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Robust Human Motion Detection and Tracking In Dynamic Background

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Abstract— Background subtraction is very important part of surveillance applications for successful segmentation of moving objects from video sequences. We present a novel & robust algorithm, for human motion detection and tracking in dynamic scenes based on background modelling technique to analyze the illumination change for detection & tracking of moving objects. Successive frame difference is taken and compared for the required set threshold for the changing pixel detection. Experimental result shows the high performance of the proposed method for human tracking in noisy backgrounds.

Index Terms — object detection, tracking, video survelliance, backgoround model, illumination change.

I. INTRODUCTION

Many computer vision applications as in video surveillance [1, 2], human-computer interface [3, 4], traffic monitoring [5], video editing, and other applications moving objects identification & tracking is a fundamental first task. The two major sources of information in video that can be used to track objects are visual features (such as color, texture and shape) and motion information. We describe the later approach for tracking.

Many methods for moving object detection have been proposed like Gaussian mixture model (GMM) [6], which uses several Gaussian functions with weight to approximate the distribution of lightness for moving object tracking. GMM and its modification [7] can perform better. However, the computational effort of GMM is so large that it is not efficient in real-time application. Furthermore, tracking quality of GMM becomes low when the tracked objects of video are rigid. A large number of different methods for moving objects detection have been proposed. They can be classified into three different types: optical flow based video segmentation [8-9]; frame difference based video segmentation [10], and background subtraction based algorithm [11-12]. Histograms are also largely employed (edge histogram [13], contrast histogram [14], etc). But those approaches allow only coarse detection of moving objects as the classification foreground/background is the same for each pixel in a block.

In this paper, an algorithm is introduced to improve the efficiency of the background subtraction. The algorithm integrates frame differences and illumination processing to obtain better performance for motion detection & tracking. Experimental results for various environmental sequences demonstrate the effectiveness and robustness of our method. The remainder of this paper is organized as follows.

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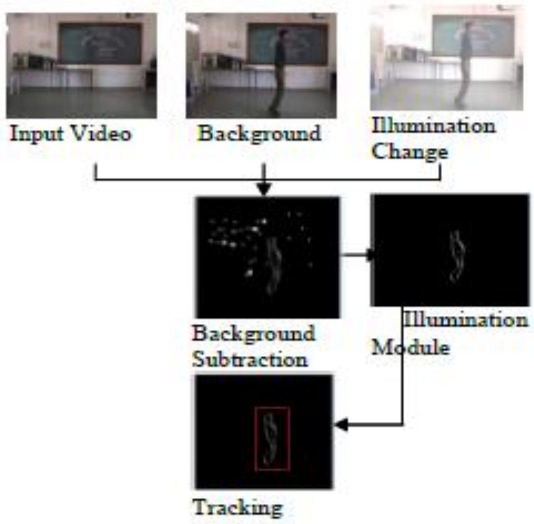
Section II describes our algorithm for human motion detection & tracking. Experiments and analysis are proposed in Section III. Conclusions are drawn in Section IV.

II. SYSTEM OVERVIEW

We propose a method for human motion detection and tracking, which includes a background module, illumination module, and object detection & tracking module. The overview of the proposed background subtraction approach is shown in Fig. 1.



Identifying moving objects from a video sequence is a fundamental and critical task in many computer-vision applications. A common approach is to perform background subtraction, which identifies moving objects from the portion of a video frame that differs significantly from a background model. There are many constraints in developing a good background subtraction algorithm. First, it must be robust against changes in illumination. Second, it should avoid detecting non-stationary background objects such as moving leaves, rain, cast by moving objects. Lastly, its internal background model should react quickly to changes in background such as starting and stopping of vehicles.

A. Background Modelling

A pixel is marked as foreground if $I_t – B_t > T$ where T is a "predefined" threshold. The thresholding is followed by closing with a 3 x 3 kernel and the discarding of small regions. The background update is $B_t + 1 = \alpha I_t + (1 – \alpha) B_t$ where α is kept small to prevent artificial "tails" forming behind moving objects. Two background corrections are applied:

1. If a pixel is marked as foreground for more than m of the last *M* frames, then the background is updated as $B_t + 1 = \alpha I_t$. This correction is designed to compensate for sudden illumination changes and the appearance of static new objects.
2. If a pixel changes state from foreground to background frequently, it is masked out from inclusion in the

foreground. This is designed to compensate for fluctuating illumination, such as swinging branches etc.

