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Motion and Feature Based Person Tracking in Surveillance Videos

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Abstract- This work describes a method for accurately tracking persons in indoor surveillance video stream obtained from a static camera with difficult scene properties including illumination changes and solves the major occlusion problem. First, moving objects are precisely extracted by determining its motion, for further processing. The scene illumination changes are averaged to obtain the accurate moving object during background subtraction process. In case of objects occlusion, we use the color feature information to accurately distinguish between objects. The method is able to identify moving persons, track them and provide unique tag for the tracked persons. The effectiveness of the proposed method is demonstrated with experiments in an indoor environment.

Index Terms- video surveillance, Motion detection, object tracking

I. Introduction

Moving Objects Detection and tracking are widely used low-level tasks in many computer vision applications, like surveillance, monitoring, robot technology, gesture recognition, object recognition etc. Many approaches have been proposed for moving object detection and tracking from videos, mainly dedicated to traffic monitoring and visual surveillance. Although the exact requirements vary between surveillance systems, there are issues that are common to all. Usually, an operator is interested only in certain objects in the scene. For instance, in surveillance of a public area, one may be interested only in monitoring the people within it rather than the entire scene In general motion detection algorithms are classified broadly into two main categories: feature based and optical flow based. Our approach is feature based. Detection of moving objects in video streams is the first stage in any automated video surveillance. Aside from the intrinsic usefulness of being able to segment video streams into moving and background components, detecting moving blobs provides a focus of attention for recognition, classification, and activity analysis, making these later processes more efficient since only "foreground" pixels need be considered. Tracking aims to describe trajectories of moving objects during time. The main problem to solve for tracking is to find correspondences of the same physical objects in different frames. Some of the relevant works in the field of motion detection and tracking is mentioned in the following section.

II. Existing Work

We survey the techniques and method relevant to object tracking, specifically approaches that perform feature based tracking and handle occlusions. For accurate tracking, the motion must be accurately detected using suitable methods, but they are affected by a number of practical problems such as shadow and lighting change over time. Many researchers have given their contributions to Motion based object detection and tracking under both indoor and outdoor scenes and provide solutions to the above mentioned problems. R. Cucchiara et al. [1] proposed Sakbot system which is a robust and efficient detection technique based on statistical and knowledge-based and use HSV color information for shadow suppression. This method is capable to deal with luminance condition changes. The mixture of Gaussians [2] is a popular and promising technique to estimate illumination changes and small movement in the background. Tracking process consists of establishing the correspondence between consecutive frames using pixels, points, lines or blobs. In the early generation, C. Wren et al. [3] proposed Pfinder method which tracks the single entire human body in the scene without occlusion. This method modeled pixel color disparity using multivariate Gaussian. In [4], color segmentation and a non-parametric approach are used for detecting contours of moving objects. Tang Sze Ling et al, [5] proposed a method that uses color information to differentiate between objects and handles occlusion. S. J. McKenna et al. [6] then proposed a method to track people through mutual occlusions as theyform groups and separate from one another using color information. In [7] I. Haritaoglu et al, employ histogram based approach to locate human body part as head, hands, feet and torso, then uses head information to find the number of people. A. J. Lipton et al. [8], using shape and color information to detect and track multiple people and vehicles in a crowded scene and monitor activities over a large area and extended periods of time. To survive in occlusion conditions, one should take advantage of multiple cues, like color, motion, edge, etc., as none of these features alone can provide universal result to different environments. The color histogram is robust against the partial occlusion, but sensitive to the illumination changes in the scene. In [9] color cues are combined with motion and cues to provide a better result. Color and shape cues are also used in [10], where shape is described using a parameterized rectangle or ellipse. In [11] the color, shape and edge cues are combined under a particle filter framework to provide robust tracking result, it also involves an adoption scheme to select most effective cues in different conditions.

