PC BASED ECG MONITORING SYSTEM

NOR HARYANTI BT DAHALAN

This report is submitted in partial fulfillment of the requirement For The Bachelor Degree Of Electronic Engineering (Computer Engineering)

Faculty of Electronic and Computer Engineering
Universiti Teknikal Malaysia Melaka

MAY 2008

UNIVERSTI TEKNIKAL MALAYSIA MELAKA
FAKULTI KEJURUTERAAN ELEKTRONIK DAN KEJURUTERAAN KOMPUTER

BORANG PENGESAHAN STATUS LAPORAN
PROJEK SARJANA MUDA II

Tajuk Projek	:	PC BASED ECG MONITORING SYSTEM
Sesi Pengajian	:	2007/2008

Saya NOR HARYANTI BT DAHALAN

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 (√) :

☐	**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)

Alamat Tetap: C192 Jalan Kenanga, Bukit Ubi,
25200 Kuantan,
Pahang.

Tarikh 9 MAY 2008

(COP DAN TANDATANGAN PENYELIA)

NORHASHIMAH BT MOHD SAAD
Pensyarah
Fakulti Kej. Elektronik dan Komputer (FKEK),
Universiti Teknikal Malaysia Melaka (UTeM),
Karung Berkunci 1200,
Ayer Keroh, 75450 Melaka

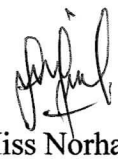
Tarikh: 12/5/08

"I, hereby declare that this thesis entitled, PC Based ECG Monitoring System is a result of my own effort except as clearly stated in references."

Signature  .

Name : Nor Haryanti Bt Dahalan
Date : 9 MAY 2008

"I, hereby declare that I have read this thesis and in my opinion, it is suitable in term of scope and quality for the purpose of awarding a Bachelor Degree in Electronic Engineering (Computer Engineering)."

Signature : 
Supervisor : Miss Norhashimah Mohd Saad
Date : 12/5/08

Special dedicated to my beloved parents, family and fellow friends, who had strongly encouraged and supported me in my entire journey of learning

ACKNOWLEDGEMENT

Firstly, a lot of thanks and deepest gratitude to my supervisor, Cik Norhashimah Bt Mohd Saad who has guide me a lot of knowledge and information regarding a final project, which is also known as Projek Sarjana Muda (PSM), due to an electrocardiogram (ECG) topic. Cik Norhashimah always guide me regarding an ECG that I never heard and knew before, willing to share a great experience especially in managing a project, encouraging me to improve my performance and able to advice for own goods. Not forgetting for Mr Mohd Sani Irwan B Salim for your advice and supported.

Not forget, my inadequate to my parents, Mr. Dahalan B Othman and Mrs. Zainon Bt Atam, my special friend, Mohd Suhairi B subaira and Siti Aisyah Bt Anas who never give up encouraging me, kind, helpful and supportive me a lot since the project begin.

In addition, thanks to all my friends who have been for supporting and encourage me a lot during completing this Projek Sarjana Muda. Finally, for those who give a contribution in my training whether direct or indirectly involved thanks a lot.

ABSTRACT

This project purpose to display electrocardiogram (ECG) signal in real time by using Real Time Data Exchange (RTDX). Signal producing will be monitoring by using Personal Computer (PC). Visual Basic 6 and measurement studio is using to develop this system. In addition, Digital Signal Processing Board (DSP) is use to change signaling from analog to digital and change it again to analog. As many as 30 sample signal will be read at one time and the signal data can be save and to be used. The information enable this system display the signal that have been save although this system is offline. Apart from that also, patient information will be recorded as identity card, name and problem stated patient. The information would be kept in database. In this method, it facilitate consumer use the system this without trouble to find patient records in file.

