LOCALIZATION OF ABNORMALITY IN XRAY IMAGES OF LUNGS

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Specially dedicate to…

My beloved parents, my dearest brother and sisters
And
To all my friends

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ABSTRACT

An automated method is presented and proposed to detect abnormalities in frontal chest radiographs which are aggregated into an overall abnormality score. The process flow or sequence of steps are approached by using pure basic image processing techniques. The aim of this project is at finding abnormal signs of a diffuse clot of region and localized the abnormalities through the size and location from the lung image but will not determine the type of abnormalities of the disease. By using MATLAB code function and program, the scheme starts by identifying the category of the input lung image in DICOM format based on histogram area values measured and followed by the image segmentation of the lung fields with edge detection function. Edges associated with the boundaries and thresholding was used and binary images were created from the grayscale on the lung image done at histogram level corresponds to lights of region of interest on dark background. The region of interest were separated and extracted from the background by Morphology process. After getting the segmentation results for the left and right lungs of the largest size of mean area, other clot regions which were separated from the expected lung fields were identified and revealed. The abnormal clot regions were marked and labeled to differentiate the abnormalities to be seen compared with normal lung images.

ABSTRAK

Satu kaedah automatik di perkenalkan dan di percadangkan untuk mengesan sebarang abnormal atau tanda-tanda tidak normal pada radiografi paru-paru atau dada. Kaedah ini di mana dengan mengikut turutan mengunakan asas-asas teknik pemprosesan imej. Projek tesis ini bertujuan mengesan sebarang tanda abnormal dalam bentuk pembekuan, pengasingan berpandukan saiz and kedudukannya pada imej radiografi paru-paru. Walaubagaimanapun, objektif tesis ini tidak termasuk dengan tujuan untuk mengesan jenis penyakit berkaitan dengan abnormal yang telah dikesani. Dengan menggunakan kod fungsi MATLAB, kaedah ini dimulakan dengan menklasifikasikan kumpulan imej paru-paru iaitu dalam DICOM format dengan berpandukan keluasan histogram, di ikuti dengan segmentasi imej paru-paru turut mengunakan fungsi pengesan titik-titik pinggir pada imej, dimana ia berkait rapat dengan sempadan dan nilai "threshold" pada imej. Imej dalam bentuk binari dengan berpandukan "grayscale" daripada histogram mengasingkan bentuk-bentuk imej yang dikehendaki adalah lebih cerah berbanding dgn latarbelakang yang gelap. Hanya pada bentuk-bentuk imej yang tertentu sahaja dan dikehendaki daripada imej asal paru-paru di asingkan dari latarbelakang imej dengan menggunakan proses Morphology. Selepas proses segmentasi bagi bahagian kiri dan kanan imej paru-paru di mana adalah nilai terbesar purata keluasan, bentuk-bentuk yang terasing daripada imej paru-paru dikesan sebagai bentuk abnormal. Pada bentuk-bentuk yang terasing ini di tanda and dilabelkan bagi membezakan bentuk yang abrnormal berbanding dengan bentuk bagi paru-paru yang normal.

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LIST OF ABBREVIATIONS

ASM	-	Active Shape Model Segmentation
CAD	-	Computer-aided diagnosis
CT	-	Computed Tomography
HANN	-	Hopfield Neural Networks
MRI	-	Magnetic Resonance Imaging
PET	-	Positron Emission Tomography
ROI	-	Region of Interest

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CHAPTER 1

INTRODUCTION

1.1 Introduction

Image analysis and retrieval are currently an active research fields mainly because of the large amount of visual data being produced in modern hospitals, and the lack of applications dealing with these data. Most often, the goal is to aid the diagnostic process.

Early research from 1970s for instance focuses on the detection of pneumoconiosis, using features extracted from pixel profiles, Fourier spectra and matrices. Lately and recent methods are applied to detect the disease in general and use a similar approach of regions of interest by selected and texture features are computed based on geometric features, responses to filters, pixel profiles and classification is performed using rules (thresholds) or feed-forward neural networks[1].

