DEVELOPMENT OF A MOVING OBJECT TRACKING SYSTEM

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Development of a Moving Object Tracking System

BONG SHIN FENG

This project is submitted in partial fulfilment of
The requirements for the degree of Bachelor of Engineering with Honours
(Electronic and Computer Engineering)

Faculty of Engineering
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This Final Year Project attached here:

Title : Development of a Moving Object Tracking System

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_____ _____

Mr. David Bong Boon Liang Date

(Supervisor)

Dedicated to my beloved family and friends

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ABSTRAK

Projek tahun akhir ini memperkenalkan satu kaedah untuk mengesan pregerakan objek daripada gambar-gambar digital bersiri. Pelbagai kaedah telah dikajikan untuk menentukan keberkesanan dalam menghapuskan benda yang tidak diingini serta kemampuan dalam mengesan sesuatu objek pada pendahuluan projek. Dalam perkembangan dunia teknologi dan digital, pemprosesan imej dan mesin menjadi semakin penting. Dengan ini, pengesan system ini dibentuk daripada kaedah pemprosesan digital imej.

Projek ini memperbincangkan latar belakang sistem, penyelidikan, metadologi yang digunakan, perbincangan keputusan dan juga pembangunan ciri-ciri sistem pada masa depan. Sistem pengesan ini direka dengan menggunakan bahasa pengaturcaraan "Matrix Laboratory (MATLAB)" and reka bentuk antaramuka sistem. Ciri-ciri utama sistem ini adalah ia berupaya untuk mengesan pergerakan untuk satu objek atau lebih objek dalam gambar-gambar berlatarbelakangan statik.

ABSTRACT

This project presents a method for tracking moving objects in a sequence of digital images. Different methods for tracking were investigated in term of noise elimination and tracking abilities at the initial stage of the project. In this digital world and technological advancement, image processing and machine vision is becoming significant. Thus, the tracking system was developed based on the digital image processing method.

This report discusses on the system background, literature, methodology, result, discussion and future system's development. The tracking system was designed using the Matrix Laboratory (MATLAB) programming language and graphical user interface. The major features of the tracking system developed in this project are capable for tracking single and multiple objects in a static scene.

LIST OF CONTENTS

LIST OF FIGURES

CHAPTER 1

INTRODUCTION

1.1 Project Overview

This is a research and design based project to develop an object tracking system for colour images. Tracking is refers to a task of tracing the progress of an object as it move about in the visual scene and is performed in order to provide information of the object. Presently, applications of the object tracking are numerous and they span a wide range of domains which may useful in surveillance, vehicle tracking or for more advance technology such as missile guidance.

Nowadays, most of the images are typically acquired in the form of digital colour images with a sensor system such as digital camera or colour scanner. Beside that, colour image processing techniques have become popular and are now used in a broad range of applications [4] so the core of the proposed tracking system would perform by using the image processing techniques.

This project aims to enhance the effectiveness of the tracking system in term of noise elimination and tracking abilities. This can be achieved by analyzing the performance of different algorithms. Then the top ranked algorithms will be selected to develop the tracking system.

1.2 Problem Statements

There are several major problems of object tracking which must be considered

1. Noise plays a role in affecting the performance of the object tracking algorithm.
2. Loss track due to the occlusion. This phenomenon occurs when a tracked object is partially or fully occluded by another object of a similar colour.
3. The tracking system is limited to track a single moving object.

1.3 Objectives

The main objectives of the project are as follows:

(a) To explore and compare different methods used to develop the tracking system

Different methods are compared to determine the best and suitable algorithms to develop effective tracking system. Noise elimination is analyzed based on the efficiency of an algorithm in reducing the noise effect in an image to the minimum level. While the tracking abilities is analyzed based on the system capability to track an object without losing it.

(b) To design and develop a framework of an object tracking system.

Based on the literature research, a tracking system is then developed by employing the image processing techniques using Matlab software. A camera is used to capture the images. Once the frames or digital image are taken, necessary process is performed to track the object of interest.

(c) To simulate the motion path by display tracking data in coordinates against frames.

