended for single-supply operation from 2.7 V to 5.5 V maximum. The supply current runs well below 50 µA, providing very low self-heating—less than 0.1°C in still air. In addition, a shutdown function is provided to cut the supply current to less than 0.5 µA.

The TMP35 is functionally compatible with the LM35/LM45 and provides a 250 mV output at 25°C. The TMP35 reads temperatures from 10°C to 125°C. The TMP36 is specified from −40°C to +125°C, provides a 750 mV output at 25°C, and operates to 125°C from a single 2.7 V supply. The TMP36 is functionally compatible with the LM50. Both the TMP35 and TMP36 have an output scale factor of 10 mV/°C.

FUNCTIONAL BLOCK DIAGRAM

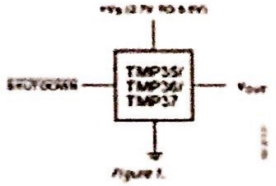


Figure 1.

PIN CONFIGURATIONS

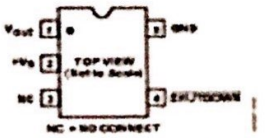


Figure 2. 8-Pin SOT-23

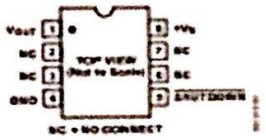


Figure 3. 8-Pin SOIC_N

Figure 4. 3-Pin TO-92

The TMP37 is intended for applications over the range of 5°C to 100°C and provides an output scale factor of 20 mV/°C. The TMP37 provides a 500 mV output at 25°C. Operation extends to 150°C with reduced accuracy for all devices when operating from a 5 V supply.

The TMP35/TMP36/TMP37 are available in low cost 3-lead TO-92, 8-lead SOIC_N, and 5-lead SOT-23 surface-mount packages.

One Technology Way, P.O. Box 9106, Norwood, MA 02062-9106, U.S.A.
Tel: 781.329.4700 www.analog.com
Fax: 781.461.3113

National Semiconductor

November 2000

LM35
Precision Centigrade Temperature Sensors

General Description

The LM35 series are precision integrated-circuit temperature sensors, whose output voltage is linearly proportional to the Celsius (Centigrade) temperature. The LM35 thus has an advantage over linear temperature sensors calibrated in Kelvin, as the user is not required to subtract a large constant voltage from its output to obtain convenient Centigrade scaling. The LM35 does not require any external calibration or trimming to provide typical accuracies of ±¼ C at room temperature and ±¾ C over a full −55 to +150 C temperature range. Low cost is assured by trimming and calibration at the wafer level. The LM35's low output impedance, linear output, and precise inherent calibration make interfacing to readout or control circuitry especially easy. It can be used with single power supplies, or with plus and minus supplies. As it draws only 60 µA from its supply, it has very low self-heating, less than 0.1 C in still air. The LM35 is rated to operate over a −55 to +150 C temperature range, while the LM35C is rated for a −40 to +110 C range (−10 with improved accuracy). The LM35 series is available packaged in hermetic TO-46 transistor packages, while the LM35C, LM35CA, and LM35D are also available in the plastic TO-92 transistor package. The LM35D is also available in an 8-lead surface mount small outline package and a plastic TO-220 package.

Features

- Calibrated directly in ° Celsius (Centigrade)
- Linear + 10.0 mV/° C scale factor
- 0.5 C accuracy guaranteeable (at +25 C)
- Rated for full −55 to +150 C range
- Suitable for remote applications
- Low cost due to wafer-level trimming
- Operates from 4 to 30 volts
- Less than 60 µA current drain
- Low self-heating, 0.08 C in still air
- Nonlinearity only ±¼ C typical
- Low impedance output, 0.1 Ω for 1 mA load

Typical Applications

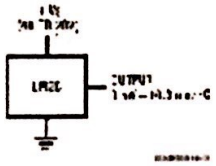
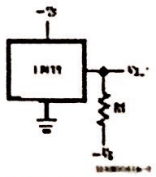


FIGURE 1. Basic Centigrade Temperature Sensor (+2°C to +150°C)



Choose $R_1 = -V_S/50\ \mu A$
V_{OUT} = +1,500 mV at +150°C
= +250 mV at +25°C
= −550 mV at −55°C

