UNIVERSITI TEKNIKAL MALAYSIA MELAKA

DEVELOPMENT OF COMPUTED TOMOGRAPHY LUNG SEGMENTATION USING IMAGE PROCESSING

This report is submitted in accordance with the requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor of Electronics Engineering Technology (Industrial Electronics) with Honours.

by

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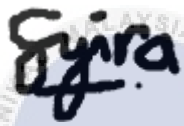

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I hereby, declared this report entitled DEVELOPMENT OF COMPUTED TOMOGRAPHY LUNG SEGMENTATION USING IMAGE PROCESSING is the results of my own research except as cited in references.

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Date: 13 February 2021

APPROVAL

This report is submitted to the Faculty of Electrical and Electronic Engineering Technology of Universiti Teknikal Malaysia Melaka (UTeM) as a partial fulfilment of the requirements for the degree of Bachelor of Electronics Engineering Technology (Industrial Electronics) with Honours. The member of the supervisory is as follow:

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ABSTRAK

Tujuan projek ini adalah untuk menganalisis segmentasi paru-paru tomografi terkomputeran (CT) yang menggunakan pemprosesan imej. Pemprosesan imej adalah teknik untuk menukar gambar menjadi format digital dan menjalankan operasi untuk menghasilkan gambar yang lebih baik atau memperoleh maklumat yang berharga. Perubahan gambar dilaksanakan secara automatik dan berdasarkan algoritma. Segmentasi adalah langkah penting dalam penilaian radiologi dan analisis diagnostik berbantukan komputer mengenai gambaran perubatan dan klasifikasi serta pendekatan komputasi untuk menentukan sempadan paru-paru tisu toraks pada tomografi terkomputeran. Selain itu, segmentasi paru-paru adalah teknik penting untuk membolehkan pemilihan kawasan yang tepat dan klasifikasi paru-paru yang lebih baik. Di samping itu, untuk menganalisis segmentasi paru-paru adalah menggunakan penapis hingar diikuti dengan ambang untuk membuat topeng binari di kawasan paru-paru. Secara rasmi, topeng binari hanya akan memilih kawasan paru-paru dan membersihkan semua kawasan di sekitar kawasan paru-paru. Topeng binari untuk menunjukkan kedua-dua paru-paru secara serentak. Hasilnya, terdapat perbandingan antara lima pesakit dengan sepuluh keping secara rawak dan berjaya segmen setiap pasangan paru-paru.

ABSTRACT

Aim of this project is to analyze computed tomography lung segmentation using image processing. Image processing is a technique for converting an image into a digital format and executing operations to produce a better image or derive valuable information. Changes in images are automatically implemented and based on algorithms. Segmentation is a significant step in the radiological assessment and computer-assisted diagnostic analysis of medical imagery and classification and the computational approach to determining thoracic-tissue boundary lung borders on computed tomography. Besides, lung segmentation is important technique to allow correct selection of region of interest and improve classification of the lung. In addition, for analyze segmentation of lung is by using noise filters followed by the thresholds are to create a binary mask for the lung area. Formally, the binary mask will only select the lung region and clear the all regions surrounding the lung area. The binary mask to show both lungs simultaneously. For the result, there is a comparison between five patients with ten slices randomly and successfully to segment every lung pair.

DEDICATION

This thesis is dedicated to;

My beloved parents,

Zamri Bin Hj Ismail and Roeslinda Binti Abd Aziz,

My Supervisor, Ts Khairul Azha Bin A. Aziz and

all my fellow friends. Thank you for always inspiring me.

