

**SMART HEALTH ALERT SYSTEM VIA SMARTPHONE**

**WONG TZE MEI**

**This report is submitted in partial fulfillment of the requirements for  
The Bachelor Degree of Electronics Engineering (Wireless Communication)**

**Faculty of Electronics and Computer Engineering  
Universiti Teknikal Malaysia Melaka (UTeM)**

**June 2013**



**UNIVERSITI TEKNIKAL MALAYSIA MELAKA**  
**FAKULTI KEJURUTERAAN ELEKTRONIK DAN KEJURUTERAAN KOMPUTER**

**BORANG PENGESAHAN STATUS LAPORAN**  
**PROJEK SARJANA MUDA II**

**Tajuk Projek** : Smart Health Alert System via Smartphone

**Sesi Pengajian** : 

1	2	/	1	3
---	---	---	---	---

Saya WONG TZE MEL mengaku membenarkan Laporan Projek Sarjana Muda ini disimpan di Perpustakaan dengan syarat-syarat kegunaan seperti berikut:

1. Laporan adalah hakmilik Universiti Teknikal Malaysia Melaka.
2. Perpustakaan dibenarkan membuat salinan untuk tujuan pengajian sahaja.
3. Perpustakaan dibenarkan membuat salinan laporan ini sebagai bahan pertukaran antara institusi pengajian tinggi.
4. Sila tandakan (    ):
 

<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
--------------------------	--------------------------	--------------------------

**SULIT\***

\*(Mengandungi maklumat yang berdarjah keselamatan atau kepentingan Malaysia seperti yang termaktub di dalam AKTA RAHSIA RASMI 1972)

**TERHAD\*\***

\*\*\*(Mengandungi maklumat terhad yang telah ditentukan oleh organisasi/badan di mana penyelidikan dijalankan)

**TIDAK TERHAD**

Disahkan oleh:

\_\_\_\_\_  
 (TANDATANGAN PENULIS)

\_\_\_\_\_  
 (COP DAN TANDATANGAN PENYELIA)

Tarikh: .....

Tarikh: .....

“I hereby declare that this report is of my own work except for the summaries and excerpts which have been acknowledged.”

**Signature** :  
**Name** : **WONG TZE MEI**  
**Date** : **6<sup>th</sup> JUNE 2013**

“I hereby acknowledge that I have checked this project and in my opinion, this project is sufficient in scope and quality for the award of Degree of Bachelor of Electronics Engineering (Wireless Communication) With Honors.”

**Signature** :

**Name** : ENGR. VIGNESWARA RAO GANNAPATHY

**Date** : 6<sup>th</sup> JUNE 2013

Dedicated to beloved family and friends.

## ACKNOWLEDGEMENT

I would like to express my deepest gratitude to all those who provided me the ability to complete this project successfully. I would like to thank my supervisor, Engr. Vigneswara Rao a/l Gannapathy for the support of my study and research. His guidance helped me in the research and writing of this thesis.

I would also like to express my sincere gratitude towards my team mates, James Teo Jiun Jye and Lim Jia Yin for all the hard works and patience that makes this project successfully done. Besides, I would like to thanks all my friends and course mates for their help and suggestions that assisted me to complete this project too.

Finally, I would like to express my greatest appreciations to my beloved family members for their support over the last few years in my tertiary education.

## ABSTRACT

Heart disease has always been ranked number one killer of Malaysians and still counting. The statistics does not show any decrement but instead, they are showing increment in a shocking rate. Most of the heart disease patient are facing the same problems, which is worrying the condition of their heart and do not know when they will be facing a heart attack. Besides, family members and friends are not able to be by their side all the while to look out for them. This project aims to develop a health alert system via smartphone that is able to alert the patient itself and predefined numbers by sending Short Message Service (SMS) when the heart is in abnormal condition. This project will be using the Bluetooth technology. The Short Message Service (SMS) sent contains important information that show the patient needs immediate help with provided exact location of patient in the form of Longitude and Latitude from the Global Positioning System (GPS) in the smartphone. Immediate help from predefined numbers for example medical teams can be dispatched as soon as possible to the patient. There will also be an alarm system in the patient's smartphone that acts to alerts the people nearby when the patient is facing an abnormality of the heart and needs immediate help. Family members will not have to be too worried as they know that this health alert system will be the guardian angel for the patient. Smart Health Alert System via smartphone helps heart disease patient by providing the role as the heart guardian and eventually helps to prevent the gradual decline in the quality of life of the people.

