Faculty of Electrical and Electronic Engineering Technology

DEVELOPMENT OF COMPUTED TOMOGRAPHY LUNG CANCER ANALYSIS USING IMAGE PROCESSING

MUHAMMAD AZRI NAIM BIN AIZAHAR

Bachelor of Electronics Engineering Technology (Industrial Electronics) with Honours

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DEVELOPMENT OF COMPUTED TOMOGRAPHY LUNG CANCER ANALYSIS USING IMAGE PROCESSING

MUHAMMAD AZRI NAIM BIN AIZAHAR

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Alamat Tetap:

30, Taman Pasir Emas,
Jalan Sungai Nipah,
11000 Balik Pulau,
Pulau Pinang

Ts. KHAIRUL AZHA BIN A AZIZ
Pensyarah Kanan
Jabatan Teknologi Kejuruteraan Elektronik Dan Komputer
Fakulti Teknologi Kejuruteraan Elektrik Dan Elektronik
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DEDICATION

Special dedication to my beloved dad, mom, brothers and sisters for their endless support, their constant love and inspiration. To my supervisor, Encik Khairul Azha Bin A. Aziz for his knowledge, motivation and guidance that has been poured tirelessly throughout completion of this project as well as to my fellow friends for their support an encouragement on me.

ABSTRACT

Image processing as it is known is a very sophisticated and widespread as well as rapidly used technology that been used nowadays, which can be used in various fields. It is also widely used especially in medical fields because it is extremely useful and very important in identifying various type of diseases that are difficult to see in the human body especially cancer which is a type of node growth in the body and was a dangerous disease that needs to be identified at an early stage so that it can be detected and get an early treatment which indirectly minimized the cases of death due to cancer. So by using an image processing technique, it can indirectly detect whether the tumor is present or not in the body and also to show that, at what stage the growth of the cancer nodes is in the lungs. Mostly this method is call as a Computed tomography or in short CT–scan. Therefore, in this paper, it focuses on all its main objective which is to designing and creating a Graphical User Interface (GUI) which can detect cancer node as well as the stage of the nodule cancer using App Designer in MATLAB software as well as analyzing the type of cancer stage by using a Computed Tomography (CT). Other than that, this project would use an Edge Detection method to determine the boundaries for each objects within the images. Besides that, this project also focus on using a Fuzzy C-Mean clustering method for the lung cancer segmentation and edge extraction. With regards to the Fuzzy C-Mean clustering approach, the outcome is not fixed to a single image iteration because it is dependent on the cluster that has been established. Thus, the more clusters applied to the image, the more varied the output of iteration. At the end, this project is capable to achieve the final result which is able to analyze and read the image as well as able to measure the size of cancer nodule by using GUI that been created in App Designer through MATLAB.

ABSTRAK

Pemprosesan gambar seperti yang diketahui adalah satu teknologi yang sangat canggih dan luas serta pesat digunakan pada masa kini, yang dapat digunakan di dalam pelbagai bidang. Ia juga digunakan secara meluas terutama dalam bidang perubatan kerana ianya sangat berguna serta penting dalam mengenal pasti pelbagai jenis penyakit yang sukar dilihat di dalam tubuh manusia terutama barah yang mana merupakan satu jenis pertumbuhan di dalam badan yang sangat berbahaya yang perlu dikenal pasti pada peringkat awal supaya ia dapat dikesan dan mendapat rawatan awal yang mana secara tidak langsung meminimumkan kes kematian disebabkan barah. Jadi dengan menggunakan kaedah pemprosesan gambar, ia secara tidak langsung dapat mengesan sama ada tumor itu ada atau tidak di dalam badan dan juga menunjukkan pada tahap mana pertumbuhan barah tersebut berada di dalam paru-paru. Kaedah ini selalunya dipanggil sebagai "*Computed tomography*" atau Pengimbas CT. Oleh itu, dalam laporan ini, ia akan memfokuskan pada semua objektif utamanya iaitu merancang dan membuat Antaramuka Pengguna Grafik (*GUI*) yang dapat mengesan pertumbuhan nod barah di paru-paru serta menganalisis jenis tahap kanser dengan menggunakan kaedah *Computed tomography (CT)* di dalam GUI tersebut. Selain daripada itu, projek ini menggunakan kaedah Pengesanan Pinggir untuk menentukan sempadan bagi setiap objek di dalam imej Pada waktu yang sama, projek ini juga akan menumpukan pada penggunaan metode pengelompokan *Fuzzy C-Mean* untuk segmentasi barah paru-paru dan pengekstrakan. Pada akhir projek ini, projek ini mampu mencapai hasilyang diharapkan iaitu dapat menganalisis dan membaca gambar serta dapat mengukur ukuran nodul barah dengan menggunakan GUI yang telah dibuat di App Designer melalui MATLAB.

