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Human Object Tracking using Background Subtraction and Shadow Removal Techniques

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Abstract: **This paper presents a novel algorithm for detecting moving objects from a static background scene that contains shadows using color images. Object tracking based on motion estimation and detection, background subtraction and shadow removal. A reference frame is initially used and considered as background information. While a new object enters into the frame, the foreground information and background information are identified using the reference frame as background model. Most of the times, the shadow of the background information is merged with the foreground object and makes the tracking process a complex one. In the approach, morphological operations are used for identifying and removed the shadow. Video sequences have been captured and tested with the proposed algorithm. Experimental results, which demonstrate the system's performance, are also shown.**

Keywords: **Background modeling and subtraction, human motion detection, shadow removal**

I. INTRODUCTION

There are three methods for object tracking template-based, probabilistic and pixel-wise. Pixel based methods is one of best method for object tracking. This method is robust against the background interfusion methods. In this kind of method, the failure detection and automatic failure recovery can be carried out effectively.

In computer vision detection and tracking the moving object In video sequences is very critical task. Possible applications are as follows (i) Visual surveillance: A human action recognition system process image sequences captured by video cameras monitoring sensitive areas such as bank, departmental stores, parking lots and country border to determine whether one or more humans engaged are suspicious or under criminal activity. (ii) Content based video retrieval: A human behavior understanding system scan an input video, and an action or event specified in high-level language as output. This application will be very much useful for sportscasters to retrieve quickly important events in particular games. (iii) Precise analysis of athletic performance: Video analysis of athlete action is becoming an important tool for sports training, since it has no intervention to the athletic

In all these applications fixed cameras are used with respect to static background (e.g. stationary surveillance camera) and a common approach of background subtraction is used to obtain an initial estimate of moving objects. First perform background modeling to yield reference model. This reference model is used in background subtraction in which each video sequence is compared against the reference model to determine possible variation. The variations between current video frames to that of the reference frame in terms of pixels signify existence of moving objects. The variation which also represents the foreground pixels are further processed for object localization and tracking. Ideally, background subtraction should detect real moving objects with high accuracy and limiting false negatives (not detected) as much as possible. At the same time, it should extract pixels of moving objects with maximum possible pixels, avoiding shadows, static objects and noise

In the detection of shadows the foreground objects are very common, producing undesirable consequences. For example, shadows connect different people walking in a group, generating a single object (typically called blob) as output of background subtraction. In such case, it is more difficult to isolate and track each person in the group.

There are several techniques for shadow detection in video sequences [1].

The main objective of this paper is to develop an algorithm that can detect human motion at certain distance for object tracking applications. We carry out various tasks such as motion detection, background modeling and subtraction, foreground detection, shadow detection and removal.

The paper organized as follows. Section II for Background Subtraction The proposed method is explained in Section II.B. In section III, we present the experimental results and we conclude the paper in the last section of the paper.

II. BACKGROUND SUBTRACTION

Human motion analysis and detection are the foremost task in computer vision based problems. Human detection aims at segmenting regions corresponding to people from the entire image. It is a significant issue in human motion analysis system since the subsequent processes such as tracking and action recognition follows the motion detection. The motion detection and foreground object extraction algorithm consists of several sequential processes. The process algorithm is described as follow.

- Sequences of video frame
- If Motion is detected. Then perform Background modeling, otherwise stop
- Perform Background subtraction/foreground object extraction
- Shadow detection and removal
- Morphology process
- Draw bounding box and human object tracking

1. A Background Subtraction

Background subtraction is a popular technique to segment out the interested objects in a frame. This technique involves subtracting an image that contains the object, with the previous background image that has no foreground objects of interest. The area of the image plane where there is a significant difference within these images indicates the pixel location of the moving objects [2]. These objects, which are represented by groups of pixel, are then separated from the background image by using threshold technique

The mode model was chosen to perform the background modeling, which provides better results. If the absolute difference between the current pixel and the mode modeled background pixel is larger than a threshold, then that pixel is considered as foreground object [3,4]. RGB values of current frames pixels subtracted with that of background modeling frame. The mean of absolute difference of red value, green value and blue value are found. If the absolute difference greater than threshold, indicates the foreground pixels else background pixels. Foreground pixels are detected by calculating the Euclidean norm,

$$D(x,y)= \{ 1, \text{ if } |(x,y)-B(x,y)|T$$
$$0, \text{ otherwise}$$

(a) (b)

