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PC-BASED PATIENT MONITORING SYSTEM- SOFTWARE DEVELOPMENT

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March 2005

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"I hereby declared that this report is the result of my own effort except as clearly stated in the source of reference"

Signature :

Name of Author : Mazrina binti Mashod

Date : 1 APRIL 2005

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To my beloved parents and to all my extended family

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ABSTRACT

The purpose of this project is to design a PC-Based Patient Monitoring System particularly for acquiring ECG signal. Electrocardiograph is medical instrument functioning graphic tracing of electric current generated by the heart muscle during a heartbeat. The ECG signal obtained by positioning electrodes on the body in standardized locations, information about many heart conditions can be learned by looking for characteristic patterns on the ECG. The ECG monitoring system also can provide the patient a good measure to monitor heart, help detect state of the disease and find changes as early as possible. This project has been divided into two main parts, software development and hardware design. However the major concentration will be focus on software development. This project used an ECG device as hardware and will be connected to the PC via parallel port by using specific software. Besides that, this project complete with database to save all the information.

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ABSTRAK

Tujuan projek ini adalah untuk mereka *PC-Based Patient Monitoring System* khusus bagi memperolehi isyarat ECG. Electrocardiograph adalah peralatan perubatan yang berfungsi untuk mengesan gambaran arus elektrik yang dijana oleh otot jantung semasa denyutan jantung. Isyarat ECG diperolehi dengan meletakkan elekrtod. pada badan yang mengikut kedudukan seperti yang ditetapakan, maklumat tentang keadaan jantung boleh diketahui dengan melihat bentuk ciri –ciri ECG. Sistem monitor ECG juga boleh memberikan ukuran yang baik untuk pesakit memonitor jantung, membantu mengesan tahap penyakit, dan mendapat perubahan seawal mungkin. Projek ini terbahagi kepda dua, rekabentuk perkasasan dan pembagunan perisian. Bagaimanapun, keseluruhan penumpuan adalah memfokus pada bahagian perisian. Projek ini menggunakan peranti ECG sebagai perkakasan dan akan disambungkan kepada PC melalui pot selari dengan menggunakan perisian yang spesifik. Selain itu, projek ini lengkap dengan *database* bagi menyimpan semua maklumat.

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LIST OF ABBREAVIATIONS

ADC	-	Analog to Digital Comveter
Bpm	-	Beats per minute
Dll	-	Dynamic Link Library
ECG	-	Electrocardiogram
Frm	-	Form
PC	-	Personal Computer
RAM	-	Random Access Memory

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CHAPTER I

INTRODUCTION

1.1 Overview

Nowadays the incidence of heart and vascular diseases are much higher than before and the age is becoming younger. Heart disease is the world's greatest killer, thus improvements in diagnosis and treatment tools are welcomed by the medical community, who are desperately seeking better ways to help patients. One of the most useful diagnostic tools for heart patients is PC-Based Patient Monitoring System which operates by measuring the tiny electrical signals emitted by heart through chest electrodes and display to computer.

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In order to complete the system, need to use the appropriate software as a platform and hardware based on requirement. This system used an ECG device as hardware and will be connected to the PC via parallel port. The PC-Based Patient Monitoring System will run under Microsoft Visual Basic. It is the best chosen for this project due to its ability in controlling the hardware operation effectively and user friendly interface. This project also has a database to save all the information

The proposition is to develop a system that will available for monitoring heart signal in hospital or by individual outside hospital. Indirectly this project can improved the quality of life of the people, for an instance save time, reduce cost and improve medicine quality.

1.2 Problem to Be Studied

PC-Based Patient Monitoring System provides essential information of person heart in order to detect various heart related decease. However, most of commercial ECG monitoring system has complicated function. Therefore, the problem to be studied is to design and implement the user -friendly system, attractive and can save time. Other problem is patient's vital signal measurement and data acquisition module. Besides that, the problem to be studied is the setup for interfacing ECG circuit to PC by using specific software.

Other than that, is to prepare the coding that can be calculated the heartbeat rate. The patient monitoring system is developed especially for hospital usage, so the system needs to have a database for patient's data and confidentiality.

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1.3 Objective Of Project

The objective of this project is to develop ECG data acquisition module. Thus this device will available for monitoring heart signal in hospital or by individuals outside hospital. So patient can continue monitoring heart at home when patients are dismissed from hospital. Besides that, to study basic knowledge about diagnosis and to make comparison between normal and abnormal signal producing by human body. Otherwise, is to develop a Patient Monitoring System that is user friendly. This is very important because without this element, user cannot understand and then they cannot interact with this project successfully.

1.4 Scope Of Project

The scope of this project is to design and implement a PC- Based Patient Monitoring System. The system can acquires signals and displays ECG signal on the PC screen. Besides that, it also has a function to calculate the number of heartbeats per minute based on ECG waveform obtained. Otherwise this project also has a database to save the information. The major concentration in this project is Software Development.

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1.5 Overview Of Remaining Chapters

The content of this report are summarized as follows:

CHAPTER II introduces the relevant literature review for this project. Discuss briefly about ECG background and methods to obtain the ECG signal from human body.