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LIST OF ABBREVIATIONS

MRI	-	Magnetic Resonance Imaging
CAT	-	Computed Axial Tomography
CT	-	Computed Tomography
PET	-	Position Emission Tomography
DCM	-	Digital Imaging and Communication in Medicine
HU	-	Hounsfield Scale
FCM	-	Fuzzy C-Mean
GUI	-	Graphical User Interface

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CHAPTER 1

INTRODUCTION

Nowadays, cancer has become a major burden of disease worldwide. Each year, more than a million of people are diagnosed with cancer around the globe, and more than half of that amount eventually die from it. In many countries, cancer have been ranked the second most common cause of death just behind the cardiovascular diseases. As all know, the cancer occurs when the cellular reproduction process in our body goes out of control. In other words, cancer is a disease characterized by uncontrolled, uncoordinated and undesirable cell division. Unlike normal cells, cancer cells continue to grow and divide for their whole lives, replicating into more and more harmful cells. To reduce this cancer disease percentage and to save a lot of life, diagnosing cancer at its earliest stages must be done so that the chance to cure the cancer become higher. There are varies of way to diagnosis a cancer such asa physical exam, laboratory test, Imaging test or biopsy. In this paper will be focus on diagnosing using a imaging test, which is by using computed tomography (CT) scan and also discuss about a systems developed for cancer detection based on CT scan images of lungs to spot any type of cancer stage as well as the detail of the patients. The background, problem statement, objective and project scope are included in this chapter.

1.1 Background

Lung cancer has been a major cause of death among types of cancers in the world. It is estimated by the World Health Organization (WHO) that in 2020 only, about 19.3 million new cancer cases has been detected and recorded throughout 2020 with nearly 10.0 million from it leading to death. It been stated by World Health Organization (WHO) that about 2.26 million cases was about a breast cancer. Follow by 2.21 million cases for lung cancer then a colon and rectum cancer (1.93 million), prostate cancer (1.41 million), skin cancer (1.20 million) and stomach cancer (1.09 million). This show that the lung cancer is the second most common cause of death just behind the breast cancer which is the most major cancer cases in worldwide. Usually, this lung cancer happens because of changes of normal cells into a tumour cells which mostly caused by interaction between a person's genetic factors with a chemicals and hazardous substances such as ultraviolet, ionizing radiation, components of tobacco and etc. But mostly, lung cancer cases happen was causes by smoking which is clearly the strongest risk factor for most people not just for the smoker but also for the non-smoker. This happens because of the exposition of radon and asbestos for the smoker and second-hand smoke and air pollution for the non-smoker. So, because of these reasons, this project has been conducted which is to help to detect the early stage of lung cancer and to avoid it from becoming worse by using a medical imaging technique which has been prove useful nowadays to detect any types of cancer that happen in the body as well as give a clear result of the lung cancer nodules compare to other techniques and processes.

1.2 Problem Statement

Lung cancer has become the most common cancer among people in worldwide especially in Malaysia. It not just causes a lot of death among the smoker but also to the non-smoker both men and women. In 2020, It is estimate that nearly 50, 000 people in the Malaysia face a new lung cancer cases with more than half (29, 530) leading to death. Although various method has been used such as the Cancer or Tumour segmentation method which is a process of separating tumour from normal tissue which is a good method because it provides a useful information of the cancer for diagnosis and treatment planning. However, it is still a challenging task due to the irregular and confusing shape of the cancer as well as lack of knowledge about the cancer. These has led many researchers all around the world to continue doing their research to find a better way on how to detect and cure this disease to decrease this lung cancer cases which has cause million and thousand death every year.

One of the better ways to doing this is by using CAT scan or usually been call as CT scan which has an able to access, collect and shows a detailed image (data) of any part of the body by emits a series of narrow beams through the whole body which been used to take an image of different angle of body as it moves through an arc which create a cross-sectional image of the body parts. These show that CT scan is more detail in collecting and show a data compared to normal x-ray scan.

Besides that, with the advanced technology that keep improving in medical field year by year which from this, introduce a new technique such as image pre-processing, image enhancement and segmentation will help to improve the quality of the image so that it become more clear without having any noise in the image.

1.3 Project Objective

The main aim of this project is to develop or design a lung cancer detector system for medical purpose by using image processing method. So this system analyze each of the image data which is in DCM format and detect a cancer nodule that exist in the data. Specifically, the objectives are as follows:

a) To develop a Computed Tomography Lung Cancer Analysis Using Image Processing in App Designer through MATLAB software.

b) To design and create a Graphical User Interface (GUI) which can detect cancer node using App Designer in MATLAB software.

c) To proposed to use a Fuzzy C-Mean clustering method for the lung cancer segmentation and edge extraction.

d) To analyse and measure the size of cancer nodule output by using GUI that been created in App Designer through MATLAB.