ABSTRAK

Projek ini bertujuan untuk memaparkan isyarat jantung (ECG) dalam masa nyata dengan menggunakan Real Time Data Exchange (RTDX). Isyarat yang terhasil akan dipaparkan dengan menggunakan Komputer Peribadi (PC). Perisian yang digunakan untuk membangunkan system ini adalah Visual Basic 6 dan measurement studio. Di samping itu juga tambahan lain adalah seperti Digital Signal Processing Board (DSP) digunakan bagi menukar isyarat dari analog ke digital dan menukarnya semula ke analaog. Sebanyak 30 sampel isyarat yang akan dibaca pada satu masa dan maklumat- maklumat isyarat tersebut bole disimpan dan diguna pakai. Maklumat tersebut membolehkan sistem ini memaparkan semula isyarat yang disimpan walaupun sistem ini tidak aktif. Selain itu juga, maklumat pesakit akan direkodkan seperti kad pengenalan, nama dan masalah pesakit tersebut. Maklumat-maklumat tersebut akan disimpan di dalam database. Dengan cara ini, ia memudahkan pengguna menggunakan sistem ini tanpa bersusah payah untuk mencari rekod-rekod pesakit di dalam file.

TABLE OF CONTENT

LIST OF TABLE

LIST OF FIGURE

LIST OF ABBREVIATIONS

ECG	-	Electrocardiogram
RA	-	Right arm
RL	-	Right leg
LA	-	Left arm
LL	-	Left leg
AV	-	Atrial Ventricular
CCS	-	Code Composer Studio
RTDX	-	Real Time Data Exchange
ADC	-	Analog to Digital to Analog Converter
DSP	-	Digital Signal Processing
PC	-	Personal Computer
GUI	-	Graphic User Interface

CHAPTER 1

INTRODUCTION

1.1 Overview

Nowadays, the volume of ECG recorded in hospital is increasing because there are so many heart diseases that attack each person in this world. The electrocardiograph (ECG) is one of the medical equipment that can measure the heart rate and produce data from patient heart into a signal in piece of paper. It is not systematic and efficient because the result maybe lost, damage and difficult to save and send to exchanging patients clinical information between health care facility.

The main objective of this project is to develop a system that can monitor the ECG signal in a real time from patient and can turn the signal or data to pc. The signal form will be displayed on monitor and save in data logger. It also make easier to receive and transfer data. This project aims to improve ECG signal to make sure the measurement is accurate while the noise can reduce by using the filter.

An electrocardiogram (ECG) is a recording of the electricity on the body surface generated by the heart. ECG measurement information is collected by skin electrodes placed at designated locations on the body. ECG signals are usually small and they may

be corrupted by various kinds of noise: power line interference, electrode contact noise, motion artifacts. So the measurement of ECG signal is a difficult task.

1.2 Objective

The objectives of the project consist of:

1. Develop the system that can monitor the ECG signal in a real time by using Digital Signal Processing and monitor the output through the personal computer.
2. Store data in memory and reuse data. Data that have been saved can replot again as a reference.
3. Display the electrocardiogram (ECG) signal by using personal computer (PC) screen.

1.3 Scope of Study

There are many kinds of method that can be used to develop this system but for this project, the scopes of work are describes as follow:

1. Process the signal by using TMS320C6713 DSP evaluating board (Digital Starter Kit) for Analog to Digital (ADC) and real time data exchange(RTDX).
2. Sampling Frequency – 8000Hz.
3. Amplitude (0 - 1V).
4. Visual Basic will be used for Graphic User Interface (GUI) in PC for real time monitoring system.

1.4 Problem Statement

Currently, ECG monitor is design by software is very costly. Normally we monitor the signal using oscilloscope. In this case, the output signal from ECG very small between 1mV until 5mV and this is problem for user measured the value and maybe the value is not very accurate. Beside that, in ECG signal it's also have a noise where it can bring error for measurement and it will be the value not very accurate. In our body, it have many signal but for this case we only want ECG signal can be monitor so this system just only monitor the ECG signal by using Visual Basic graphical user interfaces (GUI) and it can monitor signal until 1000 times and also reduce the noise from the signal.

1.5 Project Methodology

The first and second stage of this project is more focusing on literature study of basic concept DSP and also understanding the fundamental of Digital Signal Processing. The third process is learning about ECG and how the ECG functions.