The centroid coordinates of the object will be extracted and then stored in the database in the form of coordinates against the frames. These coordinates are used to show the motion path of an object movement and will be plotted in a graph.

(d) Performing simultaneous tracking of multiple objects through sequences of image

The tracking system is enhanced for detection of multiple moving objects in sequence of images. The system will be able to determine the total number of moving objects being detected in an image.

1.4 Project Scope

In general, a system that is able to track an object in a visual scene is developed. The image is processed with focus on object detection. A camera will be used to capture the moving objects. Once the frames are taken from camera, the system will compare the current frame and previous frame in order to determine significant position changes of the object of interest. Investigation is done in order to search for the best method in solving the tracking problems such as noise and tracking abilities. The lower limit of the size of the object is 10 X 10 pixels. An object smaller than this limit is considered as noise. Noises are then eliminated by using the filtering and threshold techniques. The final stage is to enhance the tracking system for detecting multiple moving objects.

1.5 Outline of Project Report

This project is organized into 6 chapters. Chapter 1 presents an overview of the contents of the project and followed by the objectives to be achieved.

Chapter 2 is devoted to the studies, researches and readings process that have been carried out. It also reviews the difference methods of image processing and type of programming languages needed to develop the prototype system.

Chapter 3 discusses about the methods of investigations, methodology development, analysis process and focuses on the designing the system through the

methods selection from Chapter 3. It discusses the selection of methods in satisfying the design requirement. It also describes the detailed requirements specification for the prototype system where the hardware and software specifications and requirement are reviewed.

Chapter 4 evaluates the performance and results of the prototype system. Approaches and testing are taken to examine the prototype system in achieving its objectives.

Chapter 5 summarizes the overall process and performance of the project. In addition, further work which can be implemented or improve the project is also being discussed.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Track is referring as the continuous line or series of traces showing where something has passed. Consequently, the most important issue in tracking is the motion detection of the objects where motion detection refers to the task of analyzing significant change of position between two different periods of frames. This project would concentrate on the image processing techniques in developing the tracking system.

Visual input is achieved through digital images obtained from a camera connected to a digital computer. After the image acquisition, object tracked is first extract from a sequence of digital colour images using the image segmentation techniques such as object extraction and detection of discontinuity. Threshold and filtering techniques are used to eliminate any noises in the system. Then the method used is extract object's centroid where the centre point of the object is determined and the changes of coordinates will be stored against frame. The techniques that will be employed to the proposed system will be discussed in a greater detail in this chapter.

2.2 Colour Models

Digital colour image processing is referring to process of digital colour images by means of a digital computer. A full colour or also known as RGB colour image can be view as three monochrome intensity images which are representing red, green and blue (primary spectral components). It is also defined as a three dimensional function image. The schematic of a RGB colour cube based on the Cartesian coordinate system is shown in Figure 2.1 [4].

Cyan, magenta and yellow (CMY) are the secondary colours which are located in the three corners of the colour model. Black and white colours are located respectively at the origin and corner farthest from the origin. Refer to the colour cube model, the gray scale colours only consists a line joining between the two points.

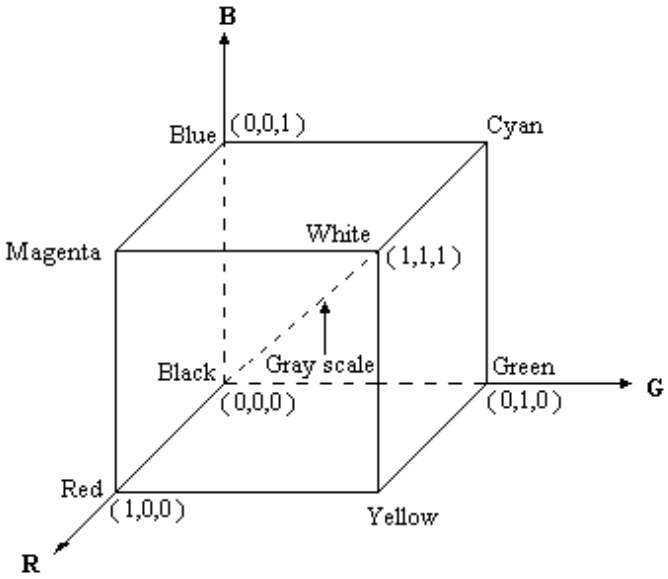

Figure 2.1: Schematic of a RGB colour cube model

An RGB colour image is formed by M x N x 3 array of colour pixels where each colour pixels is a triplet corresponding to the red, green and blue components of an RGB image at a specific spatial location as shown in Figure 2.2 [4].

