Chapter 32
Multiple Object Tracking by Scale Space Representation of Objects, Method of Linear Assignment, and Kalman Filter

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ABSTRACT

This chapter presents a multi-object tracking system using scale space representation of objects, the method of linear assignment and Kalman filter. In this chapter basically two very prominent problems of multi object tracking have been resolved; the two prominent problems are (i) irrespective of the size of the objects, tracking all the moving objects simultaneously and (ii) tracking of objects under partial and/or complete occlusion. The primary task of tracking multiple objects is performed by the method of linear assignment for which few cost parameters are computed depending upon the extracted features of moving objects in video scene. In the feature extraction phase scale space representation of objects have been used. Tracking of occluded objects is performed by Kalman filter.

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INTRODUCTION

Object tracking is a sequential method of object detection, feature selection, object representation using selected features in each frame of a video. Finally detected object(s) in each current frame is matched with object(s) of previous frame to locate an object's position in every frame of the video and thus the trajectory of an object is generated as it moves around the area under surveillance or any computerized vision system. Fast and reliable object tracking is very important in vision based systems such as

1. Surveillance systems,
2. Human computer interaction,
3. Traffic monitoring,
4. Vehicle navigation,
5. Action recognition,
6. Navigation of autonomous robots, etc.

Tracking of objects is very complex in nature due to several problems such as presence of different noise in video, unpredictable motion of objects, non-rigid or articulated nature of objects, partial and full object occlusion, change in scene illumination, changes in background etc. Usually, tracking is simplified by imposing constraints on the motion or appearance or both of the objects. For example, almost all the tracking algorithms assume that the object motion is smooth with no abrupt changes. For most of the systems, area under operation is not exactly unknown; i.e. some prior knowledge about the type and the size of the objects or the object appearance and shape are used to simplify the problem.

In this chapter, a multiple object tracking method for surveillance system is described. This system will detect objects under partial and /or complete occlusion and track all the objects simultaneously without putting any restriction on the size/dimension of the objects, i.e., objects may be cars or persons or whatever. The concept described in this chapter can be applied with some modifications, for the surveillance of any other public places like daily market place, railway station, meeting hall, parking space etc.

BACKGROUND

Several approaches of object tracking have been presented so far (Yilmaz, Javed, & Shah, 2006). They differ from each other with respect to object representation methods, features used for tracking, tracking methods employed etc. For instance objects can be represented as point i.e. the centroid (Veenman, Reinders, & Backer, 2001) or set of points (Serby, Koller-Meier, & Gool, 2004), primitive geometric shapes such as rectangles and ellipses (Comaniciu, Ramesh, & Meer, 2003),object contour which is used to represent non rigid objects (Yilmaz, Li, & Shah, 2004) and others. Objects also can be represented as scale space blobs, corners, ridges and edges (Lindeberg, 1996a, 1996b). The blobs in a video frame are related to the contrast between the spatial feature and its neighbourhood. The important features used for tracking the objects are colour in different colour spaces such as RGB, YCbCr, HSV. But none of these colour spaces are unanimously accepted as all of them are affected by noise (Song, Kittler, & Metrou, 1996). Feature like edge, which can be easily detected because of its distinct change in intensity can also be used for tracking. Edges have the advantage that it is not susceptible to illumination changes, like colour. Tracking algorithms that track on the basis of object boundaries use the edge finding algorithms. The