## ABSTRAK

Penyakit jantung telah menjadi pembunuh nombor satu di dalam kalangan rakyat Malaysia untuk jangka masa yang panjang dan masih di kedudukan yang sama. Statistik tidak menunjukkan sebarang susutan tetapi sebaliknya, menunjukkan peningkatan dalam kadar yang mengejutkan. Kebanyakan pesakit penyakit jantung menghadapi masalah yang sama iaitu risau terhadap keadaan hati mereka dan tidak mengetahui bila mereka akan menghadapi serangan penyakit jantung. Tambahan pula, ahli keluarga dan rakan-rakan tidak dapat berada di sisi untuk mengawasi mereka. Tujuan projek ini adalah untuk mewujudkan satu sistem amaran kesihatan melalui telefon pintar yang mampu untuk memberi amaran kepada pesakit tersebut dan nombor telefon yang telah ditetapkan dengan menghantar Khidmat Pesanan Ringkas (SMS) apabila jantung dalam keadaan yang tidak normal. Projek ini akan menggunakan teknologi Bluetooth. Khidmat Pesanan Ringkas (SMS) yang dihantar itu mengandungi maklumat penting yang menunjukkan pesakit memerlukan bantuan segera dengan menyediakan lokasi tepat pesakit dalam bentuk Longitud dan Latitud daripada Sistem Kedudukan Global (GPS) dalam telefon pintar. Bantuan segera daripada nombor yang telah ditetapkan contohnya, pasukan perubatan boleh menghantar bantuan secepat mungkin. Telefon pintar pesakit juga mempunyai satu sistem penggera yang berfungsi untuk menarik perhatian orang berdekatan apabila pesakit menghadapi masalah jantung dan memerlukan bantuan segera. Ahli keluarga tidak perlu terlalu bimbang kerana mereka tahu bahawa sistem amaran kesihatan ini mampu menjadi malaikat kepada pesakit. Sistem kesihatan melalui telefon pintar ini mampu membantu pesakit dengan menjadi penjaga jantung dan secara tidak langsung mencegah kemerosotan dalam kualiti hidup rakyat.



## CONTENT

CHAPTER	TITLE	PAGES
	<b>PROJECT TITLE</b>	<b>i</b>
	<b>STATUS REPORT FORM</b>	<b>ii</b>
	<b>SUPERVISOR’S DECLARATION</b>	<b>iii</b>
	<b>STUDENT’S DECLARATION</b>	<b>iv</b>
	<b>DEDICATION</b>	<b>v</b>
	<b>ACKNOWLEDGEMENT</b>	<b>vi</b>
	<b>ABSTRACT</b>	<b>vii</b>
	<b>ABSTRAK</b>	<b>viii</b>
	<b>CONTENT</b>	<b>ix-xi</b>
	<b>LIST OF TABLES</b>	<b>xii</b>
	<b>LIST OF FIGURES</b>	<b>xiii</b>
	<b>LIST OF ABBREVIATIONS</b>	<b>xiv-xv</b>
<b>1</b>	<b>INTRODUCTION</b>	<b>1</b>
	1.1 Project Background	1
	1.2 Problem Statement	2
	1.3 Project Objectives	3
	1.4 Scope of Study	4
	1.5 Brief Methodology Explanation	5
	1.6 Structure of Report	6

		x
<b>2</b>	<b>LITERATURE REVIEW</b>	<b>7</b>
2.1	Human Heart	7
2.2	Sensor	9
2.3	Smartphone	11
2.4	PIC16F877A Microcontroller	14
2.5	Bluetooth Bee Module	18
2.6	LM1117 Voltage Regulator	25
2.7	LM7805 Voltage Regulator	26
2.8	Short Message Service (SMS)	27
2.9	Global Positioning System (GPS)	29
2.10	Bluetooth Technology	32
2.11	Existing Project	33
	2.11.1 Baptist Heart Institute Investigates Early Heart Detection Device (United States, February 2008)	33
	2.11.2 Portable Device Can Detect Heart Attacks (Arab, 10 <sup>th</sup> September 2002)	34
	2.11.3 New Device Can Detect Heart Attacks Early (Miami, 9 <sup>th</sup> April 2012)	35
	2.11.4 Tiny Implant Chip Could Detect Heart Attacks Before They Happen (Switzerland, 21 <sup>st</sup> March 2013)	36
<b>3</b>	<b>METHODOLOGY</b>	<b>37</b>
3.1	Methodology	37
3.2	Project Flowchart	39
	3.2.1 Development of Hardware	40
	3.2.2 Development of Software	40

