

**BLOOD PRESSURE MONITORING SYSTEM USING PIEZOELECTRIC FILM  
SENSOR**

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**UNIVERSITI TEKNIKAL MALAYSIA MELAKA**

**BLOOD PRESSURE MONITORING SYSTEM USING PIEZOELECTRIC FILM  
SENSOR**

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**This report is submitted in partial fulfillment of the requirements for the award of  
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Specially dedicated to my beloved parents:

**Mr Baharudin bin Baharom**

**Mrs Badariah binti Harun**

Who encouraged, guided and inspired me throughout my journey of education.

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## ABSTRACT

Blood pressure monitoring system is one of the apparatus that has been use in medical field since long time ago. The design of blood pressure monitoring system was developing and upgrade following the development of technology. Blood pressure monitoring system is use to measure the human blood pressure and hate rate. Normal blood pressure measurement is about 120mmHg/80mmHg. For the upper (systolic), the pressure is 120mmHg while for the bottom (diastolic) is 80mmHg. Nowadays, the counts of patients high and low blood pressure are becoming increase but their always out of time to make an appointment with a doctors to check their health. So, in designing this project, the blood pressure monitoring system was modifying using piezoelectric film sensor to replace the function of the cuff and pressure sensor. Patient will no more feel uncomfortable that created from the cuff of blood pressure during process measurement. The piezoelectric sensor is in rectangular shape and use to measure pulse rate by attach at the wrist patient. Furthermore, the atmega32 microcontroller circuit was used as a main circuit to control amplifier circuit, piezoelectric sensor and the LCD display. The accuracy final output also can be determined by using oscilloscope. This latest blood pressure monitoring was design as user friendly, portable and affordable.



## ABSTRAK

Sistem pengawasan tekanan darah adalah salah satu peralatan yang telah digunakan dalam bidang perubatan sejak dahulu lagi. Reka cipta Sistem pengawasan tekanan darah telah berkembang dan bertambah baik mengikut perkembangan teknologi. Sistem pengawasan tekanan darah digunakan untuk memeriksa tekanan darah dan kadar denyutan jantung. Bacaan normal bagi tekanan darah manusia adalah 120mmHg/80mmHg. Untuk tekanan darah tahap atas (systolic), ialah 120mmHg manakala tekanan darah tahap bawah (diastolic) ialah 80mmHg. Semakin hari jumlah pesakit tekanan darah tinggi atau rendah semakin bertambah, tetapi mereka sering tidak mempunyai masa untuk mengatur temujanji berjumpa doctor bagi memeriksa kesihatan mereka. Maka, dalam ciptaan projek ini, Sistem pengawasan tekanan darah telah diubahsuai menggunakan penderia filem piezoelektrik untuk menggantikan fungsi 'cuff' dan penderia tekanan. Pesakit tidak lagi akan merasa tidak selesa akibat penggunaan 'cuff' dan penderia tekanan semasa bacaan diambil. Piezoelektrik film sensor ini berbentuk segiempat tepat dan digunakan untuk mengesan kadar nadi dengan meletakkannya pada pergelangan tangan pesakit. Litar mikropengawal Atmega32 digunakan sebagai litar kawalan utama yang mengawal litar amplifier, penderia filem piezoelektrik dan Paparan LCD. Ketepatan pengukuran bacaan akhir projek ini dilihat melalui oscilloscope. Ciptaan baru Sistem pengawasan tekanan darah ini akan dihasilkan mesra pengguna, mudah alih dan mampu dimiliki.

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## LIST OF ABBREVIATION

ADC	-	Analog to Digital Converter
CPU	-	Control Processor Unit
CISC	-	Complexes Instruction Set Computer
DC	-	Direct Current
EEPROM	-	Electric Erasable Programmable Read Only Memory
GND	-	Ground
I/O	-	Input Output
LCD	-	Liquid Crystal Display
LSI	-	Large-scale integration
PROM	-	Programmable Read Only Memory
PSM1	-	Projek Sarjana Muda 1
PSM2	-	Projek Sarjana Muda 2
PVF2	-	Polyvinyliden Fluoride
PWM	-	Pulse Wave Modulation
RAM	-	Random Access Memory
RISC	-	Reduce Instruction Set Computer
ROM	-	Read Only Memory
VDC	-	Voltage Direct Current
VOUT	-	Voltage Output
VLSI	-	Very Large Scale Integration



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## CHAPTER 1

### INTRODUCTION

#### 1.1 Background

Blood pressure is the force or the measurement of the force applied to the walls of the arteries by the blood in the body. While, blood pressure monitoring system is a device that use to measure a user's blood pressure and heart rate. Blood pressure is measured in the form of two numbers, the systolic blood pressure and the diastolic blood pressure. For normal healthy people, the blood pressure reading is written as 120/80mmHg, where 120 are the systolic pressure and 80 is the diastolic pressure. Systolic pressure is the pressure of the blood when the heart beats. This is the highest pressure exerted by the blood. On the other hand, diastolic pressure is the pressure of the blood when the heart rests between beats. This is the lowest pressure exerted by the blood.