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mm	-	milimetre
%	-	Percent

LIST OF ABBREVIATIONS

CT	Computed Tomoghraphy
MLP	Multilayer Perceptron
LIDC	Lung Image Database Consortium
MRI	Magnetic Resonance Imaging
TCIA	The Cancer Imaging Archive Medical
Mhd	Malteser Hilfsdienst (medical help organization)
Eq	Equation
IGRT	Image Guided Radiotherapy
EBRT	External Beam Radiation Therapy
3D	3 Dimensions
PET	Positron Emission Tomography
ROI	Regions of Interest
GGO	Ground-Glass Opacification
HU	Hounsfield Unit
SGA	Simple Genetic Algorithm
DICOM	Digital Imaging and Communication in Medicine
PACS	Picture Archive and Communication System
FYP1	Final Year Project 1
FPY2	Final Year Project 2
GUI	Graphical User Interfacing building

CHAPTER 1

INTRODUCTION

1.1 Introduction

The introduction, project background, problem statement, main objective and scope of the project are discussed in this chapter. This project focusing on the segmentation of lung.

1.2 Project background

The process of distinguishing the lung region from another tissue within the CT image often is a function of lung segmentation. Lung segmentation does not separate the typical and unhealthy lungs exactly. The first step image analysis segmentation is detected organ and boundaries of delineated either manually or automatically.

Computed tomography is an essential modality for diagnosing and guided procedures commonly used in a broad range of clinical indications. Nearly any CT image is now digitally visible, facilitating ever more advanced image restoration techniques and image processing in or as an extension to image archiving and communications systems. For pulmonary image study, the first and foremost stage is the segmentation of the lung organ. The next step is to detect the organ and to delineate its anatomical limits automatically or manually. False knowledge regarding the further detection of diseased areas and various further clinical quantifications will be created by errors in organ segmentation, so correct segmentation is a prerequisite.

It is crucial to add typical trends for the pathological imagery seen on pulmonary CT images before the explanations and assessment of the output of segmentation methods and the complexity concerning the particular type and locations of abnormal imagination if various pathological conditions occur.

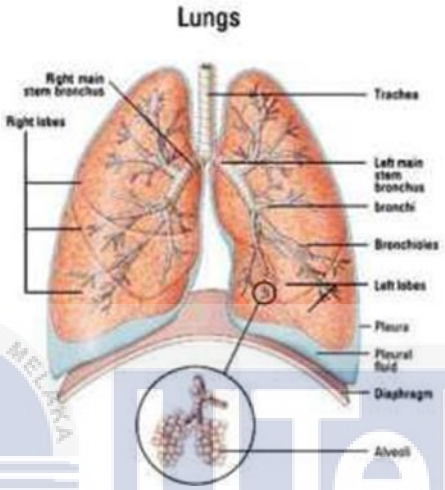

Figure 1. 1: Diagram of The Lungs

1.3 Problem Statement

Along time ago, health researchers have used medical imaging systems more commonly to detect patients' sickness. For instance, for the creation of a medical image, a CT scan is required for an imaging modality. To achieve the image quality, the image produced by imaging modalities needs to be processed first. Segmenting is a process by which an image is separated into more relevant areas for a particular purpose; it is the first step in processing and understanding the idea.

Segmentation is also used in the medical field to promote the study of the patient's form, scale, and limits of the target or area of concern. Segmentation is not straightforward; besides, there are many problems to remember in this process, like highlights, shadows, transparency and occlusion of objects. Segmentation methods are divided into two basics: segmentation based on similarity and based on discontinuity. One way based on similarity is a region growing, while the method based on the discontinuity is level set. For this project, was used the image of the lungs as the object of segmentation. Segmentation methods are then split into two fundamentals to promote this, respectively, segmentation dependent on similarities and discontinuity. The area is increasing when the technique based on discontinuity is set at the stage. The lung is an organ which in terms of its boundaries is very difficult to describe. The segmentation technique is then needed to evaluate the lung image results. The precision in determining lung diseases relies on the reliability of the methods of lung division.

