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Efficient Motion Detection Algorithm in Video Sequences

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ABSTRACT

Human motion analysis concerns the detection, tracking and recognition of people behaviors, from image sequences involving humans. 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.In this paper, an efficient algorithm is proposed for objects detection in real time video sequences. The method aims at tracking an object like (human) in motion using background subtraction technique. The tracked objects are subject to different pre and post image processing in order to extract the most important features (frame preprocessing is used for shadow removal using morphological operations). They can be used later for recognition in different security system such as (human detection for surveillance). Experimental results show that the proposed method is very efficient in terms of reliability and accuracy of detection.

Indexing terms/Keywords

Motion Detection; Object Tracking; Background Subtraction Method; Image Preprocessing, Shadow Removal.

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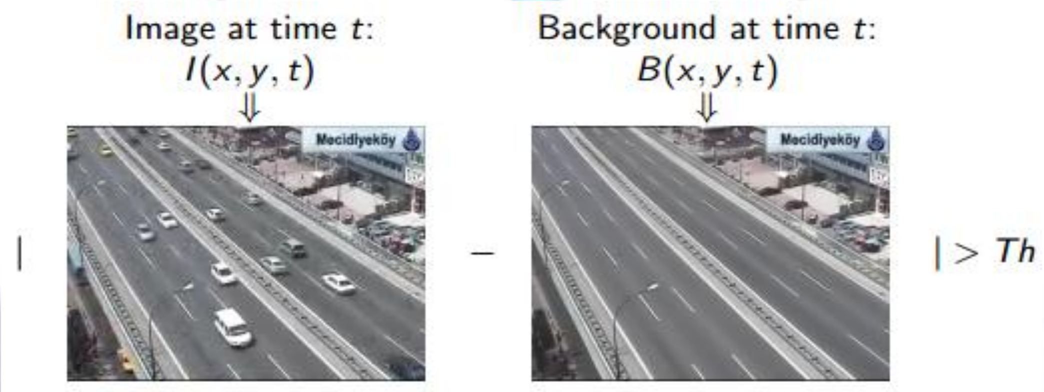
I INTRODUCTION

In video sequences, moving objects identification is a critical task in human detection and tracking, video surveillance, traffic monitoring and analysis. A common approach to identifying the moving objects is background subtraction, where each video frame is compared against a reference or background model. Pixels in the current frame that deviate significantly from the background are considered to be moving objects. These foreground pixels are further processed for object localization and tracking. Since background subtraction is often the first step in many computer vision applications, it is important that the extracted foreground pixels accurately correspond to the moving objects of interest. Even though many background subtraction algorithms have been proposed in the literature, the problem of identifying moving objects in complex environment is still far from being completely solved. There are several problems that a good background subtraction algorithm must solve correctly [1].

There are many algorithms for motion detection in a continuosus video stream when a camera is fixed; most of them based on comparing of the current vide frame with one from the previous frames or with something that is called background. In background subtraction algorithm, detecting the forground objects are the difference between the current frame and the static frame as a background [2].

$$\left| frame_i - background_i \right| \rangle Threshold$$



Where Threshold value is used to control the objects in motion with respect to the static background (improve the subtraction). A reliable and robust background subtraction algorithm should handle:

1. Sudden or gradual illumination changes,
2. High frequency, repetitive motion in the background (such as tree leaves, flags, waves, ….), and
3. Long term scene changes (a car is parked for a month).

Simple approach:

a. Estimate the background for time t
b. Subtract the estimated background from the input frame.
c. Apply a threshold to the absolute difference to get the forground mask (objects of interest).

II RELATED WORK

Over the past years, several papers have been published addressing the evaluation of BS methods In this section some related research work is described about the motion detection of the objects in a video sequences.

Wren et al. describes the real-time Pfinder system for detecting and tracking humans [3]. The background model uses a Gaussian distribution in the YUV space at each pixel, and the background model is continually updated.

In [4] the intensity difference between an input frame and a reference image as a multi-modal probability distribution, and mode detection is performed by using mean shift computation is treated. The mean shift computation is performed in a fast way using integral images or summed area tables, which gives the method real-time performance in a manner which is independent of the size of thewindow used.

Paper [5] presents a method to detect and track a human body in a video. First, background subtraction is performed to detect the foreground object, which involves temporal differencing of the consecutive frames. After this step, the classification of the object is based on two approaches: the first is a codebook approach, and the second involves tracking of the object and if the object can be tracked successfully, it is considered to be a human.
This paper [6] proposes an adaptive correspondence estimation approach between person detections in a planar scene not relying on correspondence features as it is the case in many other RANSAC-based approaches. The result is a planar

inter-image homography calculated from estimated point correspondences. The approach is self-configurable, adaptive and provides robustness over time by exploiting temporal and geometric information.

