CHAPTER 1

INTRODUCTION

1.1 Introduction

Image means picture. It can be analogue or digital. An analogue image is an image which exists on a photographic film, video magnetic tape or signal from a broadcast transmission (Joshi, 2001). Meanwhile, a digital image is a representation of two dimensional image using ones and zeros or in binary numbers. Digital image data is represented in the form of grey scale, corresponding to the intensity. It can be processed using the digital computer. The term digital image usually refers to raster images also called bitmap images. Raster images have a finite set of digital values called picture elements or pixels.

Interest in digital image processing techniques dates back to the early 1920's when digitized pictures of world news events were first transmitted by submarine cable between New York and London. Application of digital image processing concepts, however did not become widespread until the middle 1960's, when third generation digital computers began to offer the speed and storage capabilities required for practical

implementation of image processing algorithms. Since then, this area has experienced vigorous growth, having been a subject of interdisciplinary study and research in such fields as engineering, biology, computer science, medicine and chemistry. The result of these efforts have established the value of image processing techniques in a variety of problems ranging from restoration and enhancement of space-probe pictures to processing of fingerprints for commercial transactions.

Image processing is an area of study for manipulating and modifying images. Image processing involves techniques for image enhancement, restoration and smoothing by moving, copying, deleting and modifying the contents of the pixels in the image. Before an object can be extracted from scenery, a way of assessing it shape and size is needed. This can be done using edge detection or segmentation, both of which are low-level image processing task, or their combination (Gudmundsson et all, 1998). The success of the higher level recognition is, therefore highly dependent on this lower level process.

Edge is the boundary between two regions, with relatively distinct grey level properties (Joshi, 2001). In a continuous image, a sharp intensity transition between neighbouring pixels is considered as an edge. Laplacian and Sobel are classical mathematical methods for the edge detection. The Laplacian edge detection method uses a two dimensional linear filter to approximate the second order derivative of pixel values of the image. The Sobel edge detection method uses two dimensional linear filters to process vertical edges and horizontal edges separately. One of the popular methods in edge detection is the Canny Edge Detector (Heath et all, 1997). This method was introduced by John Canny on 1986.

Due to the important of edge detection in image processing many methods were developing. In real world machine vision problems, numerous issues such as variable

scene illumination make edge and object detection difficult. There exists no universal edge detection method which works well under all condition (Panetta and Wharton, 2008).

The past 25 years have seen remarkable developments in medical imaging technology. Universities and industry have made huge investments in inventing and developing the technology needed to acquire images from multiple imaging modalities, such as CT, MRI, and Ultrasound. Every modality has its own working principle and system that enable us to obtain the final images. For example, X-ray computed tomography (CT) images are sensitive to tissue density and atomic composition, and the x-ray attenuation coefficient (Hajnal et all, 2001).

Image reconstructions methods were used in order to obtain the final images in the medical imaging modalities. As an example, in x-ray tomography, image reconstruction from projection method such as the filtered back projection method was applied. After the image was reconstruct, we now can apply the image processing techniques as desired.

1.2 Problem Statement

Given an image of size $m \times n$. In what way can the image be reconstructed so as to produce binary versions which clearly display the high and low intensity pixels? The binary version is an image with black and white colour which the white colour shows the boundary of the object in the image. The white color indicates the edges and the black color indicate no edges. In medical field, the binary version of the image is a preliminary

stage in any medical decision. The selection of edge detection method is also an important step because not all method can detect the desire edges.

One of the available methods in edge detection is Canny edge detection. Canny edge detector used the first derivative of a Gaussian $G(x)$ as the optimal filter where;

$$G(x) = \exp\left(-\frac{x^2}{2\sigma^2}\right)$$

where σ is the standard deviation of the Gaussian function and x is the value from origin in one dimension case. Then, the edge point is defined to be a local maximum in the direction of n of the operator G_n applied to the image I , where $G_n = n \cdot \nabla G$ where n is normal to the edge direction. At local maximum, we have $\frac{\partial}{\partial n} G_n * I = 0$. Then the problem becomes to find the location of local maxima in the image. Since an image contains higher number of pixel, we need to use the simulation to find the edges.

1.3 Objectives

The objectives of this study include:

a) To apply the Laplacian , Sobel and Canny edge detection method on the medical images.

b) To develop a simulation of Laplacian, Sobel and Canny edge detection method.

c) To compare the performance of Laplacian, Sobel and Canny edge detection using visual assessment.

1.4 Scope

This project use Laplacian, Sobel and Canny edge detector for detecting the edges. Comparisons were made to determine which method is the best using visual assessment. Laplacian and Sobel edge detection have one parameters meanwhile Canny edge detection has three parameters. The parameters values are just any values and we do not study the best parameters values for each method. We apply the method to the medical images from x-ray tomography. Some discussion about image reconstruction from projection in x-ray tomography also included. The test image is the liver image which we aim to locate a tumor.

1.5 Project Outline

This project contains six chapters. The presentation of this project started in Chapter 1 with discussion of problem statement and objectives. It also includes scope and project outline. Chapter 2 discusses the edge detection methods. These include the Laplacian and Sobel method first. The chapter also introduces the Sobel multidirectional, the Canny edge detection method and histogram equalization.

Chapter 3 begins with a look at medical images. The discussion also includes image reconstruction from projection in x-ray tomography. This lead to Radon transform for filter back projections in x-ray tomography.

Then, in Chapter 4, our model will be presented, which apply edge detection on medical images. The simulation was used using C++ programming. We tested the model using medical image from x-ray tomography. Result and discussion presented in Chapter 5. Then Chapter 6, conclude the entire project. Supportive recommendations are given so that interested readers can follow the details.