Then the next process is simulation MATLAB software using DSP algorithm. MATLAB are choice because it contains trigonometric function that can be used to generate a sinusoidal signal. A cosine signal of amplitude A and frequency f1 can be obtained by using the MATLAB command. Then using Code Composer Studio software, we implement FFT on hardware device. Code Composer Studio is TI's flagship development tool. It consists of an assembler, a C compiler, an integrated development environment (IDE), the graphical interface to the tools and numerous support utilities like a hex format conversion tool. The DSK includes a special version of Code Composer specially tailored to features on the 6713DSK board.

After that, we are developing software. The purpose of this software is being design Graphical User Interfaces (GUI) using Visual Basic. In this software development, Rapid Prototyping was choice because it's a software development process that involves iterative development and the construction of prototypes. A

program is developing from computer (host) to display the real-time monitoring of signal and its spectrum using Visual Basic.

The next process is field testing and troubleshooting. A few tests are done to make sure that the hardware and software are work properly. If any error is detecting, the process is return to previous stage. The last process is writing a report. The report must include overall of this project documentation which explain briefly about PC Based ECG Monitoring System.

1.6 Thesis outline

This thesis represent by five chapters. The following is the outline of the PC based ECG monitoring System project in chapter by chapter.

Chapter I is discuss the brief overview about the project such as introduction, objectives, scope of the project, problem statement and project flow.

Chapter II covers theories and equations that are being used in order to complete this project. It also describe about ECG monitoring system and TMS320C6713 DSK board. The available techniques are being covered in this chapter and the better methods have been chosen for this project.

Chapter III is about the project methodology. Project methodology is about what processes are being done to complete the project. It emphasizes the details on the processes that are used. All these methodology should be followed for a better performance.

Chapter IV shows about the result and discussion such as project finding and analysis of PC based ECG Monitoring System. The result consist figures with some explanation and covers the output for this project.

Chapter V is discuss about conclusion overall of this project. It also includes suggestion for the future modification and development.

CHAPTER 2

LITERATURE REVIEW

2.1 Overview

Nowadays, all relatively inexpensive computers designed for an individual user. In medium price, personal computers range anywhere. All are based on the microprocessor technology that enables manufacturers to put an entire CPU on one chip. For education like university student, they used personal computer as reference to get knowledge or information, doing the task for assignment and also made technology experiment to improve their understanding. In the other word, personal computer is a medium of new technology to step forward for give human a good culture live.

In this section, it will be discussing about the theory and concepts that is accordingly to the project in details. Also, it will inform about the perspective and method that have been using in this project. The theory that will be discussed is about the Electrocardiogram (ECG), DSP processor, TMS320C6713 DSK, DSP and programming language and software. It also include about oscilloscope technology which is very expensive to be developed. Using the advantages of personal computer, the ECG Monitoring software is developing to give something new or preference idea for this project.

2.2 Introduction of Electrocardiograms (ECG)

The heart strong pumping action is driven by powerful waves of electrical activity in which the muscle fibres contract and relax in an orchestrated sequence. These waves cause weak current to flow in the body. Changing the relative electric potential between different point on the skin. An electrocardiogram is a biophysical instrumentation device that is used to view/record the electrical activity of the heart for various diagnostic purposes.

The electrocardiogram (or ECG) has been used extensively in medicine sine its invention in the early 1900's and has since proven to be invaluable in various diagnostic applications, such as the detection of irregular heartbeat patterns. Heart murmurs (or other abnormal heart sounds). Tissue/structure damage (such as valve malfunction) and coronary artery blockage. Other applications of the ECG are very effective in areas of sports medicine, or sports therapy. In tracking the heartbeat through various levels of physical activity to assist the patient in attaining a desired, optimum heart rate.