Nijad et al presents a low cost automatic object tracking algorithm suitable for use in real-time video based systems. The novelty of the proposed system is that it uses a simplified version of the Kanade-Lucas-Tomasi (KLT) technique to detect features of both continuous and discontinuous nature. As discontinuous feature selection is subject to noise, and would result in non-optimal feature based object tracking, the authors propose the use of a Kalman filter for the purpose of seeking optimal estimates in tracking. The integrated tracking system is capable of handling shadows and is based on a dynamic background subtraction strategy that minimises errors and quickly adapts to scene changes [7].

Liu et al [8] presents a new approach to real time human detection and tracking in cluttered and dynamic enviroments by integration of RGB and depth data. They introduced the notion of Point Ensemble Image, which fully encodes both RGB and depth information from a virtual plan-view perspective, and we reveal that human detection and tracking in 3D space can be performed very effectively based on this new representation. The proposed human detector is able to take advantage of depth data by effectively locate physically plausible candidates as a first step, and then both depth and color information is made full use of in a supervised learningmanner at the second stage.

III PROBLEM STATEMENT

The ability to reliably detect and track human motion is a useful tool for higher-level applications that rely on visual input. Interacting with humans and understanding their activities are at the core of many problems in intelligent systems, such as human-computer interaction and robotics. In real time object detection and tracking system the most difficult thing to solve is a occluded object by another objects. This problem can be solved by using first the frame differencing technique (subtraction algorithm) to detect the objects (in our study human object) and then using a dynamic template matching method to track the human objects in an efficient and accurate way. To overcome the problem of obstacle object detection a mean shift based algorithm is used. This research work allows a system that is robust with respect to occlusion, clutter, and extraneous motion.

IV PROPOSED METHODS

First of all, a general block diagram of the proposed motion detection of human objects in a real time video is given in figure 1.

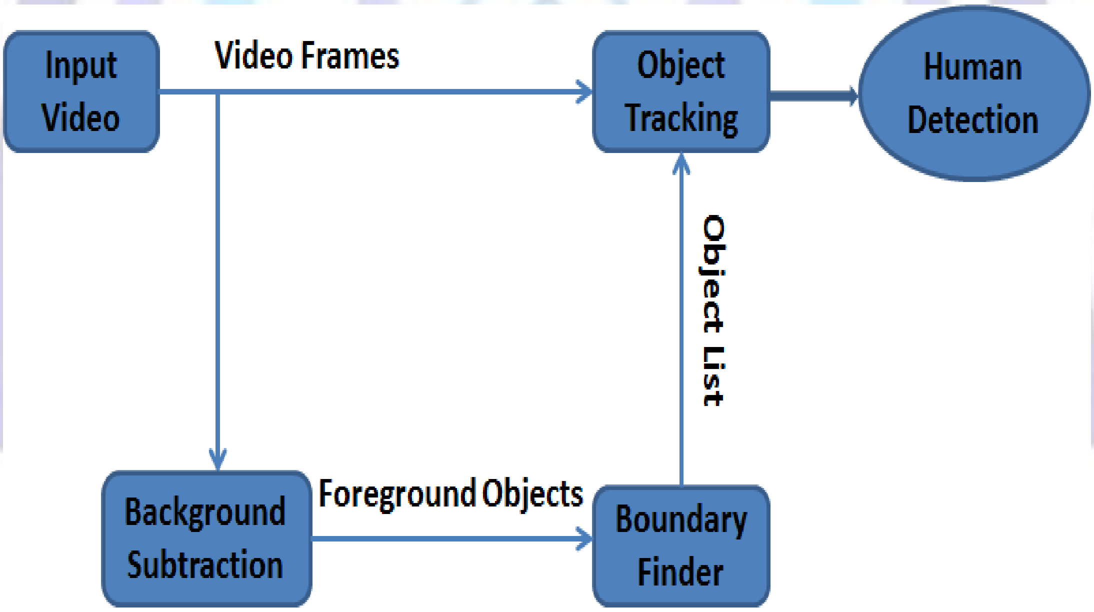


Fig 1: General diagram of human motion detection system

A. Motion Detector

Background subtraction technique is used to find the foreground object from the video and then classify it into categories like human, animal, vehicle etc., based on motion estimation between consecutive frames. The classification involves tracking of the object and if the object can be tracked successfully, it is considered to be a human. The algorithm steps for detecting human body in motion are as follow:

Step1: grap the ith frames (8 bit gray scale image)

Step2: grap (i-3) th frame

Step3: Apply background subtraction algorithm (Subtract I from (i-3))

Step4: Convert the gray image into binary using thresholding technique

Step5: In the thresh-holding technique a parameter called the brightness threshold (T) is chosen and applied to the image f[m,n] as follows:

IF f[m,n]≥T fb[m,n]=object=1

ELSE fb[m,n]=background=0

Step6: Apply some morphological operations (erosion and closing) to fill out the holes

Motion Tracker

After obtaining a human body with a motion detector that describe in section A, the center of gravity (COG) of the binary image is calculated. .The result of this operation is a set of two integers C(cog_x ,cog_y) which determines the position of the moving object in the given scene.