B. Illumination Module

We are interested in compensating illumination changes that are strong enough to prevent the tracking of objects. Object tracking is not possible without compensation because false foreground completely masks the objects of interest. Homomorphic filtering [16] models the recorded grey levels g(m, n) as the product of scene illumination i(m, n) and surface reflectance r(m, n). Clearly, structural scene changes are captured by r(m, n). Scene illumination is assumed to vary slowly over the spatial coordinates (m, n), and can hence be suppressed by applying a linear highpass filter to log(g(m, n)).

C. Object Detection & Tracking Module

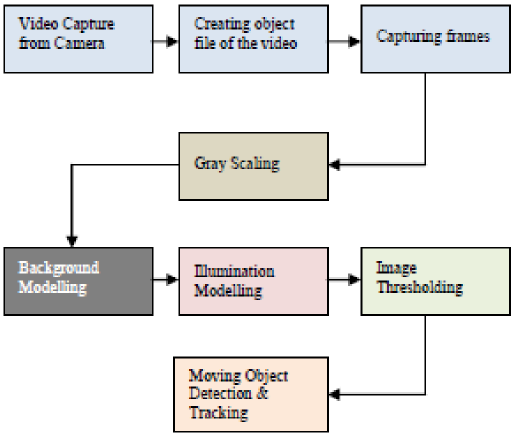


Figure 2: Block Diagram of system.

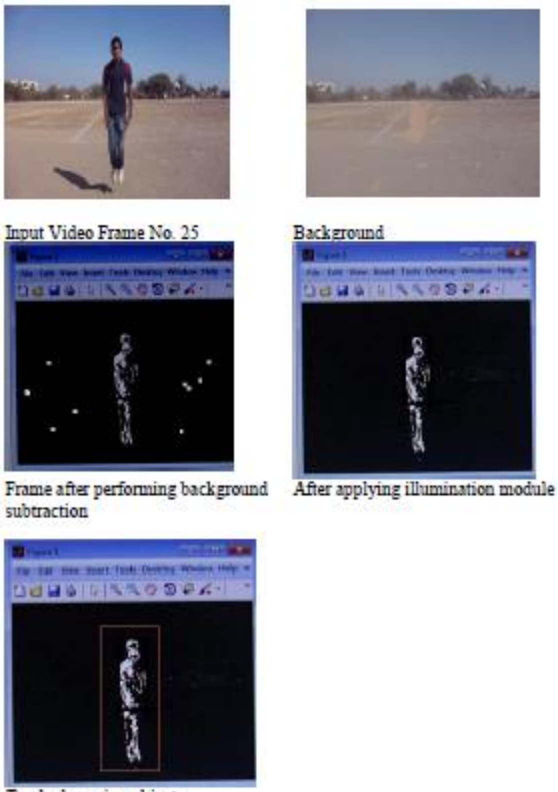
III. SIMULATION RESULTS

This section contains some experimental results for moving object detection and tracking based on the system described in Section II. The result shows performance of the proposed method. The entire test was run on the Windows platform on a 2.13GHz PC with 2.00GB of RAM.

(a) Input Video Frame No. 25
(b) Background
(c) Frame after performing background subtraction
(d) After applying illumination module
(e) Tracked moving object
illumination changes captured on playground (outdoor environment).

Figure 3: Experimental result on the indoor environment

The proposed method has achieved highly robust results in cluttered backgrounds and illumination change. Algorithm can detect and track moving object and is tested for both indoor and outdoor environments. Fig. 3 (a) shows a person running in the indoor environment, (b) depicts the background of the scene, (c) shows the result after applying the background subtraction technique, As the result in figure (c) includes the highlighted portion of stationary object also it is eliminated by applying proper illumination technique in fig (d) and finally the moving object is tracked which is shown in fig (e). Fig. 4 shows the same sequence of result in drastic illumination changes captured on playground (outdoor environment).



Input Video Frame No. 25
Background
Frame after performing background subtraction
After applying illumination module
Tracked moving object

Figure 4: Experimental result on the outdoor environment

IV. CONCLUSION

In this paper, we proposed effective motion detection & tracking algorithm for video surveillance system. Background subtraction method is used for segmentation of foreground object from background and to obtain maximum number of moving pixels. With Illumination estimation, the background model can be easily updated with change in luminance intensity by the determination of background. The algorithm efficiently tracks the moving object whose motion and appearance change drastically. We expect the study to motivate future research, to solve the problem of occlusion handling which is still the critical problem in computer vision.

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