THE APPLICATION OF HOUGH TRANSFORM FOR CORNER DETECTION

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To my loving parent, *Jamludin Bidin* and *Siti Lilah Juraimi* also my lecturers
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ABSTRACT

Corners are very attractive features of many applications in human perception and computer vision. The problem of detecting corners is simplified into detecting simple lines in a local coordinate system. As simple lines can be expressed using only one parameter, Hough Transform can detect them quickly. Other edge detectors have some problems when marking edge points around corners. Based on both gradient magnitude threshold and grey level analysis, the edge points can be detected. Using the Sobel and Kirsch Operator, an image can be extracted and provide the edge points for Hough Transform. Mean while, the Zhang Suen Thinning Method can be used to reduce the edge points into minima points to speed up the algorithm. To illustrate the problem, the interface program is developed by using *Microsoft Visual C++ 6.0*.

ABSTRAK

Titik simpang merupakan salah satu sifat-sifat objek yang penting dalam perspektif visual manusia dan komputer. Masalah di dalam mengesan simpang dipermudahkan kepada mengesan sifat-sifat garisan di dalam sistem grid atau koordinat. Kebiasaannya, ciri-ciri garisan dapat ditunjukkan di dalam parameter *Hough Transform* dengan lebih cepat. Sesetengah pengesan pinggir (*edge detector*), mempunyai masalah dalam menandakan titik pinggir di sekitar titik simpang. Berdasarkan nilai penentu kecerunan dan analisa *grey-level,* titik-titik pinggir boleh dikesan. Operator *Kirsch-Sobel* telah digunakan untuk mengekstrak imej dan membentuk pinggiran sebelum melalui proses seterusnya menggunakan Teknik *Hough Transform*. Sementara itu, Teknik Penipisan iaitu Kaedah *Zhang-Suen* digunakan untuk mengurangkan ketebalan garisan pinggir supaya menjadi lebih nipis (pinggir minima). Penggunaan kaedah tersebut adalah untuk mempercepatkan proses pengesanan simpang di dalam Teknik *Hough Transform*. Bagi menunjukkan proses pengesanan simpang, satu rekabentuk program antaramuka telah dibangunkan dengan menggunakan *Microsoft Visual C++ 6.0*.

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CHAPTER I

RESEARCH FRAMEWORK

1.1 Introduction

Feature detection such as edge and corner detection is an essential step in human perception of shapes. Such corner points contain important information about the shape of objects. The extraction of the corner points is useful for computer applications such as image recognition, segmentation, description, matching and data compression.

In human perception of shapes, a corner is not only from the mathematical concept of corners but also from the neighbouring patterns of local features. Human recognize the corners, which are consistent with each other in the description of shapes. They develop this imperfect knowledge empirically.

In industrial applications this can be an essential for safety or for quality control, which require an efficient algorithm for locating specific objects in images with the aims

of counting, checking and measuring. Sharp features and well-defined shapes such as corners help considerably with object location. If the corners can be detected computationally, the job such as counting, checking and measuring can be done efficiently.

Recently, corner detection problem is divided into two categories namely boundary-based and region-based approaches (Chen *et al.*, 1995). Boundary-based approaches use chain code to detect the corners on the boundary of an object. While the region-based approaches identify the corners directly on the grey-level image using gradient and curvature measurements.

Conventionally, a corner is defined as the junction point of two or more straight lines. Based on this definition, two characteristics of corners can be generalized (Shen and Wang, 2001). Firstly, a corner point is also an edge point. Secondly, at least two lines pass through the corner point.

1.2 Problem Statement

Given an image in digital form, the problem is to detect the corners in that image. A corner is identified at a point in the image through the non-existent of the first derivative. We apply the Hough Transform method to detect the corners in an image. The Hough Transform is applied to the boundary object of the binary image, which is can be a line or curvature. To produce the binary image also known as an edge image, we apply the Sobel and Kirsch Edge Detector and the Zhang-Suen Thinning Method to the digital image.

1.3 Objectives of Study

The following are the objectives of this dissertation:

- Design and develop a simulation model for detecting corner on the digital image.
- Apply the procedure to a real problem.
- Evaluate the performance of Hough Transform by using different threshold values.

1.4 Scopes of Study

The simulation program of corner detection has been developed using the Microsoft Visual C++. It involves an image of size 640 x 480 pixels. The simulation program uses the bitmap format to extract and analyses every pixel points in two-dimensional array. It uses the RGB values of colouring to extract the image and detect some edge lines. Then, the edge lines are used to determine the corners. In this study, the Kirsch and Sobel Edge Detector is used to obtain the edge values in binary image. The Zhang Suen Thinning Method is used to reduce the thickness of the edges. All these methods are used in pre-processing stage. In the post-processing, the Hough Transform is used to detect the corners through the edge lines obtained.

1.5 Dissertation Organization

This dissertation consists of six chapters. Chapter I is the research framework. This chapter includes an introduction of study, the problem statement, objective and scope of the study. This follows by Chapter II that briefly describes about edge and corner detection problems. Chapter III discusses in details about the Hough Transform to detect lines and corners. In Chapter IV, a case study of corner detection using the Hough Transforms is discussed. The experimental results and analyses are described in Chapter V. Lastly, Chapter VI discusses in general the conclusion and future works.

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