1.4 Objectives

The objectives for this project are:

- To develop a lung segmentation system in CT images using image processing
- To segment lung region from CT images.
- To analyze segmentation of lung in CT scans images

1.5 Scope of project

Segment lung by using image processing system is the purpose of this thesis. Besides, compared with other modalities, CT scans are more effective. Image analysis methods are commonly used to promote early care of many medical conditions with better images in the identification period. The lung segmentation utilizing a threshold procedure is achieved without the threshold value being measured. Image segmentation is a mid-level image processing process. The dataset Lung Image Database Consortium (LIDC) is used, which has 1010 CT scans of patients considering lung cancer. The LIDC data collection also includes diagnostic information on each suspicious lung nodule, not Lung CT images. The LIDC dataset will consist of the lung contour position as a golden norm, which is available to test the lung segmentation outcome. A segmentation problem may usually be considered two associated work: identifying objects and the delineation of things. Item detection implies the target object's location, while object delineation draws the spatial extent and structure of the object. When the data analysis is carried out, the images are analysed and modified using an optical or digital camera scanner. The image processing algorithm uses the program MATLAB

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

A basic summary of the current methods for lung segmentation on CT images, with uncommon accentuation on the accurate and execution of the method in cases with. An interactive system for lung segmentation is introduced, in view of pre-computed minimized districts with homogeneous surface for which general texture feature have been computed.

2.2 Medical Scanning Modalities

There are medical scanning modalities such as CT scan, Magnetic Resonance Imaging (MRI) and X-ray. For CT scan advantage is CT scan mostly used in radiotherapy cause of low cost and most reliable (Naqiuddin, Muhammad, et al., 2018), more efficient (Islam, Mahmudul, et al., 2019) and less noise (Tekade, Ruchita, and K.Rajeswari, 2018). Then for their advantage is CT scan image have some difficulties and has poor image contrast generated (Naqiuddin, Muhammad, et al., 2018). Then, for the advantage MRI, not used ionizing radiation for MRI image acquisition and non-invasive which patient acceptability is high. For the disadvantage, only greater expertise is required for utilization of MRI than others imaging modalities. Next, for the advantage X-ray, easy to handle and diagnose and the disadvantage is failed to detect normal two-dimensional and hard to detect lung cancer stages (Islam, Mahmudul, et al., 2019).

2.3 Dataset

According to (Tekade, Ruchita, and K. Rajeswari, 2018) dataset was used from TCIA repository named as, Lung Image Database Consortium and Image Database Resources Initiative (LIDC-IDRI). It was containing 1010 patient cases and also 1018 thoratic CT scan acquired in DICOM format. Besides, four radiologists have annotated lung lesions by refer it"s size as nodules > = 3mm, nodules < 3mm and non-nodules > = 3mm. Lung Nodule Analysis 2016 which is competition was held in 2016-2017 and focus on pulmonary nodules by screening LIDC-IDRI dataset CT scan images. Some nodules are annotated by more than one radiologist, as LIDC-IDRI dataset is created with the help of four radiologists. CT slices having thickness over than 2.5mm were excluded. Total of 888 CT scans in mhd and raw format which contain by this dataset. 10 extracted features were trained by MLP with 2 output classes and 30 hidden layers. The result is 95% achieved. (Paing , May Phu, and Somsak Choomchuay, 2017)

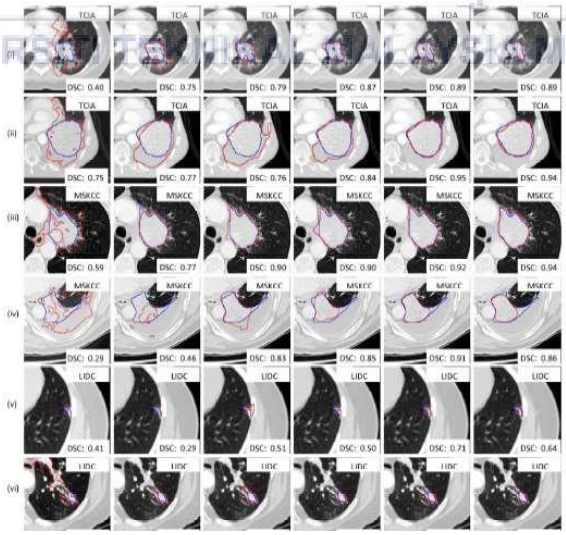

Figure 2. 1: Example Results of Segmentation by Using Technique from The Three Related Datasets