The COG is calculated by:

cog_x =cog_y + x (1)

cog_y = cog_y + y (2)

Total = Total + 1 (3)

for each pixel where x, y is the current pixel location. The resulting COG is then divided by the Total value:

cog_x = cog_x/Total (4)

cog_y = cog_y/Total (5)

to result in the final x, y location of the COG.

Finally, the positional information C(cog_x ,cog_y) is transferred to the object tracking module.

The template matching algorithm is used based on the extracting a square image from the last frame grabbed by the camera.

V EXPERIMENTAL TEST RESILTS

In figure 2 the tested samples are shown in color and gray format.

Fig 2: Sample frame i and i-3 color and gray scale

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Figure 3 presents the stages of background subtraction method based on object in motion.

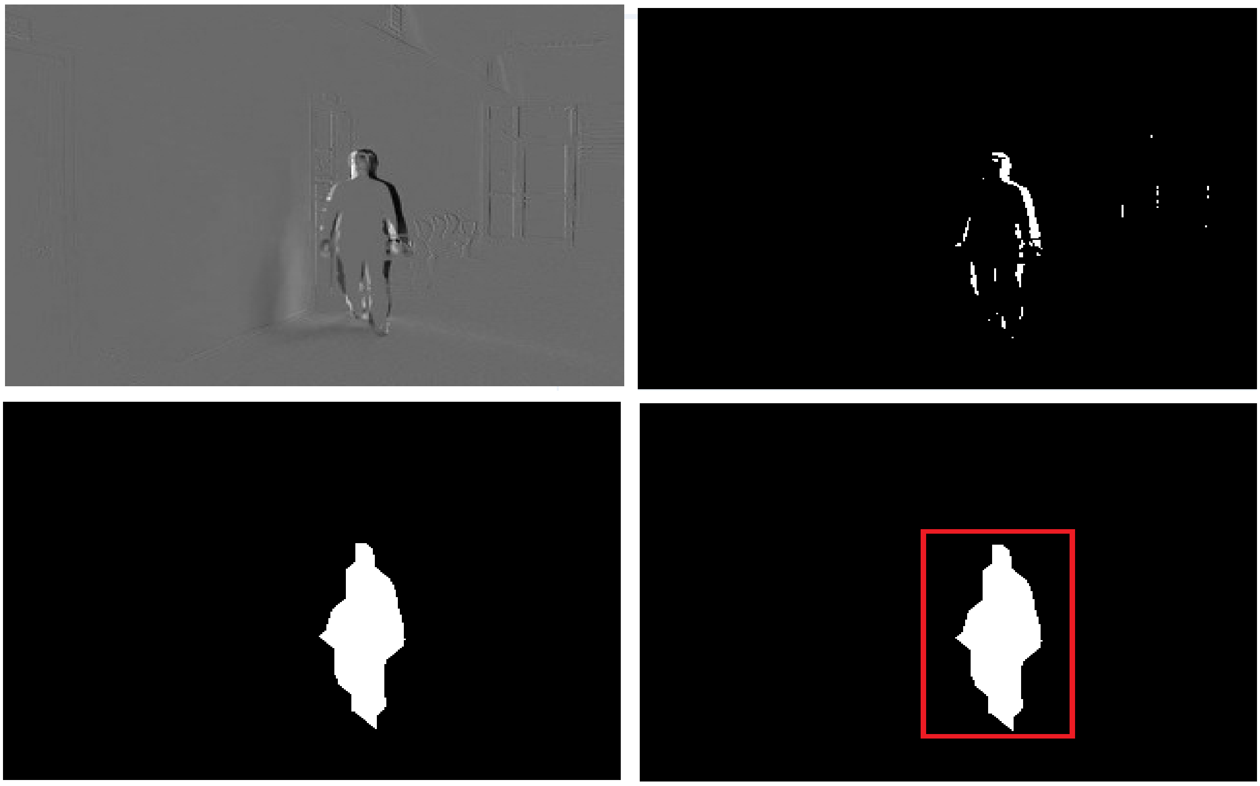

Fig 3: top left – frame difference top right – binary thresholding bottom left – bottom right – human tracking

Another test is done using multiple human objects in motion as illustrated in figure 4.

Fig 4: top left – current frame top right – frame difference bottom left – binary bottom right – human tracking

VI CONCLUSION

Efficient human body (single and multiple) detection in motion is presented. The proposed method is overcome the problem of shadowing due to the lighting condition. The human motion is tracked based on an improved template matching algorithm between consecutive frames.The experimental results show that the system is very accurate and efficient for single object detection. The detection accuracy is reached to 99.7% for different lighting condition and various distances from a camera. While for the multiple object detection the accuracy is decreased to about 98% due to the occlusion regions. The system can be very much applicable to areas like surveillance and video conferencing.

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Assist Prof. Aree Ali M. was born in Sulaimani city – Kurdistan Region – Iraq. He obtained BSc degree at the University of Mousle (1995), MSc degree in France in computer Science (2003) and PhD in multimedia system at the Univesity of Sulaimani (2008). Currently director of IT department and lecturer at the computer science department/ school of Science / University of Sulaimani.