FIGURE 2. Full-Range Centigrade Temperature Sensor

APPENDIX

B

APPENDIX B

PROGRAMMING SOURCE CODE

Upload

sketch_may13a

```
/*

VERSION         : 20170417
CHANGE TRACKING : NA
AUTHOR          : Aisyah Azahar
DESCRIPTION     : SMS Temp and Heart Rate at phone doctor  when abnormal reading occur
PARAMETER       : Heart rate and body temperature

*/

#include <SoftwareSerial.h>
#include <LiquidCrystal.h>


SoftwareSerial ss(2, 3); //(RX,TX)


LiquidCrystal lcd(8, 9, 4, 5, 6, 7);
//-----------------------------------------

#define PULSE 10

float RAW[200];
float Sens1;
int Sens1Pin = 1;
float Sens2;
```

```
ss.print(" Temp:");
ss.print(Sens2);
ss.print("c");


delay(200);
Serial.println(char(26));
ss.println(char(26));
delay(4000);
SMSx=2;
}




 }


 if (Sens2>37.8 && BPM > 40 ){
  lcd.setCursor(0, 1);
lcd.print("  FEVER");
delay(500);
 }
```

```
    lcd.print("BPM:");
     lcd.print(BPM);
      }
      if (BPM <= 41){
        lcd.setCursor(0,1 );

lcd.print(" TAKE CARE ");
      }
     countsend=0;

     Beat=0;
     if (BPM < 41){
      BPMx=0;

     }
     if (BPM >=40 && BPM < 120){
    BPMx=BPM;
     }
```

```
ss.print(" Temp:");
ss.print(Sens2);
ss.print("c");
delay(200);
Serial.println(char(26));
ss.println(char(26));
delay(4000);
SMSx=1;
}
}
```

```
  //****************************************************************************
  delay(4);




//-----------------------------------------------------------------------------




// delay(10);
}
```

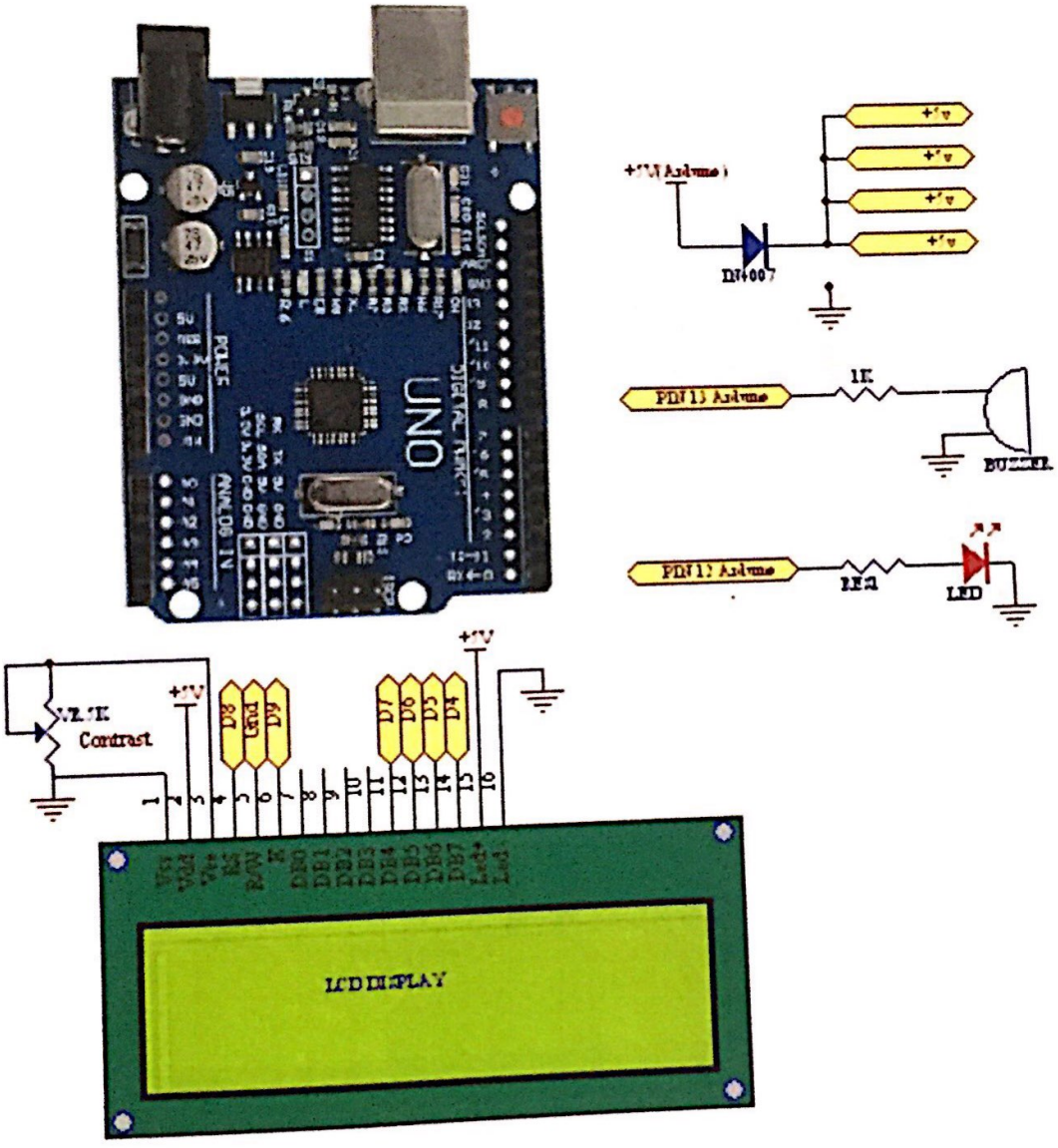
Scanned with CamScanner

APPENDIX

C

APPENDIX C

ARDUINO UNO CIRCUIT DIAGRAM



APPENDIX

D

APPENDIX D

DATA SHEET OF HEART RATE SENSOR

MAX30100

Pulse Oximeter and Heart-Rate Sensor IC for Wearable Health

General Description

The MAX30100 is an integrated pulse oximetry and heart-rate monitor sensor solution. It combines two LEDs, a photodetector, optimized optics, and low-noise analog signal processing to detect pulse oximetry and heart-rate signals.

