ABSTRACT

The rapid growths of the computer technologies of the world-wide web have increased the amount and the complexity of multimedia information. Images are the most widely used media to represent various shapes. Image segmentation is the essential step to localized shapes in an image. Image segmentation can be further categorized into three components namely; image thresholding, edge-based segmentation and region-based segmentation. Hough transform is one of the edge-based segmentation technique used to detect object of circular shape. However it was found that Hough transform is unable to detect a circular shape with unknown radius and it is also unable to detect semi-circular shape. Thus, Hough transform is enhanced to solve these problems by examining Hough peaks in the Hough matrix. Different shapes display unique distribution and pattern of Hough peaks. The results reveal that Hough peaks for semi-circular shape appear on the same x and y coordinate, and Hough peaks for circular shape appear on the different x and y coordinate. Thus, it is feasible to utilize this method to locate a circular, semi-circular or other shapes appear in the image like single line, square object, ellipse and rectangular.

ABSTRAK

Perkembangan teknologi komputer dan rangkaian web yang semakin meningkat telah menambah kompleksiti dalam informasi multimedia. Imej adalah salah satu media yang sering digunakan bagi mewakili pelbagai rupa bentuk. Segmentasi imej merupakan satu langkah asas dalam menyetempatkan rupa bentuk dalam sesuatu imej. Segmentasi imej boleh terbahagi kepada tiga komponen utama iaitu; *image thresholding*, *edge-based segmentation* dan *region-based segmentation*. *Hough transform* merupakan salah satu teknik di bawah *edge-based segmentation* untuk mengecam bentuk bulatan dalam sesuatu objek. Walaubagaimanapun, terdapat masalah yang telah dikenalpasti dimana teknik *Hough transform* tidak dapat mengecam bentuk bulatan jika tiada maklumat jejari diberikan dan teknik ini juga tidak dapat mengecam bentuk semi-bulatan. Oleh itu, masalah dalam teknik *Hough transform* telah diselesaikan dengan menambah baik teknik tersebut dengan melalui pemerhatian *Hough peaks* dalam *Hough matrix*. Rupa bentuk yang berlainan dalam sesuatu objek akan menghasilkan taburan dan corak *Hough peaks* yang berbeza dan unik. Corak *Hough peaks* untuk semi-bulatan akan terhasil pada koordinat x dan y yang sama, manakala corak *Hough peaks* untuk bulatan akan terhasil pada koordinat x dan y yang berlainan. Kesimpulannya, adalah munasabah bagi teknik *Hough transform* ini untuk mencari rupa bentuk bulatan, semi-bulatan ataupun bentuk lain yang terdapat dalam imej seperti garis lurus, segi empat sama, bujur dan segi empat tepat.

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LIST OF ABBREVATIONS

HT	-	Hough Transform
HM	-	Hough Matrix
R	-	Radius
AC	-	Accuracy
TP	-	True Positive
FN	-	False Negative
FP	-	False Positive
TN	-	True Negative

LIST OF SYMBOLS

$y = ax + b$	-	Line equation
$(x - a)^2 + (y - b)^2 - r^2 = 0$	-	Circle equation
$AC = (TP + TN) / (TP + TN + FN + FP)$	-	Accuracy equation

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CHAPTER 1

INTRODUCTION

1.1 Introduction

Image segmentation is one of the most important steps leading to the analysis of processed image data. Its main goal is to divide an image into parts that have a strong correlation with objects or areas of the real world contained in the image (Milan *et al*., 1998). The result of image segmentation is a set of regions that collectively cover the entire image, or a set of contours extracted from the image. Each of the pixels in a region is similar with respect to some characteristic or computed property, such as color, intensity, or texture. Adjacent regions are significantly different with respect to the same characteristic (Rabindra and Meena, 2009).