We can measure the blood pressure in two different manners. That is, using the cuff or by measuring it digitally. Digitally, also divide into two way measuring which is auscultatory and oscillometric method. The oscillometric method was be used for this project. The oscillometric method operated by sensing the magnitude of oscillations caused by the blood as it begins to flow again into the limb. Oscillometric method is

similar to the auscultatory method functionally. It is used in long-term measurement as well as in clinical practice.

The cuff in this type of manometer comes with an electronic pressure sensor fitted in the cuff to detect the blood flow. In this method, the mercury manometer is fitted on the wrist, elevated to the height of the heart, though the upper arm is always preferred. The cuff is inflated and released by an electrically operated pump, which then gives out a numerical readout of the blood pressure.

The piezoelectric film sensor can provide the same function with the cuff and pressure sensor. Piezoelectric film sensor was selected to replace the cuff and pressure sensor function in this project because it is very sensitive to low level mechanical movements and it has an electrostatic shield located on both sides of the element ( to minimize 50/60 Hz AC line interference). Besides that, it is responsive to low frequency movement in the 0.7 – 12 Hz range interest and the foil size was about right (1 inch / 2.54 cm long) and lastly, it has an integral connector and cable for simple connections.

## **1.2 Objectives**

Purpose of this project is design new blood pressure monitoring system with ease of operation for a group of people that need to measure their blood pressure and heart rate regularly. The modification the conventional blood pressure monitoring system by using piezoelectric will allows a user to measure their blood pressure and heart rate anytime and everywhere they want with no limited. Besides that, my blood pressure monitoring system is a self-service product.

The objective of this project is:

1. To modify the blood pressure monitor by using piezoelectric film sensor replacing the cuff and air pump.

2. To design the new pattern blood pressure monitors that portable and user friendly.
3. To display the digital output reading through the LCD display.

### **1.3 Problem Statement**

Nowadays, the patients of high and low blood pressure are becoming increase but they always out of time to make an appointment with a doctor to check their healthy. Because of that, a new modifying blood pressure monitoring system was designing with characterize self-service product and easy to use everywhere and anytime. Although there have many types blood pressure monitoring already in the market, this new modifying still continue designing to build the more advance blood pressure monitoring system. The conventional the blood pressure monitoring system was modifying by replacing the cuff and pressure sensor with the piezoelectric film sensor.

### **1.4 Scope of Project**

The function of Blood Pressure Monitoring System using Piezoelectric Film project was based on below scope of work:

1. The Blood Pressure Monitoring System was designing by modifying the conventional blood pressure monitoring system using Piezoelectric Film sensor.
2. The piezoelectric film sensor will detected the user pulse rate.

3. The amplifier circuit will be identifying and amplify the pulse rate detected from the piezoelectric film sensor as an analog signal.
4. The analog signal will be passing to the atmega32 microcontroller to continue the process which converts to the digital form.
5. Then, the oscillometric method was applying during blood pressure calculation process.
6. The digital output results will observe and display at LCD display.
7. The piezoelectric film sensor limitation reading is will never exceed the maximum limit of 160mmHg. This is because the 160mmHg is approximately more than the systolic pressure of normal healthy people.