From the recent researches are exploring for the earliest detection related to lung cancer which is one of the most serious cancers in the world, with the smallest survival rate after the diagnosis, with a gradual increase in the number of deaths every year. Survival from lung cancer is directly related to its growth at its detection time. The earlier the detection is, the higher the chances of successful treatment are. An estimated 85% of lung cancer cases in males and 75% in females are caused by cigarette smoking [2].

In the current clinical practice, hundreds of thin-sectional CT (computed tomography) images (300-600) are generated for each patient and are evaluated by a radiologist in the traditional sense of looking at each image in the axial mode, something very difficult to interpret and very time consuming to radiologists. It is important for a patient who is suspected of suffering any lung related diseases such as tuberculosis or cancer can be determined by having a clot like region and automatically detect from the visual x-ray image of the lungs.

1.2 Background

Medical image analysis is known for a complex task in which a human expert makes extensive use of the knowledge of anatomy and imaging techniques. The automatic segmentation of chest radiographs for instance is a challenging problem from a computer vision point of view. This is because there are large anatomical variations from person to person and the most important problem is that radiographs are projection images and thus contain superimposed structures. In interpreting the chest radiographs, the radiologists apply local properties like perceived intensity, uniformity, roughness, regularity, directionality, coarseness and smoothness. The detection of abnormalities is normally found in lungs through visual inspection of x-ray images of the patient.

Although computed tomography (CT) or magnetic resonance imaging (MRI) for example are generally considered as the most effective diagnostic modality for detection abnormalities of lungs, the chest radiography remains the initial procedure because of its ability to reveal some unsuspected alteration, as well as its low cost and convenient imaging display procedures.

For instance in CT, X-ray photons are used to scan the patient’s body from different angles and CT images give detailed anatomical information but no information about functionality. A tumor can for example be possible to detect in a

CT image, but there is little information about malignancy and growth rate. The combined PET/CT technique merges these two methods for medical imaging in one device. Positron Emission Tomography, PET, is a modern imaging technique in nuclear medicine for measuring and quantifying biochemical processes as shown in Figure 1.1 below for the example of the images of CT, PET and combined PET/CT. A radioactive isotope incorporated in a tracer substance is injected into the patient's body, the decay is measured from different directions with a detector and the image is reconstructed in a computer. This is the basic concept for nuclear imaging in general. Therefore, the drawback of PET/CT is that a scanner in operation needs to be located close to a cyclotron, because of the short half-life of the isotopes used. This circumstance makes the technology is costly and more expensive [3].

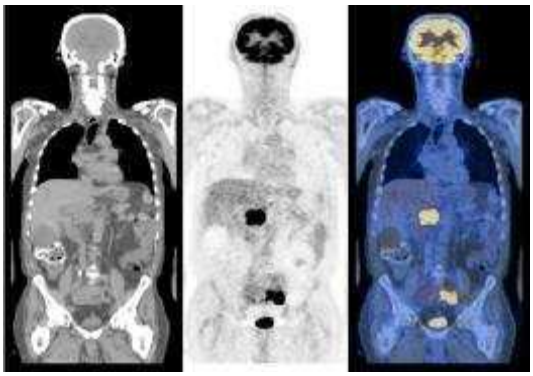

Figure 1.1: The CT, PET and combined PET/CT images

Computer-aided diagnosis (CAD) schemes for example have been developed and made by a physician who takes into consideration the results of the computer output as a 'second opinion'. Feedback from the radiologists' performance was improved when the computer results were available. Three typical tasks usually included is the extraction of organs such as lung, heart and diaphragm by using pixel classification.

The underlying idea of developing a CAD system or a software program is not to delegate the diagnosis to a machine, but rather that a machine algorithm acts as a support to the radiologist and points out locations of suspicious objects, so that the overall sensitivity (detection rate) is raised. The detection of abnormalities is

normally found in lungs through visual inspection of X-ray images of the patient as shown in Figure 1.2 as example of the lung X-ray image. A patient who is suspected of suffering any lung related diseases such as tuberculosis or cancer can be determined by having a clot like region.