The MAX30100 operates from 1.8V and 3.3V power supplies and can be powered down through software with negligible standby current, permitting the power supply to remain connected at all times.

Applications

- Wearable Devices
- Fitness Assistant Devices
- Medical Monitoring Devices

Benefits and Features

- Complete Pulse Oximeter and Heart-Rate Sensor Solution Simplifies Design
  - Integrated LEDs, Photo Sensor, and High-Performance Analog Front -End
  - Tiny 5.6mm x 2.8mm x 1.2mm 14-Pin Optically Enhanced System-in-Package
- Ultra-Low-Power Operation Increases Battery Life for Wearable Devices
  - Programmable Sample Rate and LED Current for Power Savings
  - Ultra-Low Shutdown Current (0.7µA, typ)
- Advanced Functionality Improves Measurement Performance
  - High SNR Provides Robust Motion Artifact Resilience
  - Integrated Ambient Light Cancellation
  - High Sample Rate Capability
  - Fast Data Output Capability

APPENDIX

E

APPENDIX E

CONSENT FORM FOR RESPONDENT

Borang Kebenaran

Tajuk kajian: Alat pengawasan kadar jantung dan suhu badan menggunakan teknologi tanpa wayar dari kadar yang jauh

Saya memahami mengenai maklumat kajian ini serta mendapat penjelasan lanjut daripada penyelidik mengenai tujuan penyelidikan termasuk faedah dan risikonya.

Saya _____. No kad pengenalan _____. Nombor telefon _____. "Bersetuju / Tidak Bersetuju" untuk menyertai kajian yang dinyatakan seperti diatas.

Tandatangan.

_____,

Tarikh:

APPENDIX

F

APPENDIX F

SURVEY QUESTIONNAIRE

POLITEKNIK SULTAN SALAHUDDIN ABDUL AZIZ SHAH

POLITEKNIK
Sultan Salahuddin Abdul Aziz Shah
Jabatan Pengajian Politeknik

SURVEY QUESTIONNAIRE – SURVEILLANCE OF THE HEART RATE AND BODY TEMPERATURE USING WIRELESS TECHNOLOGY FOR REMOTE DOCTOR

DISCLAIMER:

This survey is based on final year project of Bachelor of Electronic Engineering (Medical Electronic). The name of this device is Surveillance Of The Heart Rate And Body Temperature Using Wireless Technology For Remote Doctor. The aim of this survey is to understand the device after the pre-survey is done. It can be helpful to improve and to enhance the device in future. It is also to analyze the device in getting the correct readings and measurement. Participation of this survey is completely voluntary and anonymous. You may choose to discontinue this survey at any time. No harm will befall to anyone of the participation. This device is focusing for old folks and paralysed patient. All the data will be recorded and analyzed.

CONSENT:

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

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

SECTION A

1. Are you find that this device is suitable to use?

☐ Yes

☐ No

2. Are you familiar with this device? Do you heard about similar device like this before?

☐ Yes

☐ No

3. Do you understand the function of this device?

☐ Yes

☐ No

4. If this device is in market, do you prefer to have it?

☐ Yes

☐ No

5. Which one of the method did you prefer to check the heart rate and body temperature?

☐ Patient monitor

☐ Surveillance Of The Heart Rate And Body Temperature Using Wireless Technology For Remote Doctor

6. Is this device is suitable to use and help in determining the condition of heart rate and body temperature of patient?

☐ Yes

☐ No

SECTION B

Directions: Please check and rate yourself honestly based on what you actually do given the statements using the following scales:

5 - Very satisfied 4 - Somewhat satisfied 3 - Neither satisfied 2 - Somewhat dissatisfied 1- very dissatisfied

NO	STATEMENTS	5	4	3	2	1
1	Is this device convenient to use?					
2	Is this device gives the accurate readings?					
3	Can this device is safe to use to old folks/paralyzed patient?					
4	Do you agree if this device placed in market of our country?					
5	Do you think this device can minimize the time taken in monitoring of heart rate and body temperature without going to the hospital?					
6	Do you think this device is facilitate and safe to use?					

SECTION C

Please rate how strongly you agree or disagree with each of these statements.

Statements	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
I enjoy using this product.					
This product is safe to use.					
I would purchase this product.					
This product brings more benefit to user.					

Recommendation / Comments:

_____

_____

_____

_____

_____

Signature,

_____

Position: (Doctor / Nurse / Parent / User)

Date:

THANK YOU

APPENDIX

G

APPENDIC G

TESTING DEVICE TO RESPONDENT