<b>4</b>	<b>RESULTS AND DISCUSSION</b>	<b>41</b>
4.1	Results	41
4.1.1	Description of Project	41
4.2	Hardware	44
4.2.1	Controller Unit	44
4.3	Software	47
4.3.1	C Compiler Written in C Language	47
4.3.2	Eclipse Written in Java	47
4.4	Outcome	49
4.4.1	Prototype	49
4.4.2	Application in Smartphone	51
4.5	Comparisons Among Existing Inventions	56
<b>5</b>	<b>CONCLUSION AND RECOMMENDATION</b>	<b>58</b>
5.1	Conclusion	58
5.1.1	Why Smart Health Alert System (SHAS) is important?	58
5.2	Achievements	60
5.3	Recommendations	61
5.3.1	Potential of Commercialization	61
5.3.2	Research Advancement	62
	<b>REFERENCES</b>	<b>63</b>

**LIST OF TABLES**

<b>TABLE</b>	<b>TITLE</b>	<b>PAGE</b>
2.1	List of Android versions	13
2.2	Monitor station command codes	15
2.3	Monitor station message codes	16
2.4	Internal interrupts used in PIC16F877A program	17
2.5	The specifications of the Bluetooth Bee module used	19
2.6	Status of Light Emitting Diode (LED)	20
2.7	Pin function	20
2.8	Test	22
2.9	Reset	22
2.10	Get Bluetooth module address	22

## LIST OF FIGURES

<b>FIGURE</b>	<b>TITLE</b>	<b>PAGE</b>
2.1	Metria patch-based wearable sensor	10
2.2	Datasheet of PIC16F877A	14
2.3	Bluetooth Bee module	18
2.4	Bluetooth Bee module on SKXBee-board	21
2.5	Bluetooth Bee module and dongle communication	23
2.6	LM1117 voltage regulator	25
2.7	LM7805 voltage regulator	26
2.8	Signals from multiple satellites to calculate a position	30
2.9	AngelMed Guardian device	35
3.1	Flowchart of the project	39
4.1	Flow diagram of the project	42
4.2	Circuit design of controller unit	44
4.3	Circuit design of controller unit PCB	45
4.4	3D visualization circuit design of controller unit PCB (front)	46
4.5	3D visualization circuit design of controller unit PCB (back)	46
4.6	Prototype of the Smart Health Alert System (SHAS)	50
4.7	Front page of the Smart Health Alert System (SHAS)	51
4.8	Menu page of the Smart Health Alert System (SHAS)	52
4.9	Discoverable page of the Smart Health Alert System (SHAS)	53
4.10	Emergency alert page of the Smart Health Alert System (SHAS)	54
4.11	Short Message Service (SMS) to patient	55
4.12	Short Message Service (SMS) to predefined numbers	55
5.1	Flow diagram without Smart Health Alert System (SHAS)	59
5.2	Flow diagram with Smart Health Alert System (SHAS)	60

## LIST OF ABBREVIATIONS

SHAS	-	Smart Health Alert System
SMS	-	Short Message Service
GPS	-	Global Positioning System
SDK	-	Software development kit
OS	-	Operating system
bpm	-	beats per minute
MI	-	Myocardial Infarction
AMI	-	Acute Myocardial Infarction
GND	-	Ground
ADC	-	Analog to digital converter
PDA	-	Personal Digital Assistant
LAN	-	Local Area Network
apps	-	Applications
A/D	-	Analog-to-Digital
SPI	-	Serial Peripheral Interface
I <sup>2</sup> C	-	Inter-Integrated Circuit
USART	-	Universal Asynchronous Receiver Transmitter
LED	-	Light Emitting Diode
SME	-	Small and medium enterprises
GSM	-	Global System for Mobile Communications
ETSI	-	European Telecommunications Standards Institute
1G	-	First generation
2G	-	Second generation
GPRS	-	General Packet Radio Services
EDGE	-	Enhanced Data rates for GSM Evolution
3GPP	-	3 <sup>rd</sup> Generation Partnership Project