CHAPTER III outlines about the software methodology that includes software requirement and user interface design

CHAPTER IV shows about the result obtained and discussion based on the result.

CHAPTER V is the last chapter that explains about the recommends directions for future work and the benefits offered by doing so. Besides that this chapter will concludes all the information.

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CHAPTER II

LITERATURE REVIEW

2.1 Theory of Project

Basically, this project divided into two main parts, hardware design and software design. There are three electrodes are placed on human body to capture small electrical voltage produced by contracting muscle due to each heartbeat. Two electrodes are placed each on the left and right wrist, while the third electrodes is placed on the ankle of the leg as ground. The output from ECG is fed into the next stage for signal amplification and filtering purposes. Then, analog output from this stage is fed into the next stage for analog to digital conversion. Finally the digital output from ADC is sent to PC via parallel port interface. The block diagram of PC-Based Patient Monitoring System can be shown as Figure 2.1.

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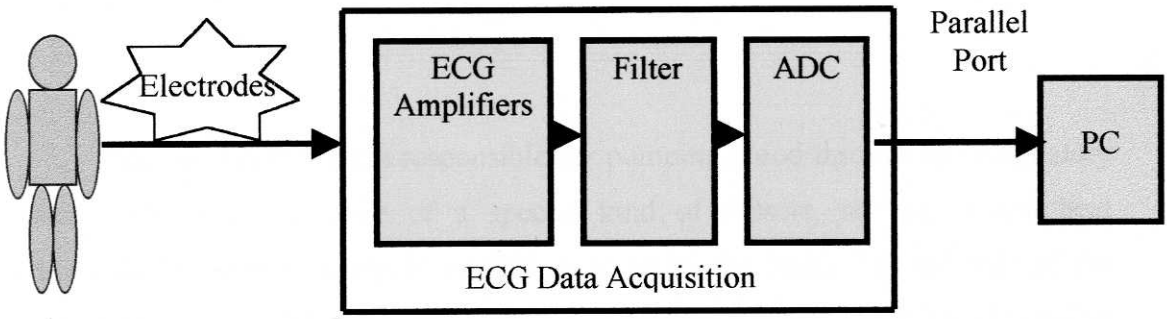

Figure 2.1: Block Diagram of PC-Based Patient Monitoring System

2.2 ECG Background

An electrocardiogram is a measurement of the electrical activity of the heart (cardiac) muscle as obtained from the surface of the skin. As the heart performs its function of pumping blood through the circulatory system, a result of the action potentials responsible for the mechanical events within the heart is a certain sequence of electrical events [1]

"The electrical activity of the heart can be recorded to monitor cardiac changes or diagnose potential cardiac problems. The principle involved is simple: body fluids are good electrical conductors. Electrical impulses generated in the heart are conducted

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through body fluids to the skin, where they can be detected and printed out by a sensitive machine called an electrocardiograph. This printout is called an electrocardiogram, or ECG."[2]

2.2.1 The Heart

The heart is the organ responsible for pumping blood through the circulatory system. The heart is made of a special kind of muscle, so that it can beat automatically without having to be told to do so by the brain. The left side of the heart drives oxygen rich blood out of the aortic semilunar outlet valve into circulation where it is delivered to all parts of the body. Blood returns to the right side of the heart low in oxygen and high in carbon-dioxide and is then pumped through the pulmonary semilunar pulmonic valve to the lungs to have its oxygen supply replenished before returning to the left side of the heart to begin the cycle again. The basic cardiopulmonary can be shown in Figure 2.2. For a 'typical' adult the heart beats at about 70-90 times a minute. If a typical individual lives for about 75 years, his or her heart will have cycled over 3.1536 billion times, pumping a total of 0.2107 billion litres of blood [3]

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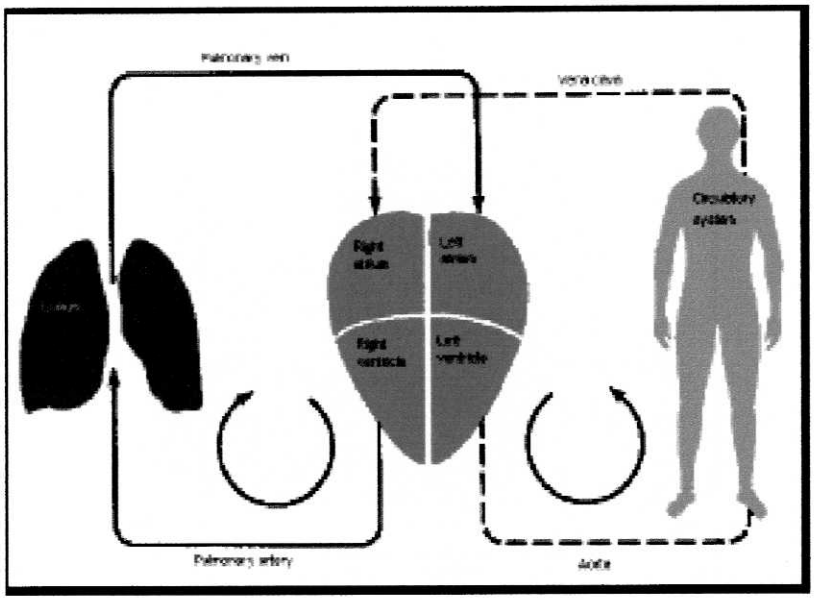

