Chapter 63
Object Classification and Tracking in Real Time:
An Overview

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ABSTRACT

Algorithms for automatic processing of visual data have been a topic of interest since the last few decades. Object tracking and classification methods are highly demanding in vehicle traffic control systems, surveillance systems for detecting unauthorized movement of vehicle and human, mobile robot applications, animal tracking, etc. There are still many challenging issues while dealing with dynamic background, occlusion, etc. in real time. This chapter presents an overview of various existing techniques for object detection, classification and tracking. As the most important requirements of tracking and classification algorithms are feature extraction and selection, different feature types are also included.

There is a growing popularity of surveillance mechanisms in public safety systems for detecting unauthorized vehicle parking, unintended luggage and unauthorized entry of persons or vehicles in a restricted area, and also in tracking of animals in forest, sport video analysis, etc. In general, the processing framework for object tracking and classification includes the four stages: detection (segmentation and modelling of the candidate object and the changing background), feature extraction (extraction of features from the object), classification (detecting the type of the object) and tracking (estimation of the possible location of the object in each frame and localization of the object in each frame).

The detection, classification and tracking of moving object are challenging tasks in the outdoor environments for various reasons like (1) incomplete details of moving object due to possible occlusions, (2)

change in environment conditions like fog, rain, lighting, haze and strong shadow effects, etc. (3) very low resolution of candidate object and (4) real-time processing and high memory requirement. Further, the efficiency of classifier and tracker depend on their ability to perform under varying camera angle and to discriminate objects.

There are many techniques proposed in recent past for classifying and tracking of objects in real time. This chapter discusses about some of the popular methods available in the literature for object detection, feature extraction, classification and tracking of objects of interest from the visual data. Each section in the following considers the methods at each stage with description and discussion. A comprehensive set of references is also presented for further consultation. Section 1 discusses about object detection. Section 2 covers briefly about different aspects of feature extraction. Classification methods are included in Section 3. Tracking aspects are discussed in Section 4. The work is concluded in the last section.

1. OBJECT DETECTION

Detection of object of interest in video is the most important step in a system for tracking and classifying object. The performance of the complete system depends on the accuracy and rate of detection of the region of interest. An object can be detected either when it first appears in the video or in every frame depending on requirement. Since it is more meaningful to detect the moving objects than to detect all the static objects in a video sequence, most methods focus on detecting such objects. The common approach is to use the temporal information that highlights the difference between the consecutive frames in a video. In the following, some popular object detection techniques are discussed in the context of object classification and tracking. The different types of object detection methods commonly used may be grouped as in Figure 1.

1.1. Point Detectors

Point detectors are used to find the points of interest in video frames which have expressive photometric descriptors. These points having useful textures are important in the applications like recognition, tracking, etc. Point detectors are less sensitive to illumination changes and can perform even in occluded environment. Moreover, they do not involve segmentation while detecting objects of interest. Most commonly used point detectors include Moravec's interest operator, Harris interest point detector, KLT detector and SIFT detector and Affine invariant point detector (Mikolajczyk & Schmid, 2002).

Figure 1. Classification of Object detection techniques
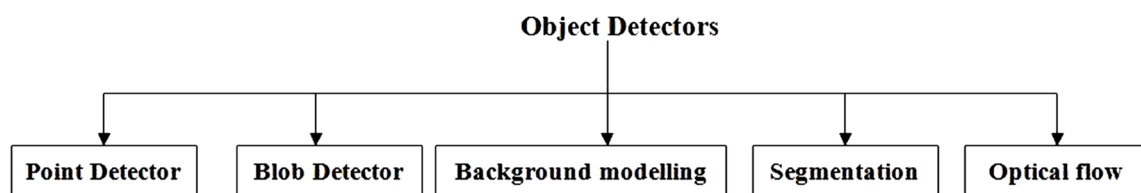
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