A Context Based Tracking for Similar and Deformable Objects

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ABSTRACT

Object detection and tracking is the most basic and important process to understand video content. Due to its numerous applications, it has attracted many researchers to the field. Lots of work has been done in tracking; however, tracking of a deformable object is still in its initial stage. Most of the start-of-art methods fail to handle rapid variations in an object’s shape and size. The task becomes even more difficult when there is multi-target tracking. In this article, the authors have proposed a novel tracking method based on context (spatio-temporal) formed from the corner points of object regions. The correlation between the targets and background based on context is used for tracking. The proposed method is successful in tracking objects that are changing their appearance (shape and size) frequently and are having near similar appearance.

KEYWORDS

Automatic Segmentation, Context Tracking, Object Tracking, Spatio-Temporal Context

INTRODUCTION

In recent years, there has been an exponential increase in the number of the videos recorded and shared over the internet. Consequently, the demand of analyzing and understanding videos automatically has also increased. Object tracking is a hard problem as many different and varying circumstances need to be included in one algorithm (Yilmaz et al., 2006). There is a plethora of work done in tracking of rigid objects like vehicles, ball, etc., under varying conditions but tracking of non-rigid objects is still a challenging task (Jalal and Singh, 2012). Fast tracking of deformable objects is necessary to handle flexible objects like rope, cloth, paper, human cell, sponge, and living creature. The tracking of deformable objects is useful in medical imaging, robotics, motion-based recognition, video indexing, etc. Tracking of such kind of objects can help us to train robot to clean the room, make us breakfast or help us in surgical operation. In spite of having broad range of applications, tracking large number of deformable objects simultaneously is very challenging, as target identity may be lost by the tracker (Chu and Smuelders, 2010).

The tracking of multiple moving objects has attracted large number of researchers to do research in this area of computer vision because of it large range of applications, to improve the quality of

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life for physical therapy patients and disabled people, to obtain automatic annotation of videos, to generate object based summaries and in traffic management to analyze flow and to detect accidents (Chu and Smuelders, 2010).

Various approaches for object tracking have been proposed. These mainly differ from each other based on the way they approach the following questions: Which representation of object is suitable for tracking? Which features should be used? How should the motion of the object be modeled? The answers to these questions depend on the circumstances and factors in which the tracking is performed. A large number of tracking methods have been proposed which attempt to answer these questions for a variety of context (Smuelders et al., 2014).

Due to the high dimensionality of the state spaces of deformable objects, perceiving deformable objects is much more difficult than perceiving rigid objects. Often, self-occlusions make it impossible to infer the full states of deformable objects from a single view (Schulman et al., 2013). In addition, many deformable objects of interest lack distinguishable key-points. While having many advantages (e.g., improving performance over time, online updating of the object and the background model, ability to derive a discriminative object detector at any time, etc.), the main challenge is to avoid drifting still being adaptive to changes in the object’s appearance. Sometimes, drifting problem also occurs due to improper annotation of object (Zhang et al., 2014).

In this paper, we present a novel detection method to detect the objects in the first frame of the video without using any background frame and tracking method that tracks the detected objects by exploiting spatial and temporal context. On the basis of this context model, the new location of the object is identified in the successive frames of the video. The rest of the paper is structured as follows. Section 2 discusses the previous work related to the tracking of deformable objects. Section 3 and 4 describes the main method of detection and tracking of object. In Section 5 results of our experiments are presented and section 6 concludes the paper.

RELATED WORKS

Although, rich literature is present for the visual object tracking, however, limited literature for the deformable object tracking. In this section, the state-of-art work regarding non-rigid (deformable) object tracking is discussed. The simplest model that is used to track deformable object is the integral histogram, in Nejhum et al. (2008) method, visual tracking is done by using histogram and articulating blocks. Nejhum et al. (2008) proposed the tracker which uses the blocks of appearance and shape descriptions, but the limitation attached with this approach was assuming the stationary background appearance with no illumination variation. The kernel-based method that uses color, gradient and intensity statistics proved to be good for the object only changing their shape but fails when there is change in illumination condition and object is occluded. The above methods are the offline approach of tracking where the model is fixed, but in case of deformable objects we need the online approach for tracking. Initially, Avidan (2005) used the concept of online approach of tracking. Most of the existing work are constrained to bounding box (either rectangular or elliptical), so in this type of tracking the background detail is also included which leads to false prediction of object location. So, to avoid this problem the object can be represented as part based model as given by Felzenszwalb et al. (2008). The more detailed models are obtained in voting-based framework like in generalized Hough transform (Godec et al., 2011). However, these approaches are infeasible for tracking the objects which are unknown.

Active contour method for segmentation is able to deal with significant change in the shape of the object. Ning et al. (2013) combines the registration and active contour segmentation to track the real contour of the target, level set is used to represent target region (including foreground and background). Using Bhattacharyya similarity measure, it locates the candidate target region. Due to its higher complexity this method is not feasible for real time tracking.
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