III. WRITE DOWN YOUR STUDIES AND FINDINGS(PROPOSED WORK)

Our algorithm aims to assign consistent identifier to each object appears in scene when individual merge into or split from the group and involves several methods to obtain the lowest possibility of false tracking and tagging. In tracking interested object (human), shadows affect the performance of tracking and leads to false tagging. To avoid this problem, we apply mean filter to remove noise which causes the image sequence to blur. Since we are using color information for tracking, blurring causes no loss of data. The structural design of our proposed method shown in Fig.1

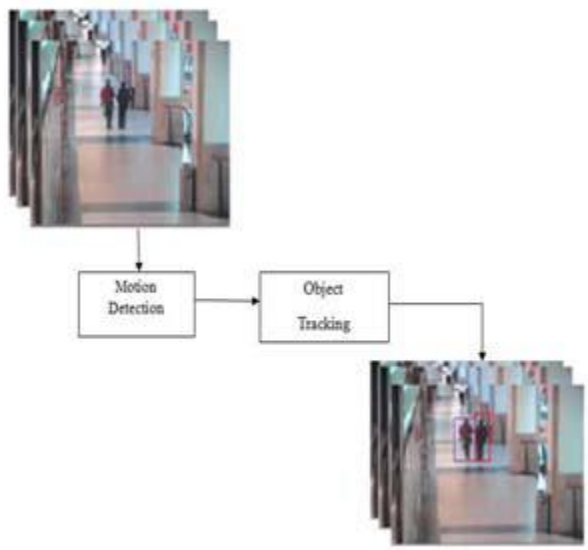

Fig. 1 System architecture

The most basic form of motion detection is the method of subtracting know background image containing no objects from an image under test. There are several methods to background subtraction, including averaging background frames over time and statistical modeling of each pixel. Preprocessing based on mean filtering is done on the input video (i.e., image sequences) to equalize the light illumination changes and also to suppress the presence of shadows.

A. Background subtraction

Preprocessing is done on the video frames to reduce the presence of noise. We apply mean filter which in turn blurs the image frames which helps in shadow removal. After preprocessing motion detection is performed. The background subtraction method is the common method of motion detection. It is a technique that uses the difference of the current image and the background image to detect the motion region. Its calculation is simple and easy to implement. Background subtraction delineates the foreground from background in the images. Following figure 2 illustrates the result of background subtraction. The drastic changes in pixel's intensity indicate that the pixel is in motion. The background subtraction step generates a binary image containing black (represents background) and white (moving pixels). Then a post processing step is applied on the binary image to label groups motion pixels as motion blobs using connected component analysis. The key idea of connected component analysis is to attach the adjacent foreground's pixel (i.e. white pixels) in order to construct a region. Connected component labeling is used in computer vision to detect connected regions in binary digital images. Blobs may be counted, filtered, and tracked.

Object tracking

Once the object areas are determined in each frame, the tracking is performed to trace the objects from frame to frame. The color information from each blob is derived and tracking is performed by matching blob color. To handle occlusion, each motion blob is

The key feature of proposed method is the color information of each object is extracted cluster-by-cluster. Each cluster has its own weightage for comparison. The color information is extracted from the motion blocks in the current frame to categorize matching color information between motion blocks in the current frame and previous frames. Subsequently, a tag is assigned to the motion blocks in the current frame. The first sub-task in object tracking is, each motion block in the current frame is segmented into areas of almost similar color as clusters (head, torso and feet). For each cluster of the motion block, color information is then derived as HSV values and stored, which helps in comparison. The second sub-task is, to identify matching color information between motion blocks in the current frame and motion blocks in the previous frames. This is done by comparing the cluster color information of a cluster of the motion block in the current frame with the cluster color information of clusters in all motion blocks in the previous frames using weighted matching. For each comparison made, the processor computes a respective comparison score. The comparison score for each of the clusters of the motion block in the current frame is stored. The processor then identifies the highest comparison score of each cluster in the current frame. This is repeated for every cluster of the motion block in the current frame.