Figure 2.2: The Basic Cardiopulmonary [3]

2.2.2 ECG Waveform

Typically, an ECG is comprised of a series of three distinguishable waves or components (known as deflection waves), each representing an important aspect of cardiac function. The first wave, known as the P wave, represents atrial depolarisation, and is a result of the depolarisation wave from the Sinoatrial node (SA node) through the atria. This action precedes and is the cause of atrial contraction. The QRS complex is the result of ventricular depolarisation. It is caused by the electrical activity spreading from the Atrioventricular node (AV node), through the ventricles via the Purkinje fibres, and precedes ventricle contraction. During this time, atrial repolarisation is also occurring however its occurrence is usually masked by the large QRS complex being detected. Finally, the T wave occurs when the ventricles repolarise. Repolarisation, is slower than depolarisation, hence the T wave is usually wider than the P wave and the QRS complex [2]. A Typical ECG Signal can be shown as Figure 2.3.

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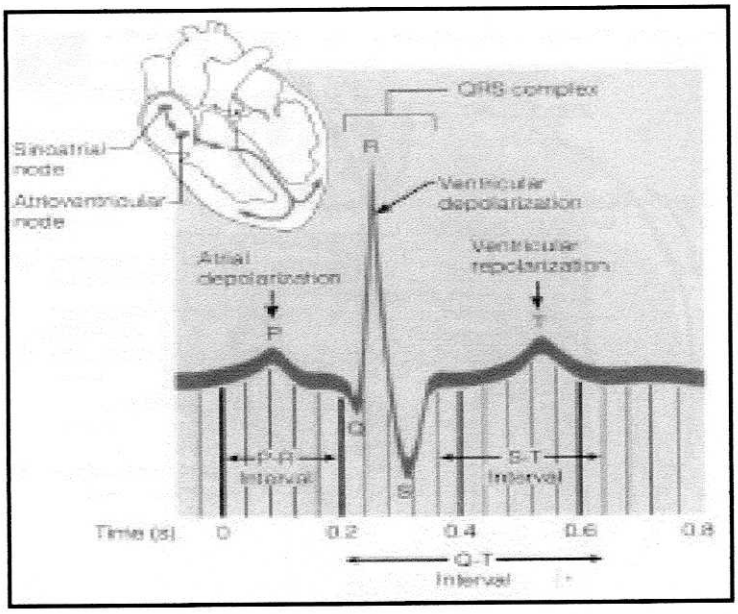

Figure 2.3: A Typical ECG Signal [2]

2.2.3 Standard ECG Measurement

To perform a clinical electrocardiograph, it is important that more than one lead (also known as a channel) be recorded in order to accurately describe the heart's electrical activity. There are two planes in which these leads may lie, which is the frontal plane (the plane of the body that is parallel to the ground when one us lying on one's back) and the tranverse plane (the plane of the body that is parallel to the ground when one is standing erect). For two or three channel ECG, only the leads in the frontal plane are required.

The frontal plane of an ECG consists of three basic leads, as can be seen in Figure 2.4. These leads are the result of the various combinations of pairs of electrodes located on the right arm (RA), the left arm (LA) and the right leg (LL) of the patient. The resulting leads are: lead I, LA to RA; lead II, LA to RA; and lead III,

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LL to LA. Very often an electrode is placed on the right leg (RL) and grounded or connected to Driven-Right-Leg circuit [2].

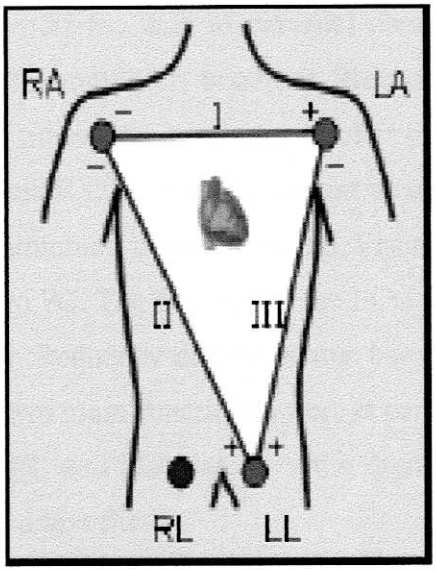

Figure 2.4: Position and Orientation of the Three Bipolar Limb Leads [2]

2.3 Literature Review

Based on research, there are many commercial ECG monitoring system has been developed. In order to be able to design ECG Monitoring System one must have some understanding about the definition of an ECG, functionality, and making comparison from the several of ECG Monitoring System to implement the simple, low cost and user-friendly system of ECG Monitoring System.

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