## 1.5 Project Methodology

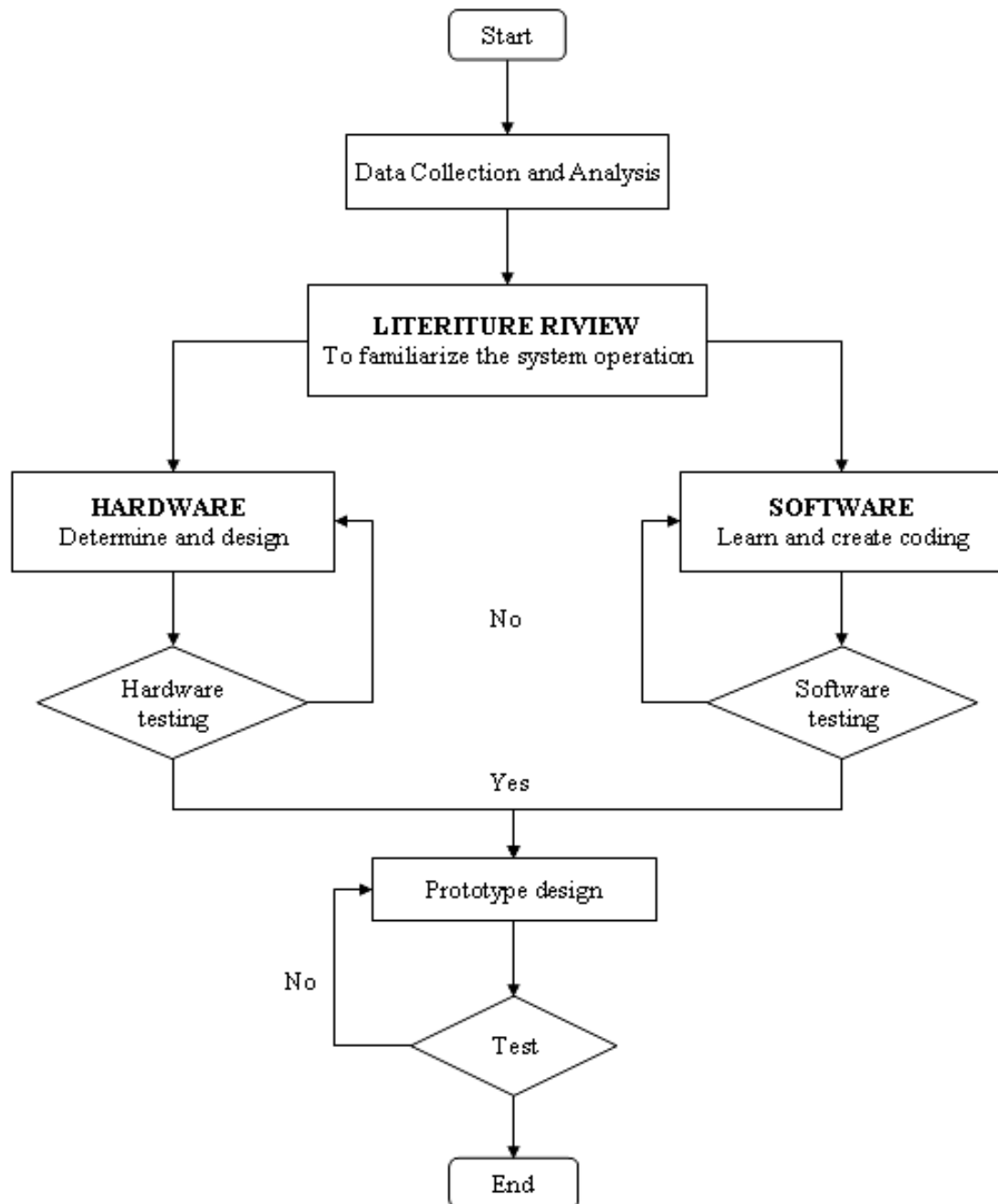


Figure 1.1 Flow chart of the project methodology.

Figure 1.1 shows about the flow of project methodology during to successful this project. The hardware and software part was proceeding separately and done simultaneously. Each of the process must be rework and repaired until the project success.

## **1.6 Report Structure**

In Chapter I was explain about the introduction chapter of this project, that include the objective, problem statement, scope of project ,project methodology and report structure.

Chapter II is about the research and the literature review part. This chapter was explained about the blood pressure monitoring system operation, oscillometric method, Atmel Atmega32 microcontroller, Piezoelectric Film Sensor, Amplifier LM358, Voltage Regulator 7805, LCD display, RC filter and the bulb, cuff and valve.

Chapter III was explain about the project methodology. The project methodology was divided into two part which for hardware and software part.

Chapter IV is explanation about the result and discussion part.

The conclusion of this project will be explained in chapter V.

## CHAPTER II

### LITERATURE REVIEW

#### 2.1 Introduction

The function of blood pressure monitoring system is to measure a human blood pressure and heart rate. In this project, the blood pressure monitoring system was modifying by using a piezoelectric film sensor to replacing the cuff and air pressure in the conventional blood pressure monitoring system. The piezoelectric film sensor will count the wrist pulse and then stop until the tiny oscillation will be measured in the air pressure inside the piezoelectric sensor. The systolic measurement will be taken when the oscillation starts happening. Then, the microcontroller will be used to detect the point where the oscillation starts to occur and the pressure inside the piezoelectric sensor will be recorded. After that, the pressure will slowly decrease. The diastolic pressure will be taken at the point where the oscillation starts to disappear. For normal healthy people, the blood pressure reading is about 120/80 mmHg, where 120 mmHg are for systolic and 80 mmHg are for diastolic measurement. Below is the classification of the blood pressure reading which available for adult aged 18 and older.