Chapter 53 Building a Multiple Object Tracking System with Occlusion Handling in Surveillance Videos

Raed Almomani Wayne State University, USA

Ming Dong Wayne State University, USA

ABSTRACT

Video tracking systems are increasingly used day in and day out in various applications such as surveillance, security, monitoring, and robotic vision. In this chapter, the authors propose a novel multiple objects tracking system in video sequences that deals with occlusion issues. The proposed system is composed of two components: An improved KLT tracker, and a Kalman filter. The improved KLT tracker uses the basic KLT tracker and an appearance model to track objects from one frame to another and deal with partial occlusion. In partial occlusion, the appearance model (e.g., a RGB color histogram) is used to determine an object's KLT features, and the authors use these features for accurate and robust tracking. In full occlusion, a Kalman filter is used to predict the object's new location and connect the trajectory parts. The system is evaluated on different videos and compared with a common tracking system.

INTRODUCTION

Object Tracking is the process of locating an object in every frame of the video frames and using its locations to generate a trajectory. The efficient object tracking is important for many computer vision applications, such as surveillance, security, monitoring, robotic vision, etc. Although many object tracking systems have been proposed, tracking is still one of the most challenging research topics in computer vision. Tracking systems face a big challenge arises from dealing with abrupt object motion, illumination variations, occlusions, scale variations, and various types of objects (Park, Makhmalbaf, & Brilakis, 2011). So, in most cases, a proposed system shows best results under specific situation.

DOI: 10.4018/978-1-4666-3994-2.ch053

In complex scenes, overlapping of moving objects greatly affects the accuracy and robustness of tracking. Thus, occlusion handling plays a central role in building a tracking system. In this chapter, we describe a system to automatically track multiple objects which are partially or fully occluded in a moving or standing pose.

Recently, there has been an increasing interest in tracking objects in moving cameras, such as cell phones, vehicles and robots. Tracking objects in moving cameras are more complicated than stationary cameras where the image motion is induced by both the camera motion and the object motion. Different techniques are suggested, such as homography-based motion detection (Kim & Kweon, 2011), Pattern Matching (Reddy, 2012), background subtraction (Sheikh, Javed & Kanade, 2009) and contour (Yilmaz, Li & shah, 2004). In this chapter, our system uses the videos that are captured by using a stationary camera. In future work, we are going to develop our system to deal with objects in moving cameras.

BACKGROUND

Generally, Object tracking can be divided into three major categories (Yilmaz, Li, & Shah, 2004): Correspondence-based object tracking, transformation-based object tracking and contourbased object tracking.

Correspondence-Based Object Tracking

Tracking is performed by collecting the object information during tracking and using this information to predict and verify the object new location. The researchers used different object previous information such as object state (velocity and acceleration) and regional information (color, texture, area and shape) (McKenna, Raja, & Gong, 1999; Zhang, & Freedman, 2005). Different filtering techniques are suggested to model object information such as Kalman filtering (Stauffer, & Grimson, 2000) and particle filtering (Rittscher, Kato, Joga, & Blake, 2000).

Transformation-Based Object Tracking

Tracking is performed by using the object information in consecutive frames to estimate the motion of the object. The most common transformation based trackers are "template matching" (Lipton, Fujiyoshi, & Patil, 1998), "Mean shift" (Comaniciu, Ramesh, & Meer, 2003) and KLT (Kanade-Lucas-Tomasi) (Shi, & Tomasi, 1994). Template matching tracker is implemented by searching the whole image for a similar template. The template matching tracker is challenged by the heavy computation required and the sensitivity to illumination variation. Mean shift, on the other hand, tracks the distribution of an object in real time with robust tracking performance. However, Mean shift tracker does not deal with deformable objects and the appearance variations decreases the tracker performance (Allili, & Ziou, 2008). KLT tracker finds features that are optimal for tracking first, and then computes the translation of these features and the quality of each tracked path (Zhou, Yuan, & Shi, 2008).

Contour-Based Object Tracking

Tracking is performed by evolving the contour of the target object in the current frame and finding its new position in the next frame. Snake (Sun, Haynor, & Kim, 2003) and level set (Paragios, & Deriche 2005) are mainly used to track object contours. Snake, active contour, uses the contour in the previous frame as an initial contour in current frame, then uses external and internal energies to fix the contour. Level set is used to represent contour as zero level set where the zero set function equals zero for each point on the contour (Yilmaz, Li, & Shah, 2004). 11 more pages are available in the full version of this document, which may be purchased using the "Add to Cart" button on the publisher's webpage: www.igi-global.com/chapter/building-multiple-object-tracking-system/77587

Related Content

Entropy based Range Optimized Brightness Preserved Histogram-Equalization for Image Contrast Enhancement

Krishna Gopal Dhal, Sankhadip Sen, Kaustav Sarkarand Sanjoy Das (2016). *International Journal of Computer Vision and Image Processing (pp. 59-72).*

www.irma-international.org/article/entropy-based-range-optimized-brightness-preserved-histogram-equalization-forimage-contrast-enhancement/170596

Video Content-Based Retrieval Techniques

Waleed E. Faragand Hussein Abdel-Wahab (2004). *Multimedia Systems and Content-Based Image Retrieval (pp. 114-155).*

www.irma-international.org/chapter/video-content-based-retrieval-techniques/27057

A Structural Analysis Based Feature Extraction Method for OCR System For Myanmar Printed Document Images

Htwe Pa Pa Win, Phyo Thu Thu Khineand Khin Nwe Ni Tun (2012). *International Journal of Computer Vision and Image Processing (pp. 16-41).*

www.irma-international.org/article/structural-analysis-based-feature-extraction/68002

A Large Margin Learning Method for Matching Images of Natural Objects with Different Dimensions

Haoyi Zhou, Jun Zhou, Haichuan Yang, Cheng Yan, Xiao Baiand Yunlu Liu (2016). *Computer Vision and Pattern Recognition in Environmental Informatics (pp. 323-341).*

www.irma-international.org/chapter/a-large-margin-learning-method-for-matching-images-of-natural-objects-withdifferent-dimensions/139600

Classifying Behaviours in Videos with Recurrent Neural Networks

Javier Abellan-Abenza, Alberto Garcia-Garcia, Sergiu Oprea, David Ivorra-Piqueresand Jose Garcia-Rodriguez (2017). *International Journal of Computer Vision and Image Processing (pp. 1-15).* www.irma-international.org/article/classifying-behaviours-in-videos-with-recurrent-neural-networks/195006