STREAMING CLUSTERING ALGORITHMS FOR FOREGROUND DETECTION IN COLOR VIDEOS

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Abstract: A new method is given for locating foreground objects in color videos.This is an essential task in many applications such as surveillance. The algorithm uses clustering techniques to permit flexibility and adaptability in the description of the background. The approach is an example of the streaming data paradigm of algorithms design, which only permits limited information to be retained about previous video frames. Experimental results show that it is an effective and robust technique.

1 INTRODUCTION

Many authors have developed methods of detecting people in images (Haritaoglu et al., 1998; Wren et al., 1997); a comprehensive survey (Moeslund and Granum, 2001) reviews most of the relevant references. Most of this work has been based on background subtraction using color or luminance information. Recently, edge information has been used for background subtraction (Jabri et al., 2000; McKenna et al., 2000) These methods usually use a number of frames to ”learn” a model of the background scene which is later used to classify pixels in new images as either a background or a foreground. These methods assume that the camera does not move from frame to frame since any movement of the camera or the background objects could cause static parts of the scene to be classified as a moving foreground. The results frequently suffer from false positives/negatives and require additional post-processing to remove false objects and/or holes. In this paper, we present a novel moving object detection and tracking method.

In this paper we explore another technique for representing the background image and we use it successfully to do foreground detection. A primary motvation for our technique is that representing the background by the mean image is not effective in many applications. A fixed camera will typically experience vibrations. The background, even if “fixed”, will move sightly: leaves will flutter, waves will shimmer, and distant objects will move a little. Another motivation is that a fixed camera, such as is used by surveillence, will over time see a change in the “fixed” background; lights will go on and off, the sun’s shadows will move, and the color palette will drift.

To address these concerns in a natural way has led us to use clustering methods. The general idea is to represent each small patch of the frame by a small set of exemplars, which are regarded as the centers of clusters. Each disjoint cluster represents an equivalence class of very similar patches; small variations will be recognized as members of the same equivalence class. Two disjoint clusters can represent different states of the same background; a flag may furl and unfurl. And, gradual changes can be addressed by permitting the location of the cluster centers to be self-adjusting.

2 BACKGROUND

This algorithm brings together two ideas, not previously used for foreground detection. The first is the use of clustering techniques. Clustering is a well-studied problem with an enormous literature (see, for example, (Duda et al., 2000)). Clustering can be regarded as a paradigm for unsupervised learning; the

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