MOVING OBJECT DETECTION IN A SEQUENCE OF IMAGES TAKEN FROM NON-STATIONARY CAMERA

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A thesis submitted in fulfilment
of the requirements for the award
of the Degree of Master of Engineering (Electrical)

Faculty of Electrical Engineering
Universiti Teknologi Malaysia

OCTOBER 2004

To My Loving and Caring Family …

ACKNOWLEDGEMENTS

My first thanks is for my supervisor, Associate Prof. Dr. Syed Abdul Rahman, whose constant support, patience and unbounded enthuasiasm were of invaluable help. His devotion to the needs of the students and the encouragements have made working with him a true delight. Thanks for helping me to kickstart this research by providing insights and his work as reference.

My sincere appreciation to my fellow collegues in the Computer Vision, Video and Image Processing (CVVIP) Research Group, sharing the similar research interests. I value the camaraderie we share as well as the time they spent to share with me enriching ideas, as well as their concern. My gratitude especially goes to Sani, Phaik Yong, Nuha and Nansah for many hours of discussions, as well as assistance with the programming stuff and image acquisation.

My sincerest thanks to all those who have helped to make this thesis possible. Warmest regards to my parents, sisters and brother for their seamless caring encouragement and moral support that has made this journey possible.

Without exception, a special thank to my fiance Nor Hafizah Bt. Ngajikin for her consistent encouragement and concern over time that made the journey enjoyable and meaningful. Without her unwavering support, love and devotion, this achievement would not have progressed as far as it did.

ABSTRACT

Moving object detection is a vital aspect of motion analysis. It has drawn an increasing attention in the recent years due to its applications such as in communication, traffic monitoring, security surveillance, robot navigation and servoing. Despite the fact that much research efforts have been devoted to this area, detecting moving object using non-stationary moving camera remains a great challenge. The research undertaken in this thesis is mainly concentrated on developing a reliable and robust detection system which incorporates some operation on images such as thresholding, blob labelling, blob matching, filtering and blob analysis. The basic idea behind this system is that the motion of the moving object is different with the motion of background object. Path transversed within a certain period of observation of the moving object is usually longer than background object. By using blob labelling and blob matching operation, this system would be able to track binary blobs over an arbitarily long image sequence. The criteria for matching binary blobs from two adjacent frames are position, height, width, area, colour and aspect ratio. If the the path transversed of a binary blob within a certain period of observation is sufficiently long, then the tracked blob is considered as moving object.

ABSTRAK

Mengesan objek bergerak merupakan satu aspek yang penting dalam analisis pergerakan. Ia semakin mendapat perhatian dalam beberapa tahun kebelakangan ini disebabkan aplikasinya dalam komunikasi (persidangan video), pengawasan lalulintas, pengawasan keselamatan, pengemudian dan pengawalan robot dan sebagainya. Walaupun banyak usaha penyelidikan telah ditumpukan dalam bidang ini, pelaksanaan satu sistem mengesan objek bergerak dengan menggunakan kamera bergerak masih menjadi satu cabaran. Penyelidikan yang dijalankan ini memberi penekanan kepada penghasilan satu sistem mengesan objek bergerak yang tepat, jitu dan efisien, dengan meggunakan kaedah-kaedah dalam Pemerosesan Imej seperti *thresholding, blob labeling, blob matching, filtering* and *blob analysis.* Konsep atau perkara asas dalam membangunkan sistem ini ialah pergerakan objek bergerak adalah berbeza dengan pergerakan objek statik. Jarak perjalanan bagi objek bergerak dalam satu jangka masa tertentu adalah lebih jauh berbanding jarak perjalanan bagi objek statik. Dengan meggunakan *blob labeling* dan *blob matching,* sistem ini berupaya menjejak *binary blobs* dalam satu jujukan imej. Kriteria yang digunakan untuk proses *blob matching* ialah posisi, ketinggian, keluasan, saiz dan warna blob. Jika jarak perjalanan dalam jangka masa tertentu bagi sesuatu blob itu telah melebihi jarak minima yang telah ditetapkan, maka blob itu dikira sebagai blob bergerak.

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OFC	-	Optical Flow Constraint
RGB	-	Red Green Blue
PC	-	Personal Computer
RAM	-	Random Access Memory
CCD	-	Charged Coupled Device
CPU	-	Central Processing Unit
GUI	-	Graphical User Interface

CHAPTER 1

INTRODUCTION

In everyday life, humans visually keep detecting and tracking a multitude of objects with certain objectives in mind. Examples are orientation in the environment, recognizing persons in the surroundings, locating, recognizing, monitoring and handling of objects.