1.4 Scope of Project

The main purpose of this project is to create a system that can analysis the data and display it in the App Designer. The system was created by using a Graphical User Interface (GUI) and also using DICOM image files from The Cancer Imaging Archive (TCIA) dataset that been provided as a data for the GUI. The DICOM image from the TCIA dataset come in various type of nodule which is suitable for testing the created GUI. By using a Computerized Tomography (CT) scan method which is the most suitable method to diagnose and detect the cancer or lung nodule as well as an image processing technique such as image pre-processing, image enhancement and segmentation which help to improve the quality of the data image so that it become clearer without having any noise in the image.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

The study is about a research on a cancer and how to detect it in early stage. This research been conducted by using an imaging test method which is, a computed tomography (CT) scan or simply, CT-Scan. This method used powerful X-rays, a form of radiation, to create detailed pictures of the inside of your body in a shape of cross-sectional image or “slices” image which been call “tomographic images” and contain more detailed information than a conventional x-rays but with a more radiation exposure effect compare to other imaging test such as MRI and PET scan. But with advanced technologies that keep improving year after year, decreasing CT radiation dose without affecting image quality is a hot direction for research of medical imaging nowadays. So basically, the goal in this section is to educate people on the basics of cancer and cancer treatment. Possessing this knowledge will, I hope, help people to better understand what cancer is, how it occurs, and how to make informed choices about cancer care options.

2.2 Related Work

2.2.1 Implementation of Image Processing Technique For Identifying Different Stage of Lung Cancer

Based on journal “Implementation of Image Processing Techniques for Identifying Different Stages of Lung Cancer” by Anjali Sevani, Hardik Modi, Sagar Patel and Himanshu Patel say that Lung cancer or Lung carcinoma is an uncontrolled cell growth tumour in the tissue of the lungs. This Lung cancer can be categories into two types which is Small Cell Lung Cancer (SCLC) and Non-Small Cell Lung Cancer (NSLC).

2.2.1.1 Stage of Lung Cancers

There is total four stages of the lung cancer as below:

Table 2.0 : Stage of Lung Cancer

Stages	Descriptions
Stage I	The cells of cancer are present only in the lungs and have not spread to any lymph nodes. The size of tumor is < 3 cm.
Stage II	The cells of cancer are presents in the lung and nearby lymph nodes. The size of tumor in this stage is between 3 cm to 7 cm.
Stage III	In this stage, cancer cells are occurred in the lung and in the lymph nodes in the middle of the chest. In this stage, the size of tumor is > 7 cm.
Stage IV	This stage of cancer is very dangerous and impossible to recover. In this stage, cancer cells are spread into both lungs or to another part of the body, such as the liver or other organs

Through this, it can be assumed that if the tumor is in the first or in the second stage, it can be recovered. If the tumor is in the third stage of the cancer, it will be a bit difficult to recover. But when tumor is in dangerous stage which is fourth stage, in which there will be no more chances to remove the lung tumor because the cells of the cancer are spread through all the part of the body which is very difficult to recover. As a treatment of the lung cancer, several image processing techniques especially CT (Computed tomography)-scan must be used to detect whether tumor is present or not and also to shows that, in which stage the cancer is present in nodes of the lungs through CT- scan (Computed tomography) image.

2.2.1.2 Image Processing Techniques

There are a few processes of lung cancer detection which mainly use to detect cancer by using image processing techniques.

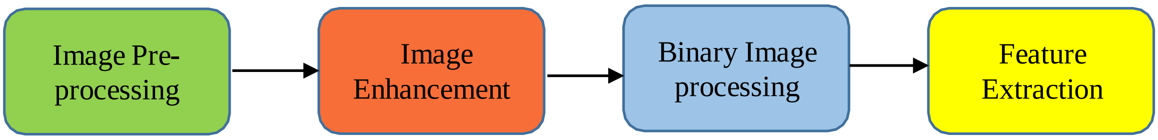

Figure 2.0 :Image Processing Technique

a) Image Pre-processing

For the first step which is Image Pre-processing, the image needs to be resized first as well as improve the quality of the image by removing unnecessary parts and the image noise. This is because the image sources that been obtained from various sources may possible different in terms of size and quality. So, to get a better image and result in our case, to specify the stages of the cancer in image processing, image resizing is the most important factor. After resizing the image, the image will be converted into the grayscale image. In grey scale image, the value of each pixel is single sample, which carries only intensity information of the pixel. This type of images is the result of measuring the intensity of light at each pixel in a single band of the light spectrum such as infrared, ultraviolet, and visible light. So, by converting image to grayscale, it will make the detection of an intensity object (cancer) from the background easier. [1]

b) Image Enhancement

Secondly to improve the quality of the image, Image enhancement will be used. This is because by using Image Enhancement, it will make the image look better as