Chapter 13
Background Subtraction and Object Tracking via Key Frame–Based Rotational Symmetry Dynamic Texture

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ABSTRACT

Developing universal methods for background subtraction and object tracking is one of the critical and hardest challenges in many video processing and computer-vision applications. To achieve superior foreground detection quality across unconstrained scenarios, a novel Two Layer Rotational Symmetry Dynamic Texture (RSDT) model is proposed, which avoids illumination variations by using two layers of spatio temporal patches. Spatio temporal patches describe both motion and appearance parameters in a video sequence. The concept of key frame is used to avoid redundant samples. Auto Regressive Integrated Moving Average model (ARIMA) (Hyndman & Rob, 2015) estimates the statistical parameters from the subspace. Uniform Local Derivative Pattern (LDP) (Zhang et al., 2010) acts as a feature for tracking objects in a video. Extensive experimental evaluations on a wide range of benchmark datasets validate the efficiency of RSDT compared to Center Symmetric Spatio Temporal Local Ternary Pattern (CS-STLTP) (Lin et al., 2015) for unconstrained video analytics.

INTRODUCTION

Object Detection and Tracking

Video analysis commonly has three key steps: moving region detection, tracking that region of object in the video sequences, analysing the behaviour of that object. One of the essential tasks in the field of image processing and computer vision is background subtraction.

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Background subtraction is the process of moving target detection from background model. It is used for further processing in video sequences. The main purpose of background subtraction is segmenting out the image into foreground and background. It is a widely used approach to reduce the problem and process only the relevant information from the image. Background subtraction is still a research area because of the necessity of a fast and lighting independent method. In fact, foreground detection has long been an alternative path to image segmentation. Whichever way is inherently the better approach, foreground detection has the additional advantage in that it immediately reduces the problem by extracting the moving regions.

The proposed Key Frame Based Rotational Symmetry Dynamic Texture framework includes background learning and subtraction and vehicle-object identification and tracking. The proposed work is based on two layers of spatio temporal patches. A Spatio temporal patch is the grouping of spatio temporal blocks. It describes not only the appearance of spatial structural information but also describes the temporal motion between two spatio temporal blocks. Key frames concept has been used to drastically reduce the processing overhead between spatio temporal blocks. Auto Regressive Integrated Moving Average (ARIMA) is a time serial analysis model used for parameter estimation, and forecasting. Object tracking is also one of the challenging tasks in the field of computer vision. Tracking can be defined as the problem of estimating the trajectory of an object in the image plane as it moves around the scene. Feature identification is an important step in object tracking. Selected feature must be insensitive against the appearance variation caused by numerous factors such as illumination, pose angle, and background clutter and camera motion. Uniform Local Derivative Pattern for each object is taken as the feature for tracking the objects. The way for tracking multiple objects whose number is unknown and varies is also presented in this chapter. This chapter focuses on traffic surveillance and monitoring. The camera is mounted stationarily and the vehicles are in motion. Monitoring the vehicles helps to manage better the traffic flows.

Application of Object Detection and Tracking

The primary motivation behind background subtraction is that it can be used to reduce the problem set for further processing that is a just processed part of the picture that contains the relevant information. It segments the image into foreground and background.

Some of the applications are as follows (Huang, 2011; Kuralkar & Gaikwad, 2012):

- **Visual Surveillance:** A human action recognition framework processes image sequences captured by video cameras by observing delicate zones, for example, bank, departmental stores, parking areas and country border to figure out whether one or more humans engaged are suspicious or under criminal activity.
- **Content Based Video Coding:** This system generates the video content. Video has to be segmented into video objects and tracked as they traverse across the video frames.
- **Traffic Is Consistently Observed Using Cameras:** Any vehicle that breaks the traffic rules or is included in other illegal act can be tracked down easily if the surveillance system is supported by an object tracking system. This framework can be utilized to check the number of the vehicles, identify the vehicles and track them.
- **Animation:** Object tracking algorithm can also be extended for animation.