

PORTABLE DIGITAL BLOOD PRESSURE MONITOR

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DEDICATION

To my beloved parents: Encik Yahaya bin Mohd Yaakop and Puan Sekaniah binti Basuni, thanks for encouragement and never ending support. May Allah (S.W.T) always bless of you forever.

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ABSTRACT

Portable Digital Blood Pressure Monitor is a project to sense the human blood pressure who have controlled by the microcontroller PIC16F877A. Basically, 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 Tele – Medicine and technology advancement, a new form of blood pressure meter is desirable. The existing products in the current market are using variety of controller where the cost is higher. In this project, PIC is used that able to simulate the measurement in real time. The combination of hardware and PIC programming can be determine of blood pressure readings that integrated with pressure sensor. The combination element operates on oscillometric principle which gives the results in terms of systolic and diastolic reading. At the end of this project, the blood pressure that portable and affordable price to consumer is produced.

ABSTRAK

Projek Pengukur Tekanan Darah Digital Mudah alih ini digunakan untuk mengesan tekanan darah manusia yang dikawal oleh pengawal mikro iaitu PIC 16F877A. Secara asasnya, meter alat tekanan darah ini diperlukan bagi menentukan tahap tekanan darah seseorang individu. Pada masa kini, terdapat pelbagai jenis alat pengukur tekanan darah yang terdapat di pasaran yang dikeluarkan oleh pelbagai syarikat. Oleh itu, selaras dengan perkembangan teknologi pada masa kini yang menuju ke arah aplikasi Tele – Perubatan menyebabkan keperluan untuk mencipta projek ini meningkat mengikut keperluan. Kebanyakan produk yang terdapat di pasaran menggunakan pelbagai jenis pengawal yang harganya sangat mahal. Untuk projek ini, PIC digunakan kerana ia berupaya untuk simulasi pengukuran dalam masa nyata. Gabungan perkakasan dan pengaturcaraan PIC membolehkan bacaan tekanan darah yang disambungkan dengan pengesan tekanan. Hasil gabungan kedua – dua elemen ini membolehkan ia beroperasi pada prinsip oscillometri yang mana ia dapat membaca bacaan sistolik dan diastolik. Di akhir projek ini, satu alat pengukur tekanan darah dapat dihasilkan di mana ia adalah mudah alih dan mempunyai harga yang mampu dimiliki oleh pengguna.

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LIST OF SYMBOLS/ ABBREVIATIONS

AHA	-	American Heart Association
ADC	-	Analog to Digital Converter
CP	-	Cuff Pressure Signal
DC	-	Direct Current
DMM	-	Digital Multimeter
DIP	-	Dual Inline Package
DIY	-	Do it Yourself
FET	-	Field Effect Transistor
FSR	-	File Select Register
INDF	-	Indirect Register
KPA	-	Pascal Unit (Pressure)
LCD	-	Liquid Crystal Display
LED	-	Light Emitting Diode
MA	-	Medical Assistant
MAP	-	Mean Arterial Pressure
MCU	-	Microcontroller
MMHG	-	Milimeter s of Mercury
PIC	-	Peripheral Interface Controller/ Programmable Intellegent Computer
RAM	-	Random Access Memory
RC	-	Resistor – Capacitor
USB	-	Univrsal Serial Bus

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CHAPTER I

INTRODUCTION

This chapter will explain about the overview of the project, the objectives of the project, problem statement, scope of the project, project methodology and thesis outline to complete this project.

1.1 Project Overview

This project is to design and build a portable blood pressure monitor device that can measure blood pressure and heart rate by using cuff and bladder. This device has three main parts, external components such as cuff, valve, rubber ball, LCD, analog circuit and microcontroller.

The analog circuit is use to convert the pressure value inside the cuff into readable and usable analog waveforms. The Microcontroller Unit (MCU) samples the waveforms and will perform Analog to Digital Converter (ADC) to further calculations. The MCU also controls the operation of the components such as the ON/OFF button and Liquid Crystal Display (LCD). The outputs of this project are “*systolic*” and “*diastolic*” of blood pressure and heart rate. This project will be designed as a portable device.

Nowadays the people very alert about their healthy. By using this device, it's make the life easier to check or measure their blood pressures and heart rate. This project will be applied to the future medical gadget with affordable price.

1.2 Objective of the Project

The main objective of this project is to design a Portable Digital Blood Pressure (*Digital Sphygmomanometers*) with affordable price that can do by own self or another word known as Do It Yourself (DIY).