Image segmentation can be divided into three methods. The first method is based upon a technique called image thresholding, which uses predetermined gray levels of the pixels (Arthur R. Weeks, 1996). The second method is edge-based segmentation that uses the discontinuities between gray level regions to detect edges/contours within an image. Edges play a very important role in the extraction of features for object recognition and identification (Arthur R. Weeks, 1996). The final method of image segmentation is to separate an image into several different regions

based upon desired criteria called region-based segmentation (Arthur R. Weeks, 1996).

The method that been used in this paper is edge-based segmentation. This approach is very important segmentation approaches that remain today and have large group of information of edges that can be found in the image. This method is depending on the edges that can found in the images. There are several techniques that using the edge-based segmentation method. For example, edge image thresholding, edge relaxation, border tracing, and Hough transform.

The Hough transform was developed to detect general images that have different shapes for example lines, circles or ellipse. The Hough transform is a robust and often used voting-based technique for identifying objects with a simple parametric model (Tomas S. *et al*., 2008).

1.2 Problem Background

Nowadays, most of the machines are using the application of circle detection and image segmentation in real lives. Therefore, the famous applications that are using circle detection and image segmentation for example are to locate tumors and other pathologies, to locate objects in satellite images, iris recognition and face recognition. Hence, one of example method that are functioning to do the image segmentation and to detect a circle is Hough transform. Unfortunately, Hough transform method also have some problems and weaknesses such as large memory or space used, the quality of data is dependent on the efficiency of the Hough transform, slow speed processing, and high computational and storage requirements.

The existing Hough transforms that studied by Rabindra and Meena (2009), shows the result of their research on circle detection is not efficient where there is compulsory to give the information of the radius. Current Hough transform need to provide minimum and maximum value of radius in detecting a circle. Circle with no information of radius cannot implement this method. One more problem occurred when it detects semi-circle as circle. The currently method cannot detect the line in the image and conclude that the shape of the image is fully circle.

Hence, modified Hough transform is proposed so that these problems can be solved and increase the performance of the existing Hough transform.

1.3 Problem Statement

As mentioned above, there are two main problems in Hough transform where it cannot detect circle with unknown radius and it detect the semi-circle as a circle. Hence, a modified Hough transform is proposed to solve the problems and improve the performance of existing Hough transform.

The research questions are:

a) *How the performance of Hough transform for semi-circle detection in image segmentation?*
b) *How circles with unknown radius can can be detected using the Hough transform?*
c) *How to overcome these problems to improve the accuracy of Hough transform technique?*

1.4 Dissertation Aim

The aim of this dissertation is to enhance the Hough transform in detecting circle with unknown radius and detecting a semi-circle as a semi-circle rather than a full circle effectively.

1.5 Objectives

The objectives of this research are:

i) To improve the Hough transform to detect circle with unknown radius.
ii) To enhance the Hough transform to detect a semi-circle.
iii) To test the effectiveness of the proposed method using sample circle and semi-circle images.

1.6 Dissertation Scope

The scopes of this dissertation defined as follows:

i) Using MatLab 2009 as a tool.
ii) Solve problem only for circle detection and semi-circle detection.
iii) The data to be tested will be taken from the internet and previous researcher to compare with the proposed method.

1.7 Significance of the Dissertation

This dissertation studied the Hough transform for detecting circle without information of radius and cannot detect semi-circle correctly. The outcomes of this study will contribute to verify the performance of modified Hough transform in order to solve problems of circle detection. The performance of proposed method will be evaluated to show its improvement. The results are compared to the previous Hough transform that have not been improved yet to see whether this approach can give better performance on image segmentation. This new modified approach could be used to the development of a methodology that will be of value in future studies of circle detection in image segmentation.

1.8 Organization of Dissertation

The dissertation consists of five chapters which are Chapter 1 represent the introduction of the study, problems background, problem statement, dissertation aim, objectives, dissertation scope, and significance of the dissertation. Chapter 2 is about the literature reviews on the image segmentation and Hough transform. Chapter 3 discusses the dissertation methodology and the experimental result in Chapter 4. Chapter 5 is to conclude this study and suggestion for future work are explained.