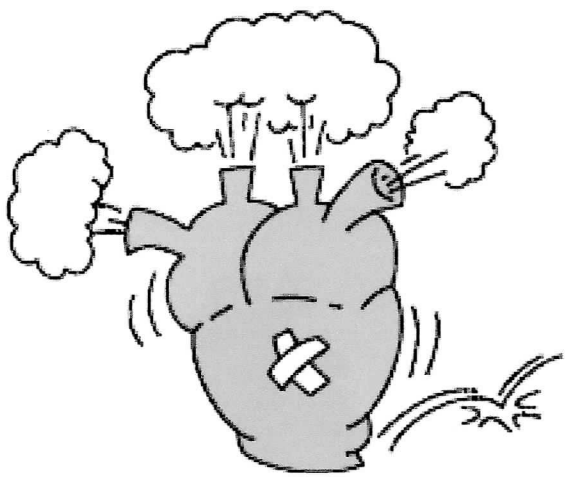


Figure 2.1: ECG used to diagnosis abnormal heart.

Figure 2.2: ECG for sports therapy.

Therefore, while the concept of an ECG is not a novel one, the attraction of this project lay in the challenge to build simple , compact, operational medical device at low cost. The basic design theory is as follows:

- The electrical activity of the heart is detected using electrodes placed on the surface of the chest cavity. These electrode acts as bio-tranducers to convert the signal from its existing form in the body (ionic) into electrical current in the wires.
- The generated signal is put through an amplifier to allow for observations, measurements and recording to be made. This stage is extremely important, as the cardiac is very small, i.e. on the order of mili-volts, thus a large amplification is necessary for any use to be made of the signal.

2.3 The Electricity of the Heart

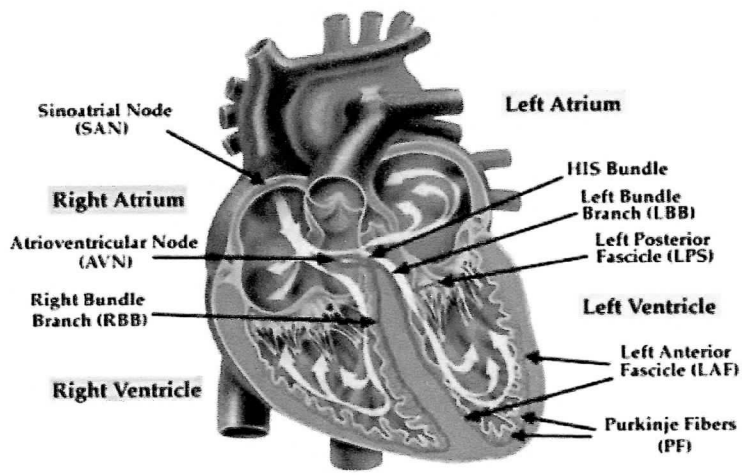


Figure 2.3: The heart diagram

Depolarization is contraction of any muscle is associated with electrical changes. These changes can be detected by electrodes attached to the surface of the body. Since all muscular contraction will be detected, the electrical changes associated with contraction of the heart muscle will only be clear if the patient is fully relaxed and no skeletal muscles are contracting.

The heart has four chambers, two little ones (right and left atrium), and two large ones (right and left ventricles). The main role of the left and right atriums is to squeeze their walls when they are full with blood so they can fill the ventricles, which are downstream from them. Although the heart has four chambers, from the electrical point of view it can be thought of as having only two, because the two atria contract together and when the two ventricles contract together.

Assume the atria pump as a priming pump. By pouring its blood into the ventricle, it prepares it for pumping similar to pouring gasoline into a carburetor to prepare the engine for action. When the ventricles are full of blood their walls contract, and it imparts high pressure to the blood inside them. The blood from the right ventricle flows to the lungs and the blood from the left ventricle flows to the body.

The electrical discharge for each cardiac cycle normally starts in special area of the right atrium called the 'Sinoatrial (SA) node'. Depolarization then spreads through the atrial muscle fibres. There is a delay while the depolarization spreads through another special area in the atrium, the 'atrioventricular node' (also called the 'AV node', or sometimes just 'the node'). Thereafter, the electrical discharge travels very rapidly, down specialized conduction tissue: first a single pathway, the 'bundle of His', which then divides in the septum between the ventricles into right and left bundle branches. The left bundle branch itself divides into two. Within the mass of ventricular muscle, conduction spreads somewhat more slowly, through specialized tissue called 'Purkinje fibres'.