3G	-	Third generation
UMTS	-	Universal Mobile Telecommunication System
4G	-	Fourth generation
LTE	-	Long Term Evolution
SMSC	-	Short Message Service Center
HLR	-	Home location register
DoD	-	Department of Defense
SS	-	Space segment
CS	-	Control segment
US	-	User segment
DGPS	-	Differential Global Positioning System
RF	-	Radio frequency
ISM	-	Industrial, Scientific and Medical
SIG	-	Special Interest Group
EPFL	-	Swiss Federal Institute of Technology in Lausanne
PCB	-	Printed Circuit Board

**APPENDIX**

<b>NO</b>	<b>TITLE</b>	<b>PAGE</b>
A	Android Manifest of ACN Application	66
B	“Menu.java”	69
C	“SMS.java”	74
D	“Standby.java”	77



## **CHAPTER 1**

### **INTRODUCTION**

This chapter discussed about the project background, the problem statements of the project, objective of the project and scope of work.

#### **1.1 Project Background**

Smart Health Alert System (SHAS) functions as an intelligent system that works together with a smartphone. The Smart Health Alert System (SHAS) via smartphone creates a system that has a sensor to sense any irregular condition of the patient's heart and will automatically send Short Message Service (SMS) to predefined numbers such as the patient itself, family members and medical teams to alert them about the patient heart's condition.

The exact location of where the patient is currently at, in the form of Longitude and Latitude provided by the Global Positioning System (GPS) will also be included into the Short Message Service (SMS) to aid the medical team to reach to the patient within the golden time.

The Smart Health Alert System (SHAS) via smartphone is a cost effective and useful health alert system that helps the patient to monitors the heart's condition and

eventually helps to prevent the gradual decline in quality of life of the people. This smart system will be established by using the Bluetooth technology. Through this system, patients will be alert about their heart's condition anytime and anywhere.

With this system, patient can be independent as their family members, friends and health consultants do not have to worry for not being by patient's side all the time to make sure that patient is fine. This Smart Health Alert System (SHAS) is beneficial as it decreases the risk of death in people's life.

## **1.2 Problem Statement**

For more than three decades of periods, the heart problem has been the number one killer of Malaysians. The statistics shows no signs of decrement of the numbers of people died because of heart problem. Unfortunately, the numbers are actually increasing at a quite shocking rate. In Malaysia, there are 10 million of people who have unhealthy cholesterol level in their body, one out of five Malaysian will be suffering from diabetic and about 50% of the Malaysians are suffering from obesity. All of these people are exposed to high risks of having heart problem [1].

Patients who had heart problem are worried about their heart condition almost every minute. Some of them might need to spend most of their time in the hospitals and most of them could not enjoy their daily routine. They need more attention and care for their heart's condition. Heart problem attacks its victims suddenly but sometimes "silently". There is no proper system to help patients to understand the condition of the heart by themselves.

Most of the patients do not know when the heart will be having problems again that may cause damages to the heart muscle or even lead to death. There are no special devices or anyone to tell them about how the current condition of their heart. Therefore, heart attack patients with history should go for regular check-up for their heart but they usually forget or missed the appointment. This might caused their heart to become worse day by day.

It is hard for the family members, friends or the health care providers to know the exact condition of the patient's heart as they are not besides them all the time to check on their condition.

Besides, there is no proper way to identify the location of the patient who is suffering from a heart attack so no help can be sent to them as soon as possible. The patient itself is also unable to notify those around them that he is suffering from heart attack and unable to get immediate help within golden hour which is the first hour after the onset of heart attack [2].

### **1.3 Project Objectives**

- a) To develop a health alert system via smartphone that monitors the condition of the heart.
- b) To study Short Message Service (SMS) functionality and create a system that will automatically send the Short Message Service (SMS) to predefined numbers when the sensor detects any irregular condition of the patient's heart.
- c) To study on Global Positioning System (GPS) and create a system that is able to locate the exact location of patients who is suffering a heart attack.
- d) To study on an alarm system that alerts the people around patient through smartphone when patient is suffering a heart attack.

## 1.4 Scope of Study

The scope of this project comes in a few categories as stated:

- a) Develop an Android software program for the smart health alert system by using the Eclipse software development kit (SDK) written in Java. This software program will be used by modern smartphones with Google's Android mobile operating system (OS).
- b) Create the pairing of BlueBee with smartphone through Bluetooth technology where users need to activate the system before using it and once system is triggered, it will automatically sends Short Message Service (SMS) to predefined numbers.
- c) Global Positioning System (GPS) that will provide the exact location of the patient in Longitude / Latitude and be included in the Short Message Service (SMS).
- d) Short Message Service (SMS) that will be automatically sent to predefined numbers which can be easily changed or updated, functions to remind about heart's condition and alerts if any medical help is needed.
- e) Alarm system that is able to catch people's attention through audible and visible notification to notify them about the patient who needs help.