Fig 1. Background subtraction and moving object identification (a) Video Frame, (b) Background,

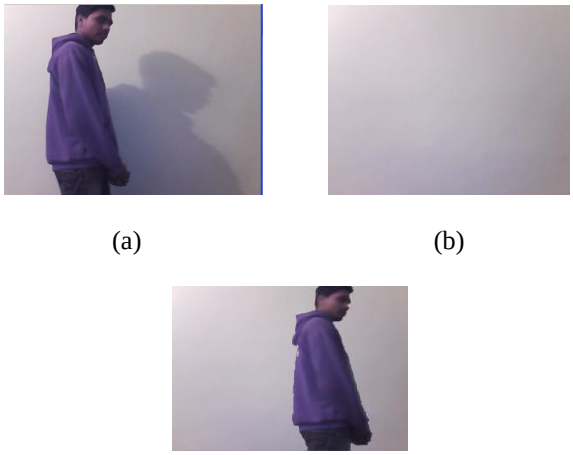
Fig.1 shows the video frames used for the background Subtraction and moving object identification. In Fig. 1(a) shows video frame. In Fig. 1(b), the background frame is shown and that has been used for constructing the background model.

B Shadow Detection and Removal

There are several techniques for shadow detection in video sequences [5–7, 8, 9,10–12], and the vast majority of them are based on color video sequences. Once the foreground object identified, each foreground pixels are checked whether they are part of a shadow or the object. This process is necessary, since, shadow of the some of the background object may get combined with the foreground object. This causes the object tracking task as a complicated task. For pixel (*x*, *y*) the shadow can be detected and removed as given below,

Firstly current image should be subtracted from background image. The resultant image then be converted into gray level using rgb2gray function. Now , the gray level image contents whose values greater than threshold value are filled with holes in the binary image.

If threshold is low, several foreground pixels corresponding to moving objects may be misclassified as shadows. On the other hand, selecting a larger value for threshold results in less false positives, but pixels related to actual shadows may not be detected [13].



(a) (b)

(c)

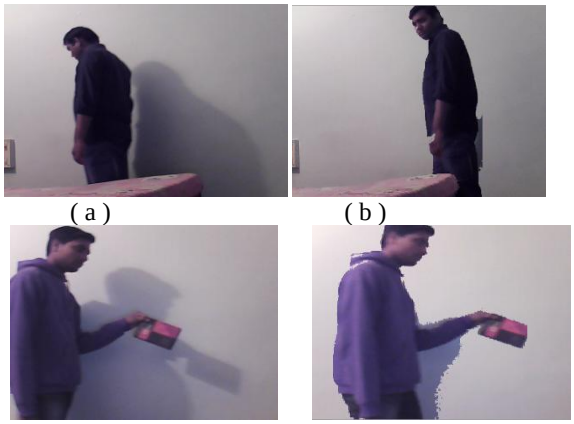
Fig.2. Background subtraction and shadow removal (a)Video Frame, (b)Background Subtraction, (c)Remove Shadow

Fig.2 shows video frames with shadows and the identification of the same. The foreground and background objects are identified and are shown in Fig. 2(b) and (c). In Fig. 3(c), Eqs.5-8, are applied and shadows are identified. In this approach, two dilation and one erosion operation processes were carried out. For objects having area less than 0.5% of total image area has removed.

III EXPERIMENTAL RESULTS

The experimental results are presented to show that the proposed methods can achieve promising performance in background subtraction and foreground object extraction. This system detects and tracks the moving objects exactly. In this approach, the background scene is modeled using a set of background image frames, which basically consists of 5-30 consecutive frames. The object pixels are segmented out from its background followed by post-morphological process

Fig. 3(a)-(d), shows the object tracking process. This video is a homemade video and objects were tracked. In Fig. 3(a) and 3(c) the original Video frame is shown.. Using 3(a) and (c), the foreground and background information are extracted and subtracted for getting the target object, which is shown in Fig. 3(b) and 3(d). It is observed that the proposed work detects the object effectively.



(a) (b)

(c) (d)

Fig.3.Object tracking process (a) Video Sequences, (b) shadow detection and removal (c) Video Sequences, (d)shadow detection and removal

IV CONCLUSION

In this paper, an approach capable of detecting human motion and extract object information which involves human as object has been described. The algorithm involves modeling of the desired background as a reference model for later used in background subtraction to produce foreground pixels which is the deviation of the current frame from the reference frame. This algorithm efficiently removes the shadow of human object.

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