1.3 Problem Statement

Basically, digital blood pressure is uses in the Healthcare Centre and monitored by experience person such as a doctor, nurse or medical assistant (MA). Therefore, people have to check their blood pressure level at the nearby clinic or hospital. As a result, this project will solve the problem with friendly features and affordable price. So, by using this digital blood pressure monitor people can check by their own health conditions, save more money and time.

1.4 Scopes of Project

In this project there have three main parts. The first part is to identify the external hardware that will be used such as cuff, motor, valve and LCD. The pressure sensor uses to detect the point of systolic and diastolic and process in the Microcontroller Unit (MCU). The PIC16F877A is used to control all the input and output devices such as the A/D conversion and calculation, until the measurement is completed. All the measurement will be displayed on the LCD.

The second part is to design the circuits that include the microcontroller circuit, amplifiers and voltage regulator. All the circuit will combine together and operate by supply +5 Volts input voltage. The important part is the microcontroller circuit who receives the input before produce the output.

The last part is to program the microcontroller to monitors the tiny pulsations of the pressure in the cuff. This part is very hard to determine because there are two different measurements, systolic and diastolic. In systolic reading, pump and valve are the important part to determine the measurement. Air in the cuff as the input and it pressure was proportion to the voltage. In this condition, pressure sensor senses the pulse in for a moment before the microcontroller read the input voltage. Then, the value of voltage will compare with the measurement in hexadecimal value to produce the systolic reading on the LCD. When the cuff starts to deflate, the voltage also decreases. The blood begins to flow through the arm and diastolic measurement can be obtained. All the process controlled by the microcontroller and the measurement finished.

Basically, this project combined the hardware and programming to control the input and the output. There are processes of simulation are done by using software such as MultiSim 2001 for amplifier, band pass filter and voltage regulator. In designing currently, Proteus 7.0 is used and C Compiler is used for writing the in C language.

1.5 Project Methodology

There are several methods in order to finish this project and achieve the objective. The first method that used is literature review about the components that will be used included the Microcontroller Unit (MCU), hand cuff, switch, LCD, pressure sensor, amplifier, 9V to +5V Voltage regulator, resistors, capacitors, LED, rubber ball and valve. Then, the blood pressure must design in portable, small and reduce the production cost.

The second method is Microcontroller programming. The program is difficult part to design because it will integrate with the hardware before show the result on the LCD. To ensure that the coding is proper function, simulation on C Compiler and Proteus 7.0 are used. As the result, the error will fix before the hex file read to the PIC16F877A.

The last part is hardware and software integration. The programming must be able to integrate with the Microcontroller circuit. This part is very important because the device can measure the systolic, diastolic and heart rate. Totally, this project can measure human blood pressure as accurate as the existing product in the market.

1.6 Outline of Thesis

This thesis consists of five chapters where the first chapter discusses about the introduction of the project, the main objective, problem statement, scope of the project and the methodology that use to complete the project. Chapter 2 will discuss more on theory and literature reviews that have been done. This part also consists of blood pressure reading, the measurement method that will use and the components that use to design this project included hardware and software.

In Chapter 3, the discussion will be on the methodology hardware and software implementation. The result and discussion will be presented in Chapter 4. Chapter 5 is discussing the conclusion and recommendation of this project and future work that can be done.

CHAPTER II

LITERATURE REVIEW

2.1 Introduction

Blood pressure, which is basically the force that blood exerts on the inner walls of a vessel, is an important determinant in the flow of blood in the body. When the heart is contracting during ventricular systole, the maximum pressure exerted against the walls of the arteries is systolic pressure. During relaxation of the ventricle, the pressure that results is termed diastolic pressure. These pressures are measured in millimeters of mercury (*mmHg.*). The typical adult blood pressure is 120/80 mmHg. Young people may have lower values.

Blood pressure is one of most important measurements which indicate person's health condition. Abnormal blood pressure reading may indicate diseases which can be prevented by treatment. Blood pressure usually known as “silent killer” that can be either cardiac disorder or the malfunctions of our body systems.

Statistic shows that 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 as a smart way to measure personal health condition. Furthermore, blood pressure management is a step towards a healthier lifestyle.

A relatively ancient mercury column can be a good device for explaining how blood pressure is measured. With a stethoscope illustrating the Korotkoff sounds and the mercury sphygmomanometer showing the pressure differential, it is easy to explain the basis of the measurements. The newer electronic instruments have a similar problem with sensitivity to sounds as well as overall accuracy [1].

