PERPUSTAKAAN UMP
0000071255

ECHOCARDIOGRAM: LEFT VENTRICLE CHAMBER DETECTION USING IMAGE PROCESSING

THOIEBAH AHMAD MUKHTAR

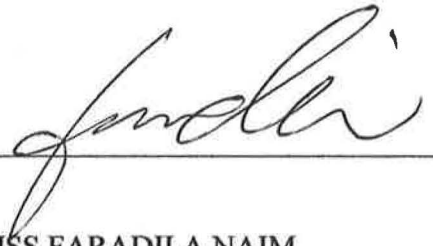
This thesis is submitted as partial fulfillment of the requirements for the award of the Bachelor of Electrical Engineering (Electronics)

Faculty of Electrical & Electronics Engineering

Universiti Malaysia Pahang

JUNE, 2012

"I hereby acknowledge that the scope and quality of this thesis is qualified for the award of the Bachelor Degree of Electrical Engineering (Electronics)"

Signature : 

Name : MISS FARADILA NAIM

Date : ٢١.٦.٢٠١٥

"All the trademark and copyrights use herein are property of their respective owner. References of information from other sources are quoted accordingly; otherwise the information presented in this report is solely work of the author."

Signature : 

Author : THOIEBAH BINTI AHMAD MUKHTAR

Date : 21st JUNE 2010

DEDICATION

Specially dedicated to

AHMAD MUKHTAR BIN MAHMUD
HASNAH BINTI DIN
HABSAH BINTI AHMAD MUKHTAR
ATIQAH BINTI AHMAD MUKHTAR
FATHIAH BINTI AHMAD MUKHTAR
THOLHAH BINTI AHMAD MUKHTAR
AMIRUL AMIN BIN AHMAD MUKHTAR
AMIRAH BINTI AHMAD MUKHTAR
AMIRUDIN ARIF BIN AHMAD MUKHTAR

lecturers

and

friends.

ACKNOWLEDGEMENT

First of all, I am grateful to Allah S.W.T because with His permission, I have completed this thesis successfully. Secondly, lots of thanks to my beloved parent and siblings who are not tired of giving moral support and their prayers to me. In particular, I wish to express my sincere appreciation to my supervisor, Miss Faradila Naim who has provided encouragement, guidance, critics, advices, motivation and friendship. Without the continued support and interest, this thesis would not have been the same as presented here. My sincere appreciation also extends to all my colleagues and others who have provided assistance at various occasions. Their views and tips are useful indeed. Unfortunately, it is not possible to list all of them in this limited space.

ABSTRAK

Ventrikel kiri adalah salah satu daripada empat ruang di dalam jantung manusia. Ia menerima darah beroksigen daripada atrium kiri melalui injap mitral dan dipam ke dalam aorta melalui injap aorta. Kegagalan injap jantung boleh memberi kesan kepada produktiviti penghantaran darah ke bahagian lain tubuh manusia. Kesan kegagalan ini akan membawa kepada kematian. Ekokardiogram merupakan ujian diagnosis untuk mengesan penyakit yang berpunca daripada jantung. Kajian ini adalah berdasarkan video ekokardiogram yang telah diambil daripada Hospital Universiti Kebangsaan Malaysia (HUKM). Video yang diambil ini merupakan video pesakit injap jantung kiri. Kajian dilakukan dengan memproses video tersebut sehingga terhasilnya imej statik. Daripada imej statik tersebut, proses imej telah dilaksanakan untuk mendapatkan saiz ventrikel kiri jantung. Objektif bagi kajian ini adalah untuk mengesan sifat-sifat ruang jantung daripada imej ekokardiogram yang diambil daripada pesakit di HUKM. Dalam kajian ini, analisa saiz injap jantung telah dilakukan. Teknik pemprosesan imej digunakan untuk mengesan saiz atau diameter ruang ventrikel kiri. Hasil yang dijangka adalah untuk membangunkan antara muka pengguna grafik (GUI) yang berkebolehan mengimport imej ekokardiogram dan memaparkan parameter menggunakan simulasi MATLAB.

ABSTRACT

The left ventricle is one of the four chambers in the human heart. It receives oxygenated blood from the left atrium through the mitral valve and pumped into the aorta through the aorta valve. Heart valve failure could affect the productivity of the delivery of blood to other parts of the human body. The effect of this failure will lead to death. Echocardiogram is a diagnostic test to detect heart diseases. This study is based on the echocardiogram video taken from the Hospital Universiti Kebangsaan Malaysia (HUKM). This video is a video taken of patients left ventricle valves. The study was done with the video processing to generation of static images. From the static image, the image has been carried out to obtain the size of the left ventricle of the heart. The objective of this study was to detect the properties of cardiac chamber echocardiogram images taken from patients. In this study, an analysis of the size of the heart valves has been committed. Image processing techniques used to detect the size or diameter of the left ventricular chamber. Results are expected is to develop a graphical user interface (GUI) with the ability to import and display parameters echocardiogram images using MATLAB simulation.

