Chapter 12
Moving Object Detection and Tracking Based on the Contour Extraction and Centroid Representation

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ABSTRACT

This chapter presents a novel approach for moving object detection and tracking based on contour extraction and centroid representation (CECR). Firstly, two consecutive frames are read from the video, and they are converted into grayscale. Next, the absolute difference is calculated between them and the result frame is converted into binary by applying gray threshold technique. The binary frame is segmented using contour extraction algorithm. The centroid representation is used for motion tracking. In the second stage of experiment, initially object is detected by using CECR and motion of each track is estimated by Kalman filter. Experimental results show that the proposed method can robustly detect and track the moving object.

INTRODUCTION

Whenever human observe a scene from a video, objects in scene despite being static keep on changing or moving rapidly with in a snapshot of time. Under such circumstances, detecting and tracking of objects in a scene is absolutely essential. However, active research has been progressing in this specialized field for the last three decades and as a result several algorithms have evolved for object detection

DOI: 10.4018/978-1-5225-7368-5.ch012

and tracking. A robust, accurate and high performance approach is still a great challenge today. The difficulty level of this problem highly depends on how the object to be detected is defined and tracked. For a critical evaluation, frame differencing algorithm is chosen for object detection and Kalman filter is chosen for object tracking. Kalman filter algorithm is successfully implemented for tracking single objects with and without occlusions. In each case, tracking efficiency is determined with error covariance estimation. It is found that as error covariance tends to zero and goes to negative, the covariance of the predicted state becomes low and uncertainty is reduced. It is proved that Kalman filter is the best estimator and subsequently the experimentation is extended to multiple objects without occlusions and successful results are revealed.

BACKGROUND

The active research on object detection is going on for past few decades. The general approach for object detection is background subtraction, also known as foreground detection. Background subtraction is a challenging task, especially in complex dynamic scenes that might contain moving trees, rippling water, etc. Many approaches are presented in literature to deal with background subtraction (Elgammal 2014; Bouwmans 2011; Brutzer et al., 2011; Bouwmans et al., 2008). Huapeng Yua et al. (2014) proposed object detection using contour level top down information. Recently Kooij et al. (2015) proposed a novel approach for multiple object detection using their appearance. It identifies the minimal set of objects from a frame, from which the features are extracted. It focuses mainly on appearance rather than temporal cues. In tracking by detection method, target objects are detected and these are combined with consistent tracks. For example, human detectors can be trained on Histogram of Gradient (HoG) features or by analyzing about spatial occupancy to explain background/foreground masks (Ben Shitrit et al., 2011; Fleuret et al., 2008; Liem and Gavrila, 2011). In terms of tracking, online trackers on a frame by frame basis can be differentiated (Breitenstein et al., 2011; Kim et al., 2012; Yan et al., 2012).

OBJECT TRACKING USING CONTOUR EXTRACTION AND CENTROID REPRESENTATION

A primitive experiment is conducted on single object moving with a constant speed and no occlusions. In this perspective a series of videos captured using Nikon COOLPIX 12.0 mega pixels are used for motion analysis. For moving object identification, frame differencing technique is chosen. In this technique, absolute difference between two successive frames i and i+1 is calculated. For each of the differenced image that is obtained in each of the successive iteration, a grey threshold is calculated and is applied. As a result the differenced images are transformed into binary images. To smooth the binary image, normalized box filter is applied and then again grey threshold is calculated. As a result, the perfect binary image is produced. For each of the moving object that is identified in the preprocessed image, a centroid is computed. This centroid represents the moving object in each of the differenced image. Finally a trajectory is drawn by connecting the centroids for all the differenced images. The results obtained after testing the algorithm in a video is presented for discussion. The pseudo code for object detection and tracking using Contour Extraction and Centroid Representation (CECR) is shown below.