Assume **z** represent the arbitrary vector in RGB colour space and the colour components are a function of coordinates (x,y), then equation can be derived as:

$$\mathbf{z}(x,y) = \begin{bmatrix} c_R(x,y) \\ c_G(x,y) \\ c_B(x,y) \end{bmatrix} = \begin{bmatrix} R(x,y) \\ G(x,y) \\ G(x,y) \end{bmatrix} \qquad (2.1)$$

For an M x N size image means there are MN c(x,y) vectors for x = 0 to M-1 and y = 0 to N-1.

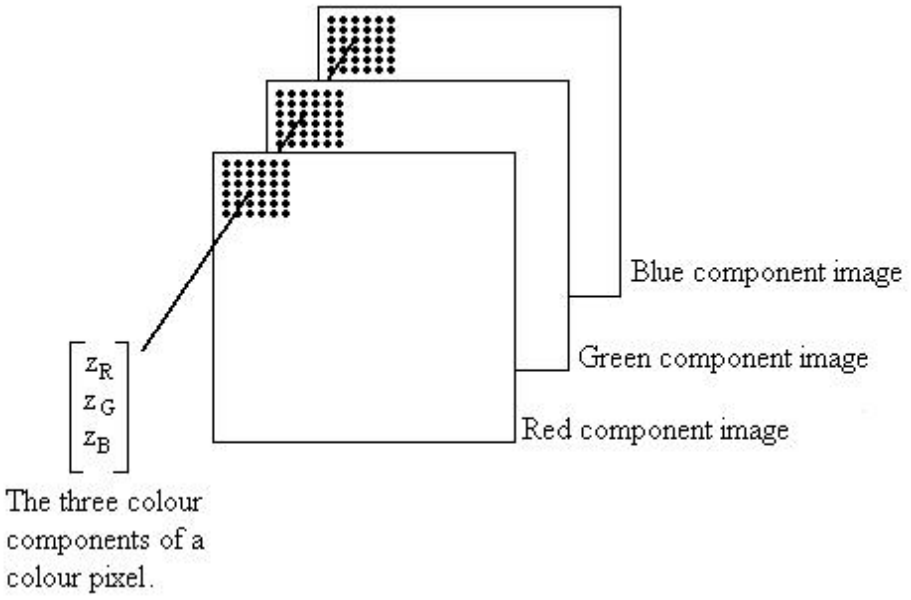

Figure 2.2: Spatial mask for RGB colour image

2.3 Colour Image Processing Techniques

Colour image processing refers to processing digital colour images by using the digital computer. This processing is divided into two major areas: full colour and pseudo colour processing [4].

Full colour image is formed by three component images which are the red, green and blue components [4]. The full colour image is a multi channel image which denotes as a 24-bit RGB (red, green, blue) colour image. Each component of the RGB image is an 8-bit image so a total of $(2^8)^3$ = 16,777,216 colour content in the 24-bit colour image. There are two approaches for full colour image processing.

Pseudo colour image processing is conveying colour into gray values. A pseudo-coloured image is a single channel image. The purpose of using the pseudo colour is for human visualization and interpretation of gray scale events in an image [4]. Differences in colour in the pseudo-coloured image reflect differences in intensity of the object.

There are two major categories in the full colour image processing. The first category is dealing with each component individually in an image [4]. The red, blue and green components in an image are extracted into individual image from an original colour image as shown in Figure 2.3. Each extracted component is a gray-scale image and this allows the use of gray-scale image processing methods. The processed result of each component is then added to form a composite processed colour image.