TABLE OF CONTENTS

LIST OF FIGURE

CHAPTER 1

INTRODUCTION

1.1 Overview

The left ventricle (LV) is the largest chamber of the heart. The chamber consists of two valve which is mitral valve and aortic valve. It receives oxygenated blood from the left atrium via the mitral valve, and pumps it into the aorta via the aorta valve. The failure of heart valve can give effect to unproductive of blood delivery to the other part of human body. A major problem of LV namely Mitral Valve Prolapse (MVP) where a condition in which the heart's mitral valve does not work well. The flaps of the valve are "floppy" and do not close tightly. These flaps normally help seal or open the valve. Much of the time, MVP does not cause any problems. Rarely, blood can leak the wrong way through the floppy valve. This can lead to palpitations, shortness of breath, chest pain, and other symptoms. Figure 1 below show the MVP condition.

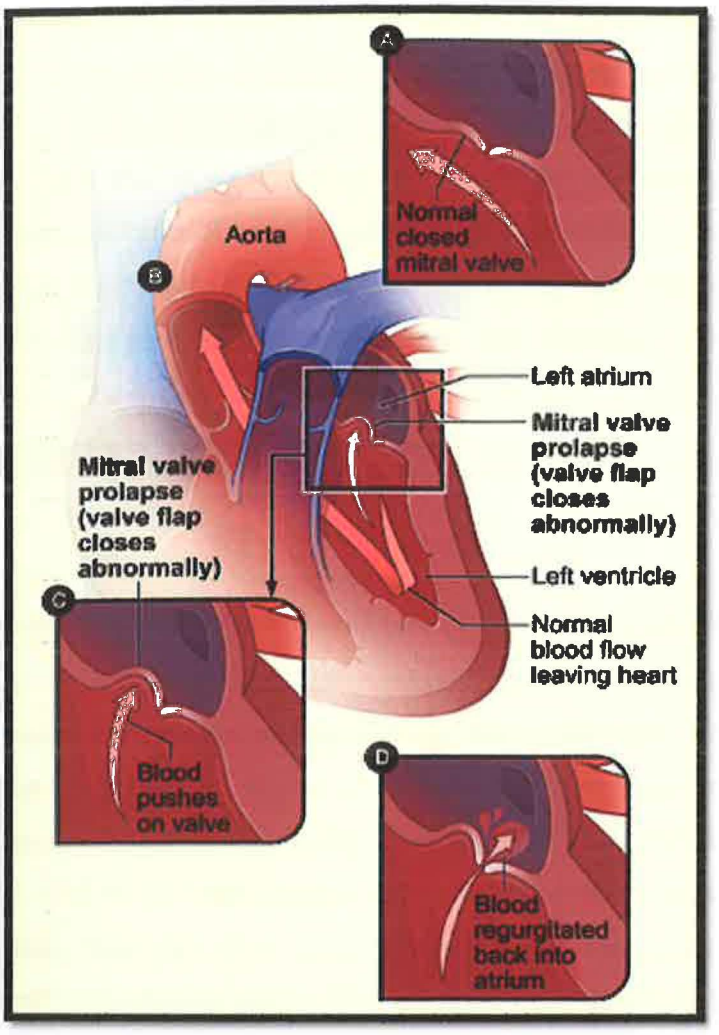


Figure 1.1: (A) A normal mitral valve. The valve separates the left atrium from the left ventricle. (B) A heart with mitral valve prolapses. (C) A close-up view of mitral valve prolapses. (D) A mitral valve that allows blood to flow back into the left atrium.

One of the methods to identify this problem is through an echocardiography (echo) also known as cardiac ultrasound. Echo is a painless test that uses sound waves to create moving pictures or video of heart. The pictures show the size and shape of heart. They also show how well heart chambers and valves are working. Echo also can pinpoint areas of heart muscle that are not contracting well because of poor blood flow or injury from a previous heart attack. A type of echo called Doppler ultrasound shows how well blood flows through heart chambers and valves. Echo can detect possible blood clots inside the heart, fluid buildup in the pericardium (the sac around the heart), and problems with the aorta.

This project is a part called "*Biomechanical Analysis and Prediction on Heart Valve Behavior by Fluid Structure Interaction Approach*" research done by the member of Faculty of Mechanical Engineering. The information obtained by the project based on the prediction can be made through engineering concept of fluid structure interaction. Based on this study, the concept will be applied by numerical simulation and next to be implemented into a software form to be used in the medicine practice. With this tool, medical practitioners can easily monitor and predict the current properties of heart valve so that they can decide on the prevention method. This study also will analyze the element of velocity, pressure, friction and strength of the cardiovascular system focusing to the heart valve.