## 1.5 Brief Methodology Explanation

The methodology will begin with the start process. Then, it flows to the literature review process where the studies on the human heart, sensors, smartphone, PIC16F877A microcontroller, BlueBee device, Short Message Service (SMS), Global Positioning System (GPS) in Longitude/Latitude and Bluetooth technology are done.

Next, it will continue with the software and hardware development in parallel. On the software part, the studies on Eclipse software development kit (SDK) written in Java, Short Message Service (SMS), Global Positioning System (GPS) in Longitude/Latitude and Bluetooth technology concept will be done while on the hardware part, the sensors, PIC16F877A microcontroller, BlueBee device and Android smartphone will be reviewed.

These software and hardware will undergo the integration process to check for compatibility. If the compatibility is successful, it will proceed to the next process which is the testing and troubleshooting process. If the compatibility is unsuccessful, the integration process will be repeated until it succeeded.

In the testing and troubleshooting part, test runs will be conducted to check for stability and functionality. It will then proceed to the verification process where the output will be confirmed for accuracy and results. Lastly, it stops at the end process.

## 1.6 Structure of Report

In Chapter 1, the introduction is a brief overview of the whole project that has been carried out. The importance of the projects and the main perspectives of the researches are explained too. As for the objectives of the project, the list to be achieved are listed and described in detail. The problem statements will discuss about the issues related to the project conducted in order to find the suitable solutions to solve and improve the existing situation. The scope of study of the project are well stated which includes limitations or restrictions of the project, other materials or equipments that covers software and hardware.

In Chapter 2, the literature review of the researches made for the project were explained in order to consider the critical points of the current knowledge of the findings which includes theoretical studies. Studies on the existing projects which have some similarity with the proposed project were briefly explained too.

In Chapter 3, the methodology of the proposed project will be used as the guideline system to help to solve the problems faced while handling this project. Specific ways and ideas in order to make this project successful were implemented.

In Chapter 4, the final output from the project was explained and discussed. The analysis of the software and hardware were also discussed too. The Graphic User Interface (GUI) of the project was shown in the result part. Comparisons between the existing projects and the proposed project were made.

In Chapter 5, the conclusion of the proposed project was discussed and recommendations towards the project were suggested.

## **CHAPTER 2**

### **LITERATURE REVIEW**

This chapter will discuss about the reviews of the researches done which is related to this project. There are project reviews on the human heart, sensors, smartphone, PIC16F877A microcontroller, BlueBee device, Short Message Service (SMS), Global Positioning System (GPS) in Longitude/Latitude, Bluetooth technology concept and existing project.

#### **2.1 Human Heart**

The heart is one of the most valuable organs in the human body. It functions as a pump, hollow muscle that pumps blood throughout the blood vessels by repeated and rhythmic contractions. A heart is principally composed of cardiac muscle and connective tissue. Cardiac muscle is an involuntary striated muscle tissue found only in this organ and responsible for the ability of the heart to pump blood.

The walls of a human heart are made up of three layers while the cavity is divided into four parts. The two upper chambers are called the left and right atria while the two lower chambers are called left and right ventricles. It is the atria that draw the

blood from the lungs and other parts of the body while the ventricle is the one that pump it to the lungs and other parts of the body.

Heart beats approximately 72 times per minute to pumps blood which carries all the vital materials that helps human bodies function and removes waste materials that the body does not need. With the average heart rate of 72 beats per minute (bpm), the heart is able to pump about 5 liters of blood per ventricle or about 10 liters of blood total per minute. If the heart ever discontinues to pumps blood, the body will start to shut down and after a very short period of time the human will die [3].

The human heart as one of the most important organs in the human body provides a continuous blood circulation through the cardiac cycle. Heart pumps about 80cc of blood per heart beat. A normal heart rate is 60 to 100 heart beats per minute (bpm) [4]. During a heart attack, the heart rate becomes slow; below 60 heart beats per minute (bpm).

Heart disease could be silent in the early stage. Heart attack occurs when the blood supply could not reach to a part of the heart, causing heart cells to die: usually due to blockage of coronary artery. There are a few symptoms of a heart attack that includes discomfort or pain in the chest and arm, heartburn, sweating or vomiting, shortness of breath and irregular or rapid heartbeats.