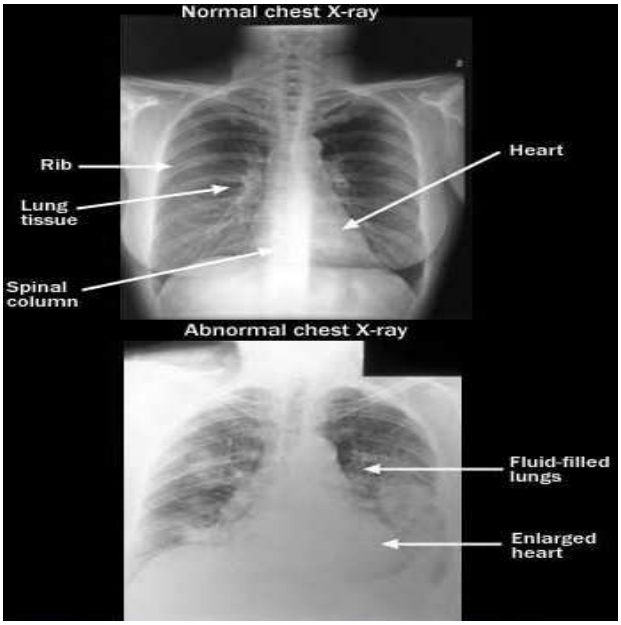

Figure 1.2: Lung X-ray image

The underlying idea of developing a CAD system or a software program is not to delegate the diagnosis to a machine, but rather that a machine algorithm acts as a support to the radiologist and points out locations of suspicious objects, so that the overall sensitivity (detection rate) is raised. The detection of abnormalities is normally found in lungs through visual inspection of X-ray images of the patient. A patient who is suspected of suffering any lung related diseases such as tuberculosis or cancer can be determined by having a clot like region.

Since the detection is based purely on human vision, different medical officers may decide different, thus, leading to inconclusive results. Finally, finding or isolating and quantify the normal or an abnormal pattern such as texture or shape. Indeed, for the radiology, this last step is certainly is the more complex and their variations are complicated.

1.3 Objective

This project aims on developing an algorithm or process flow for automated system to perform detection of any abnormalities on the lung image but will not determine the type of abnormalities of the disease. More specifically to automatic detect the abnormal region and location from the visual X-ray image of the lungs by multiple stages in isolating and localizing based on the image processing and methodologies. Abnormalities are detected based on deviation of clot region from expected symmetries between the left and right lungs, using such features as size or area and its location of the aerated of lungs regions.

1.4 Scope of Work

The program flow is developed using MATLAB code function applying the image processing methodology. The step of sequence involved image analysis by extracting information from the image as for the basic; grouped and categorized the related size of images by quantifying the histogram area, discontinuity of gray-level values and intensity such as edges. By the similarity of gray-level values involves in partitioning an image into the expecting similar regions according to a set of predefined criteria. The extraction clot of region is by applying morphological process and displaying the image by marking on region of interest for abnormalities detection.

1.5 Problem Statement

As the detection or identification originally based purely on human vision, different medical officers which mentioned earlier may give different opinions and diagnosis, thus, leading to inconclusive results. In the image analysis of chest

radiographs is the complex “background” of superimposed normal anatomical structures to which the analysis must be somehow insensitive. The challenge consists of segmenting corresponding regions within the lung fields which is not an easy task since there are many types and and sizes of lung images, different exposure levels of the different organs. For the methods in the related theory and work section include gray level thresholding techniques that would have the problem of selecting the suitable and accurate threshold values. Furthermore, extraction of region of interest using morphological process will not be a straight forward procedure. This is to avoid re-screening through the important region or area which may accidentally be removed or filtered. For medical images, this must be taken consideration seriously. Thus, the repetition mode with the developed program of specific algorithm or flows is proposed to meet the objective of detecting the abnormalities from the lung images.

1.6 Report Layout

The layout of this report would be as follows:-

Chapter 1: Brief introduction of project, including objectives, scope of work and problem statement.

Chapter 2: Literature review of other research and published technical paper of this project related and methods approached.

Chapter 3: Theories and methods approached.

Chapter 4: Design, work flow and methodology.

Chapter 5: Results and output analysis.

Chapter 6: Conclusion and recommendation.

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