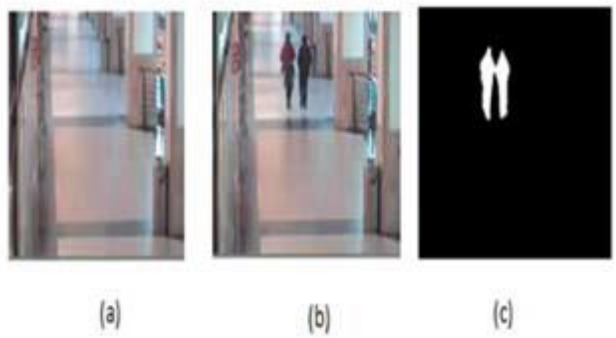

Fig. 2 Background Subtraction

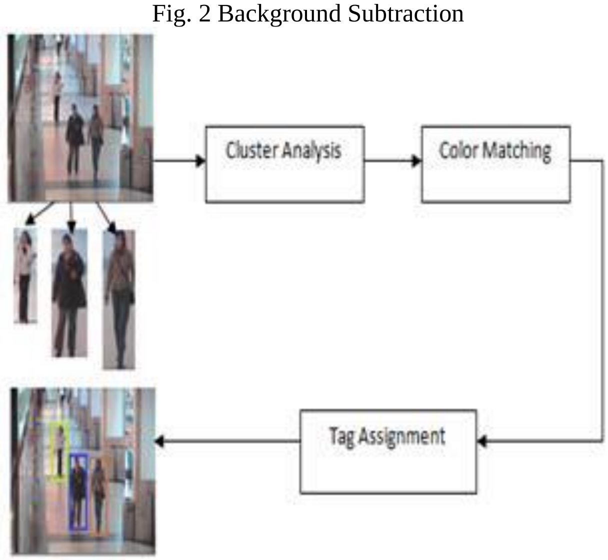

Fig.3 The work flow of color-based motion tracking component

IV. RESULTS AND DISCUSSION

The above algorithm is implemented using Matlab on Windows 7 platform and tested with 4GB RAM. The test video for this example is in the PETS-ECCV'2004 – CAVIAR database, which is an open database for research on visual surveillance.

A. Motion detection

Accuracy in motion detection is important for efficient tracking. The threshold should be set in such a way to avoid shadow to a greater extent also the blob size should be maintained properly and it depends on the application. The figure 4 shown below illustrates the results with various threshold values.

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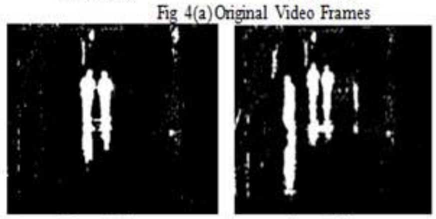
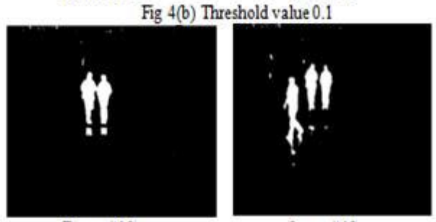
Frame #10 frame #40

Fig 4(a) Original Video Frames



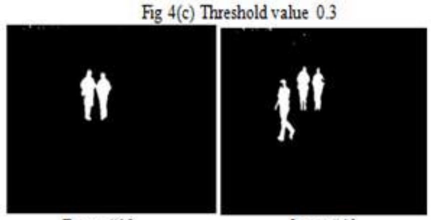
Frame #10 frame #40

Fig 4(b) Threshold value 0.1



Frame #10 frame #40

Fig 4(c) Threshold value 0.3



Frame #10 frame #40

Fig 4(d) Threshold value 0.6

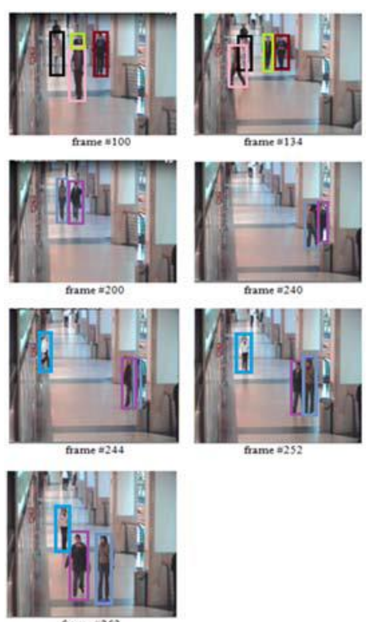


Fig 5 Occlusion handling

Object tracking

Assigning a suitable tag accurately during occlusion condition is illustrated below. Color feature extraction and matching provides good solution in assigning tags and clustering helps in reducing the cost of comparison. Fig 5 shows handling occlusions during tracking..

V. CONCLUSION

The advantages of using color as feature to achieve object's similarity is analyzed and found that it is robust against the complex, deformed and changeable shape (i.e. different human profiles). In addition, it is also scale and rotation invariant, as well as faster in terms of processing time. Color information is extracted, stored and compared to find uniqueness of each object.

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