To obtain the simulation concept using fluid structure interaction, the echo video need to processed. The echo video need to process because to get the static image before continue to the next step of image processing technique using Matrix Laboratory (MATLAB) simulation software. The software was used for image processing to detect and measure the diameter of the left ventricular area. The image processing technique and the basic mathematical calculation was applied to get clearer image and the size of left ventricle area. As a result, the size of area can be obtained and will be shown on graphical user interface.

REFERENCES

[1] K Wang, AJ Sims, A Murray, *"A Comparison of 2D and 3D Edge Detectors in Semi-Automated Measurements of Chamber Volumes Using 3D Echocardiographic Laboratory Phantom Images"*, Computers in Cardiology 2009; 36:1-4

[2] James D. Thomas, and Zoran B. Popovic, *"Assessment of Left Ventricular Function by Cardiac Ultrasound"*, Journal of the American College of Cardiology, 2006

[3] Murilo Foppa, Bruce B Duncan and Luis EP Rohde, *"Echocardiography-Based Left Ventricular Mass Estimation. How Should We Define Hypertrophy?"*, Article of Cardiovascular Ultrasound, 2005

[4] Members of the Chamber Quantification Writing Group are : Roberto M. Lang, MD, FASE, Michelle Bierig, MPH, RDCS, FASE, Richard B. Devereux, MD, Frank A. Flachskampf, MD, Elyse Foster, MD, Patricia A. Pellikka, MD, Michael H. Picard, MD, Mary J. Roman, MD, James Seward, MD, Jack S. Shanewise, MD, FASE, Scott D. Solomon, MD, and William J. Stewart, MD, *"Recommendations for Chamber Quantification: A Report from the American Society of Echocardiography's Guidelines and Standards Committee and the Chamber Quantification Writing Group, Developed in Conjunction with the European Association of Echocardiography, a Branch of the European Society of Cardiology"*, the American Society of Echocardiography, 2005

[5] V Ahanathapillai, J.J. Soraghan, P. Sonecki, *"Delaunay Triangulation Based Image Enhancement for Echocardiography Images"*, 17th European Signal Processing Conference (EUSIPCO 2009), Glasgow, Scotland, August 24-28, 2009

[6] Gila Perk, MD, Paul A. Tunick, MD, FACC, and Itzhak Kronzon, MD, FACC, *"Non-Doppler Two-dimensional Strain Imaging by Echocardiography–From Technical Considerations to Clinical Applications"*, Review Article, the American Society of Echocardiography, 2006

[7] Yefeng Zheng, Adrian Barbu, Bogdan Georgescu, Michael Scheuering, and Dorin Comaniciu, *"Fast Automatic Heart Chamber Segmentation from 3D CT Data Using Marginal Space Learning and Steerable Features"*, research paper, 2007

[8] John B. Partridge and Robert H. Anderson, *"Left Ventricular Anatomy: Its Nomenclature, Segmentation, and Planes of Imaging"*, Clinical Anatomy 22:77–84 , 2009

[9] Ali Ihsan Günal, Erdogan Ilkay, Ercan Kirciman, Ilgin Karaca, Ayhan Dogukan, and Huseyin Celiker , *"Blood Pressure Control and Left Ventricular Hypertrophy in Longterm Capd and Hemodialysis Patients: A Cross-Sectional Study"*, Peritoneal Dialysis International, Vol. 23, pp. 563–567, International Society for Peritoneal Dialysis, 2003

[10] Eric Sincoff, M.D., *"The Matlab Program in Echocardiography"*, http://rwjms1.umdnj.edu/shindler/imageproc.html [Accessed: November 2011]

[11] *"About Heart Failure"*, Website: American Heart Association, Link: www.heart.org, [Accessed: March 2012]

[13] Chapter 13, *"Heart Valve Disease"*, Jeffrey R. Bender, M.D, Yale University School of Medicine : Heart Book

[14] Fadi Shamsham, M.D., And Judith Mitchell, M.D., State University of New York Health Science Center at Brooklyn, Brooklyn, New York, *"Essentials of the Diagnosis of Heart Failure"*, Am Fam Physician 1;61(5):1319-1328, 2000

[15] Sheila Chan, Gopalakrishnan Sainarayanan, *"Fuzzy-Based Boundary Enhancement For Echocardiogram Using Local Image Characteristics"* Malaysian Journal of Computer Science, Vol. 19(2), 2006

[17] Kalpana Saini, M. L. Dewal, and Manoj Kumar Rohit *"Comparative Study of Edge Detectors in case of Echocardiographic Images"*, International Conference On Methods And Models In Science And Technology (Icm2st-10); Doi:10.1063/1.3526210 , 2010

[18] M.R.Hassanzadeh, G.R. Ardeshir, and M.R.Karami Mollaei, *"Two New Methods for Finding Endocardial and Epicardial Boundaries in Echocardiographic Images Using Wavelet Analysis"*, European Journal of Scientific Research, Vol.27 No.2, pp.264-274 , 2009

[16] Donald L. Warkentin, MD, for McKesson Health Solutions LLC, *"Mitral Valve Prolapse"*,Clinical Reference Systems, 2004