

DEVELOPMENT OF A PC INTERFACED BLOOD PRESSURE METER (E-BPMS)

IDA LAILA BINTI AHMAD

UNIVERSITI TEKNOLOGI MALAYSIA

PERPUSTAKAAN UTHM



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UNIVERSITI TEKNOLOGI MALAYSIA

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(e-BPMS)

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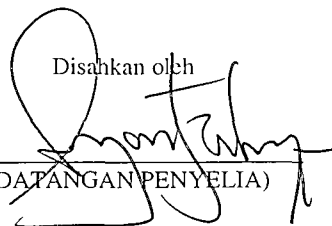
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JALAN LENCONG BARAT,
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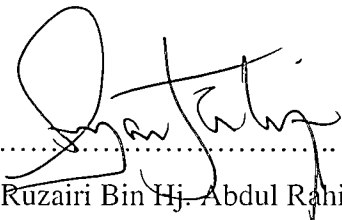
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Signature	:	
Supervisor	:	Prof. Dr. Ruzairi Bin Hj. Abdul Rahim
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DEVELOPMENT OF A PC INTERFACED BLOOD PRESSURE METER
(e-BPMS)


IDA LAILA BINTI AHMAD

A project report submitted in partial fulfilment of the
requirements for the award of the degree of
Master of Engineering (Electrical-Electronics & Telecommunications)

Faculty of Electrical Engineering
Universiti Teknologi Malaysia

MAY 2006

I declare that my project report entitled “*Development of a PC Based Blood Pressure Meter (e-BPMS)*” is the result of my own research except as cited in references. The project report has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

Signature : 

Name : Ida Laila binti Ahmad

Date : May 2006

*To my beloved parents; Encik Ahmad Bin Shapii and Puan Aslinah Masran,
thanks for encouragement and never ending support.*

*My dearest sisters; Ida Liyani and Ida Farhana Afiqah credits go to both of
you for all the joyous moments.*

*And for my great hearted fiancé; Redzuan Shah Bin Yussoff, my deepest
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understanding.*

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ABSTRACT

Blood pressure meter is an essential instrument to determine our blood pressure status. Nowadays, there are various types of blood pressure meter available manufactured from various companies. In order to meet the demand on telemedicine and technology advancement, a new form of blood pressure meter is desirable. This prototype of blood pressure meter is interfaced with a personal computer (PC) which able to simulate the measurement process in real time. The proposed system was named e-BPMS (Electronic Blood Pressure Measurement System) suggests the usage of both hardware and software in determining blood pressure reading. Hardware elements operate on oscillometric principle which gives the results in terms of systolic, diastolic and MAP (Mean Arterial Pressure). Furthermore, these results will be presented and simulated on the software end. e-BPMS graphical user interface (GUI) was developed by using Visual Basic 6.0 (VB6) language which highlights the user friendly attributes. Moreover, the simulated waveform will evaluate the blood pressure and gives beneficial advises in term of controlling blood pressure to be optimal. This application shows significant improvement on the overall performance and gives reliable results. The framework used to design e-BPMS is easy to understand and it can be extended further to endorse new application area.

ABSTRAK

Alat mengukur tekanan darah adalah penting untuk memberikan status kesihatan tekanan darah seseorang individu. Kini, terdapat pelbagai jenis alat mengukur tekanan darah yang beroperasi menggunakan teknik-teknik yang berlainan dikilangkan oleh pelbagai pengeluar. . Kepsatan perkembangan teknologi pada masa ini untuk mencapai aplikasi Tele-Perubatan menyebabkan keperluan untuk mencipta satu alat mengukur tekanan darah yang baru meningkat. Projek ini bertujuan untuk mencadangkan satu alat mengukur tekanan darah yang baru menggunakan prinsip osilometrik di mana ianya dihubungkan dengan komputer peribadi dan boleh mamaparkan simulasi bagaimana tekanan darah seseorang ditentukan. Prototaip alat mengukur tekanan darah ini dinamakan e-BPMS iaitu singkatan untuk “Sistem mengukur tekanan darah elektronik”. Sistem ini boleh dibahagikan kepada dua elemen iaitu “hardware” dan juga “software”. “Hardware” akan memberikan keputusan analisis dalam bentuk bacaan sistolik, diastolik dan juga purata tekanan arteri. Seterusnya bacaan ini akan dipaparkan oleh “software” yang telah diprogramkan menggunakan bahasa pengaturcaraan “Visual Basic 6.0” (VB6) pada komputer. Hasil prototaip ini berjaya memberi keputusan yang tepat dan berjaya memenuhi objektif projek ini dan ianya boleh diperbaiki lagi di masa akan datang.

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LIST OF SYMBOLS/ ABBREVIATIONS

<i>A/D</i>	-	Analog-Digital
<i>AAMI</i>	-	Association of Advancement Medical Instrumentation
<i>ABPM</i>	-	Ambulatory Blood Pressure Monitoring
<i>ADC</i>	-	Analog to digital Converter
<i>AHA</i>	-	American Health Association
A_p	-	Attenuation
<i>ASCII</i>	-	American Standard Code for Information Interchange
<i>atm</i>	-	Atmospheric unit (pressure measurement)
<i>CMOS</i>	-	Complementary MOSFET
<i>COM</i>	-	Component Object Model
<i>CP</i>	-	Cuff Pressure signal
<i>CPU</i>	-	Central Processing Unit
<i>CTS</i>	-	Clear To Send
<i>DIY</i>	-	Do It Yourself
<i>DSR</i>	-	Data Set Ready
<i>DTR</i>	-	Data Terminal Ready
<i>e-BPMS</i>	-	Electronic Blood Pressure Measurement System
<i>EIA/TIA-232E</i>		Serial Communication Standard
<i>EMI</i>	-	Electromagnetic Induced Voltage
<i>FET</i>	-	Field Effect Transistor
<i>GND</i>	-	Ground
<i>GPIB</i>	-	General Purpose Interface Bus
<i>GUI</i>	-	Graphical User Interface
<i>Hz</i>	-	Hertz (unit of frequency)
<i>LCD</i>	-	Liquid Crystal Display