2.2 Blood Pressure

Blood pressure is can be defined as the pressure of the blood against the walls of the arteries. Basically, blood pumped from the heart and its pumps blood into the arteries and through the circulatory system. Blood pressure is measured in millimeters of mercury (*mmHg*) and recorded as two numbers systolic pressure "*over*" diastolic pressure. The cuff will block the blood flow in the vessel before slowly released to get the systolic reading, this measurement is recorded when the blood starts flowing again where it is a maximum pressure produce by the heart.

For example, the doctor might say "120 over 80" 120/80 mmHg as a blood pressure reading. The measurement is taken when the doctor puts the cuff around patient's arm and pumps it up. Nowadays, the digital measurements take over to replace the manual method and it is very easy to read by the doctor event by the patient.

In order to obtain accurate data with the indirect blood pressure methods that are used in surveys, it is important to follow the prescribed procedures precisely. Otherwise, correlation with the true blood pressure no longer holds. Therefore, the instructions

given in the following sections should be incorporated into manuals of operation in their entirety.

In daily life, blood pressure changes from instant to instant and is influenced by many physiological and environmental factors. As part of this survey accurate measurements depend on many factors. 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).

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 based on physiological, lifestyles, gender and others [1].

2.3 Definition of Pulse

Pulse is the rhythmic expansion and contraction of an artery caused by the impact of blood pumped by the heart. The pulse can be felt with the fingers at different pulse pressure points throughout the body and heard through a listening device called a stethoscope. In this survey you will use the radial pulse (at the wrist) and the brachial pulse (inside of arm at the elbow) to obtain the pulse and blood pressure measurements.

2.4 Blood Pressure Diseases

Today, people not care about their health that will cause disease and usually come from the unbalance food taken. For example, the unlimited fat habit taken who will cause 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 capability of blood vessel to absorb is diminishes with time. These causes the older people are more likely to experience hypertension. Some people also may suffer low blood pressure (hypotension) due to low blood volume in their body system.

Generally, high blood pressure is related to high salt intake in our food consumption. Since people nowadays are exposed to busy life routines made them consuming bad diet habit which eventually promotes obesity (overweight). Cigarette habit and alcohol intake may also contribute to this problem. The main factor that people expose to this hypertension is lack of exercise and unbalance food taken in daily routine.

This high blood pressure problem also related to some people who have the history of high blood pressure in their families that have been identified to be one of the hypertension reasons. Beside that, people who are on medication or under doctor's prescription need to observe the irregularities in their blood pressure. Certain hormones, like adrenaline which is released when people under stress may also cause certain blood vessels to constrict, and this raises the blood pressure. The blood pressure reading also may increase when certain people are exposed to constant stress it means that the heart has to work too hard. So, this stress needs to reduce as possible before it too late [3].

2.5 Method of Measuring Arterial Blood Pressure

In the measurement procedure a cuff is wrapped around a person's arm with an inflatable rubber bag inside the cuff centered over the brachial artery. Enough air pressure is pumped into the cuff to close the artery. Air pressure is then released by opening the thumb valve. When the pressure in the cuff is equal to the pressure on the artery, the artery opens and the blood begins to return to the part of the artery that was closed. As the blood returns to the artery, pulse sounds begin. These sounds can be heard through a stethoscope placed over the brachial pulse point. The sounds continue for a time while the cuff is deflated slowly, eventually becoming too faint to hear.

The cuff is connected by tubing to a manometer, which shows the amount of pressure on the artery. When the first pulse sounds are heard, the reading on the manometer measures the systolic blood pressure. The last sound heard is the diastolic blood pressure. In children, the muffling of sound or fourth sound is often used as the diastolic blood pressure rather than the disappearance of sound [3].

2.6 Measurement Procedures

There are several procedures must be follows to get the accurate reading from the blood pressure. The subject should abstain from eating, drinking (anything else than water), smoking and taking drugs that affect the blood pressure one hour before measurement. This is because a bladder affects the blood pressure it should have been emptied. Besides that painful procedures and exercise should not have occurred within one hour and before take the reading subject should have been sitting quietly for about 5 minutes. Subject should have removed outer garments and all other tight clothes. The sleeve of shirts, blouses, etc. should have been rolled up so that the upper right arm is bare. The remaining garments should not be constrictive and the blood pressure cuff should not be placed over the garment. Blood pressure should be measured in a quiet room with comfortable temperature. The room temperature should have been recorded