Although much has been learned from biological and human vision for image processing and analysis, the markedly different tasks and capabilities of the function modules have to be kept in mind. It is not possible to simply transfer or copy the human biological vision to machine vision system. However, the basic functionality of the human vision system can guide us in the task of how these principles can be transferred to technical vision system such as motion analysis. The analysis of motion gives access to the dynamics of processes. Motion analysis is generally a very complex problem. The true motion of objects can only be inferred from their motion after the 3-D reconstruction of the scene.

The increasing use of video sensors, with Pan-Tilt and Zoom capabilities or mounted on moving platforms in surveillance and autonomous driving vehicle

applications, have focused the attention of researchers on the detection of moving objects in a video streams acquired by a moving platform.

1.1 Objectives

The main goal of this project is to develop a system which is capable to detect and track moving object from the frames captured by a non-stationary camera. It attempts to make use of the blob labeling, blob analysis and blob matching technique in order to accurately detect and track a moving object

1.2 Project Scopes

In general, there are 2 main components in any motion detection system. One is the scene, more often called the world, and the other is the observer, which, in most cases, is represented by the camera. For analyzing motion detection, it is imperative to understand the configuration between the camera and the world, as each one of them is treated in a slightly different manner. There are 3 possible configurations

1. stationary camera, moving objects (SCMO)
2. moving camera, stationary objects (MCSO)
3. moving camera, moving objects (MCMO)

In this project, the research is based on moving camera, moving objects (MCMO) system.

The proposed detection and tracking algorithm is mainly concentrated on robustly detecting the movement of a single moving object from an image sequence obtained from the moving camera. Nevertheless, the algorithm has a capability to detect multiple moving objects but with some constraints.

Each frame of the captured image sequence is fixed to a size of 256 x 256 pixels. The processing of the acquired image sequence is performed in the binary format, which has 2 value; '0' and '1'.

The system that will be developed is an off-line system and not real time or simulation. The entire moving object detection and tracking program is developed using Microsoft Visual C++ version 6.0.

Camera motion is strictly translation and not rotation or pan-tilt.

1.3 Problem Statements

Problems concerning about this system can be classified into two categories; motion detection and motion tracking.

Motion detection involves verifying the presence of a moving object in image sequences based on the object's temporal change and possibly locating it precisely for tracking or recognition purpose.

Whereas motion tracking is an iterative process of determining the trajectory of a moving object during a video sequence, by monitoring the the object's spatial and temporal changes, including its presence, position, size, shape, etc. This is done by solving the temporal correspondence problem, i.e the problem of matching the target region in successive frames of a sequence of images taken at closedly-spaced time intervals.

These two processes are closely related because motion tracking usually starts with detecting moving objects, while detecting an object repeatedly in subsequent image sequence is often necessary to help and verify tracking.

1.4 Application of Motion Detection and Tracking System

Detecting and tracking a moving object in a dynamic video sequence has been a vital aspect of motion analysis. This detecting and tracking system has become increasingly important due to its application in various areas, including communication (video conferencing), transportation (traffic monitoring and autonomous driving vehicle), security (premise surveillance) and industries (dynamic robot vision and navigation).

Specifically, the main application targeted by the proposed detecting and tracking algorithm is for implementing an autonomous driving system. The system can be used to automatically detect and track any moving object exist in the traffiic scenes such as moving cars in highway within the view of the moving camera. Obstacle detection is one of the key functions in an autonomous driving vehicle.

1.5 Thesis Outline

Chapter 1 provides readers a first glimpse at the basic aspects of the research undertaken, such as objectives, scopes, problem formulation and the application targeted by the developed moving object detection and tracking system.

Chapter 2 gives an insight to the existing vision-based moving object detection and tracking algorithms developed by the various researchers, and subjectively classify them into four categories.

Chapter 3 elaborates on the methodology of the proposed detection and tracking algorithm. This chapter gives an explaination for each main stages in the developed detection system such as blob labeling, blob analysis, blob matching and a testing for moving blob criteria.

Chapter 4 is mainly devoted for demonstrating the experimental results and performance of the proposed detection and tracking algorithm on some off-line image sequences.

Chapter 5 deals with the summary and conclusions of the research. A number of research findings obtained from the empirical results of the implemented detection and tracking system are also discussed. Lastly, some realistic extensions as well as possible enhancements for the research are provided.

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