<i>MAP</i>	-	Mean Arterial Pressure
<i>mmHg</i>	-	Unit millimeter mercury
<i>MOSFET</i>	-	Metal Oxide Semiconductor FET
<i>MS Chart</i>	-	Microsoft Chart (ActiveX function)
<i>MS Comm.</i>	-	Microsoft Communication (ActiveX function)
<i>MSC</i>	-	Multimedia Super Corridor
<i>NIBP</i>	-	Non Invasive Blood Pressure
<i>Pa</i>	-	Pascal unit (pressure measurement)
<i>PC</i>	-	Personal Computer
<i>PIC</i>	-	Peripheral Interface Controller
<i>RC</i>	-	Resistor-Capacitor
<i>RS-232</i>	-	Serial Communication Protocol
<i>RTS</i>	-	Request to Send
<i>R_{XD}</i>	-	Received data
<i>SI</i>	-	International System (unit of measurement)
<i>SPBRG</i>	-	Baud rate generator
<i>TTL</i>	-	Transistor-Transistor Logic
<i>T_{XD}</i>	-	Transmit data
<i>UART</i>	-	Universal Asynchronous Receiver/Transmitter
<i>V</i>	-	Volt (unit of voltage)
<i>VB6</i>	-	Visual Basic 6.0
<i>V_{DC}</i>	-	Direct current Voltage
<i>V_{out}</i>	-	Voltage output
<i>V_s</i>	-	Voltage Supply
<i>WHO</i>	-	World Health Organization

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CHAPTER 1

INTRODUCTION

1.1 Background

Blood pressure is one of most important measurements which indicate person's health condition. Abnormal blood pressure reading may lead to various diseases which can be prevented by treatment. Blood pressure related diseases are usually being referred as "silent killer". The consequence promoted can be either cardiac disorder or the malfunctions of our body systems. Considering these huge effects may be too harmful for human body, thus preventive action needs to be taken. High blood pressure is an epidemic disease which always a major concerns in developed countries. Statistic shows the great number of cases for the past decades, which triggers the insight to prevent and control this disease rather than cure it. Nowadays, the need for a reliable medical technologies and analysis is desirable, since the users prefer to experience their medical diagnosis themselves. Home monitoring provides an accurate record of measurements over time helps in planning an overall personal health regimen. Furthermore, blood pressure management is a step towards a healthier lifestyle.

1.2 Theory

1.2.1 Blood pressure

Blood pressure is defined as the pressure of the blood against the walls of the arteries. It is the resultant of two forces. One is created by the heart as it pumps blood into the arteries and through the circulatory system. The other is the force of the arteries as they resist the blood flow. Blood pressure is measured in millimeters of mercury (mmHg) and recorded as two numbers systolic pressure "over" diastolic pressure. For example, the doctor might say "130 over 80" 130/80 mmHg as a blood pressure reading. The measurement is taken when the doctor puts the cuff around patient's arm and pumps it up.

The pressure exerted by the cuff will block the blood flow in the vessel. As the pressure is released slowly, blood starts to flow again and the doctor can hear the flow using a stethoscope. The number at which blood starts flowing again is recorded as maximum output of pressure of the heart (systolic). Then, the doctor will continue releasing the pressure of the cuff and listens until there is no sound. The number (80) indicates the pressure in the system when the heart is relaxed (diastolic).

According to American Heart Association (AHA), optimal blood pressure with respect to cardiovascular risk is less than 120/80 mmHg. However, unusually low readings should be evaluated to rule out medical causes. If the patient exhibits low readings every measurements, there is a potential of having low blood pressure (hypotension). The systolic pressure of 120 to 139 mmHg or diastolic pressure of 80 to

89 mmHg is considered as at risk of having high blood pressure (pre hypertension). Furthermore, blood pressure reading of 140/90 mmHg is considered elevated high (hypertension). The range of blood pressure recommended by AHA is summarized in the Table 1.1 below.

Table 1.1: Blood pressure classification for adults given by AHA

Category	Systolic (mmHg)	Diastolic (mmHg)
Normal	< 130	<85
High Normal	130-139	85-89
Hypertension		
Stage 1 (mild)	140-159	90-99
Stage 2 (moderate)	160-179	100-109
Stage 3 (severe)	108-209	110-119
Stage 4 (very severe)	≥ 210	≥ 120

Blood pressure reading is known to be varied between one people to another. It is recommended by AHA that ideally, blood pressure must be checked at least twice a year and it should be more often if it is high. Some of the factors affecting blood pressure can be classified into several categories concerning physiological, gender, lifestyles and many others. The elaboration of these factors will be in following section.

1.2.2 Factors contributing to blood pressure diseases

Firstly is the elasticity of blood vessel determines the amount of blood flow at one time. The nature of blood vessel changes as we age, as the vessel gets thicker, the