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RESEARCH ARTICLE

The Autonomous Detection and Tracking of Moving Objects - A Survey Work

P Sanyal[1], S K Bandyopadhyay[2]

[1]West Bengal University of Technology, India

[2]Vice Chancellor, West Bengal University of Technology, India
[1]pritimoy.sanyal@gmail.com; [2]skb1@vsnl.com

Abstract— The video frame mainly consists of foreground and background objects. For effective detection and tracking of moving objects background subtraction is a very important part of surveillance applications for successful segmentation of objects from video sequences. In this paper we mainly survey these methods for autonomous detection and tracking of moving objects.

I. INTRODUCTION

Now a day, video surveillance of human activity is one of the most important tools for security purpose and traffic which can usually track the people or car. It is also an important tool to avoid undesired interaction between moving objects. A video surveillance system must be capable of continuous operation under various weather and illumination conditions. It can be used as an effective tool for automatic recognition of human faces. It has a great potentiality to act as an emerging research field that gathers many researchers from different disciplines such as image processing, pattern recognition, computer vision, graphics, and multimedia. The video frame mainly consists of foreground and background objects. For effective detection and tracking of moving objects background subtraction is a very important part of surveillance applications for successful segmentation of objects from video sequences. The accuracy, computational complexity, and memory requirements of the initial background extraction are crucial in any background subtraction method. Foreground detection algorithm should exactly detect moving objects. Till now numbers of foreground detection algorithms are present which can be divided into three categories: frame difference, optical flow and background subtract. In this paper we mainly survey these methods for autonomous detection and tracking of moving objects.

II. MATERIALS AND METHODS

In our survey work we mainly concentrated on several online video processing works which can be grouped into above mentioned categories.

Karan Gupta and Anjali V. Kulkarni [1] proposed a method which can be tracked the moving object based on frame differencing and dynamic template matching technique. There are three key steps in implementation of this object tracking system:

- Detection of interesting moving objects,
- Tracking of such objects from frame to frame,
- Analysis of object tracks to automate the pan-tilt mechanism

A. Frame Differencing

The system first analyses the images, being grabbed by the camera, for detection of any moving object. The *Frame Differencing* algorithm is used for this purpose, which gives as output the position of the moving object in the image. This information is then used to extract a square image template (of fixed size) from that region of the image. The templates are generated as and when the appearance of the object changes significantly.

B. Dynamic Template Matching

The newly generated template is then passed on to tracking module, which starts tracking the object taking the template as the reference input. The module uses template-matching to search for the input template in the scene grabbed by the camera. If the object is lost while tracking (signifying that the object has changed its appearance) a new template is generated and used. Since the image templates, being used for matching, are generated dynamically the process is called Dynamic Template Matching.

C. Pan-Tilt Mechanism

The movement of the object is analyzed for automation of the Pan-Tilt mechanism. Depending upon the movement of the object the pan-tilt mechanism is operated to keep the object in the camera's view.

This proposed algorithm is suitable for detection of single moving object even under bad lighting conditions or occlusions accurately. The system has been automated using a pan-tilt setup which is synchronized with the algorithm. Such an automated object tracking system can be used in applications where accurate tracking is required but good lighting conditions cannot be provided. The system is also very much applicable to areas like surveillance and video conferencing.

In another work by K Suganya Devi, N Malmurugan and R Sivakumar [2], optical flow and Separable Morphological Edge Detector or SMED are described for efficient foreground extraction which is applied in road traffic analysis. Optical flow is the velocity field which distorts one image into another very similar image. This method utilizes pixel intensity changing and relevance to determine the movement of pixels in image sequence. In fact, it is very difficult to calculate the true velocity field using image sequence and optical flow represents information of moving objects, so the optical flow field can be used to replace velocity field. However, each optical flow cannot get rid of the light influences which result in background noises. In this work they proposed a new foreground detection approach called OF-SMED which makes use of Lucas-Kanade optical flow. A perfect foreground cannot be obtained by using optical flow alone due to some brightness change. But, optimal foreground can be obtained by OF-SMED effectively. Besides that they proposed a new morphological edge-detection operator separable morphological edge detector (SMED) as existing edge detectors have some disadvantages with noise. In this paper they depicted the following algorithm for optical flow with SMED:

- The output frames of the optical flow and background modeling method is taken as the input to SMED.
- The two consecutive frames are taken and SMED edge detector is applied to the frames.
- So, the edge are sharpen while compare to the former and the median filter is applied again in order to reduce the noise

They informed that the above mentioned optical flow with SMED method has the following advantages:

- Almost all noises are removed
- No foreground is lost
- The final object detection result will be optimal.
- The processing time is very fast
- Computation time is low
- The proposed method is cost effective

Thus low cost vision based system Optical Flow-SMED play an important role in monitoring, controlling, and managing the whole traffic system and has the potential to be used for applications such as electronic road pricing, car park management system, detecting stolen vehicles. Thus Optical Flow-SMED proves to be an optimal approach for traffic and crowd monitoring with error rate of 1.74% which is a satisfied result.

But interaction with computer machine and human by several interfaces like keyboard and mouse or camera should be improved for designing the control mechanism of online video tracking system. Thus several intelligent interfaces are proposed that allow users to interact with the computer more naturally and effectively. Such systems are particularly important for elderly and physically challenged persons. In the work of Suman Deb, Diptendu Bhattacharya and Mrinal Kanti Debbarma [3]the primary goal is to develop a computer vision system that make computers to perceptive a user’s natural communicative signals such as voluntary eye blinks and interpretation of blink patterns for communication between man and machine. This proposed method will be beneficial to those who are with certain disabilities because the traditional human-computer interfaces demand good manual agility and refined motor control which are usually absent in those peoples with disabilities. They proposed robust, accurate algorithms to detect eyes and measure the duration of blinks, and interpret them in real time to control a nonintrusive human-computer interface. They divided their proposed system into two primary major modules. The first one will detect voluntary eye blink and second module will trigger an onscreen soft agent which will interpret the blink into proper mouse movement and different mouse actions. The algorithm used by the system for detecting and analyzing blinks is initialized automatically, dependent only upon the inevitability of the involuntary blinking of the user. Motion analysis techniques are used in this stage, followed by online creation of a template of the open eye to be used for the subsequent tracking and template matching that is carried out at each frame. This is a very low cost and robust system works only with any standard web camera connected to a personal computer.

Aree Ali Mohammed, Astrid Laubenheimer Yusra and Ahmed Salih proposed a method [4] by which face can be detected in online video by dynamic template matching technique. Face detection in a still image is not a new idea but in this paper they proposed a new face tracking concept which is known as hybrid face detection method. In image-based face detection a false positive is a number of detected objects that are not faces while in the sense of video are a number of detected faces that are representing the face of another person. To increase the efficiency of video image tracking is to reduce the false positive alarms to get a high detection rate. To obtaining this they used the manual threshold algorithm which is as follows: (Figure 1)

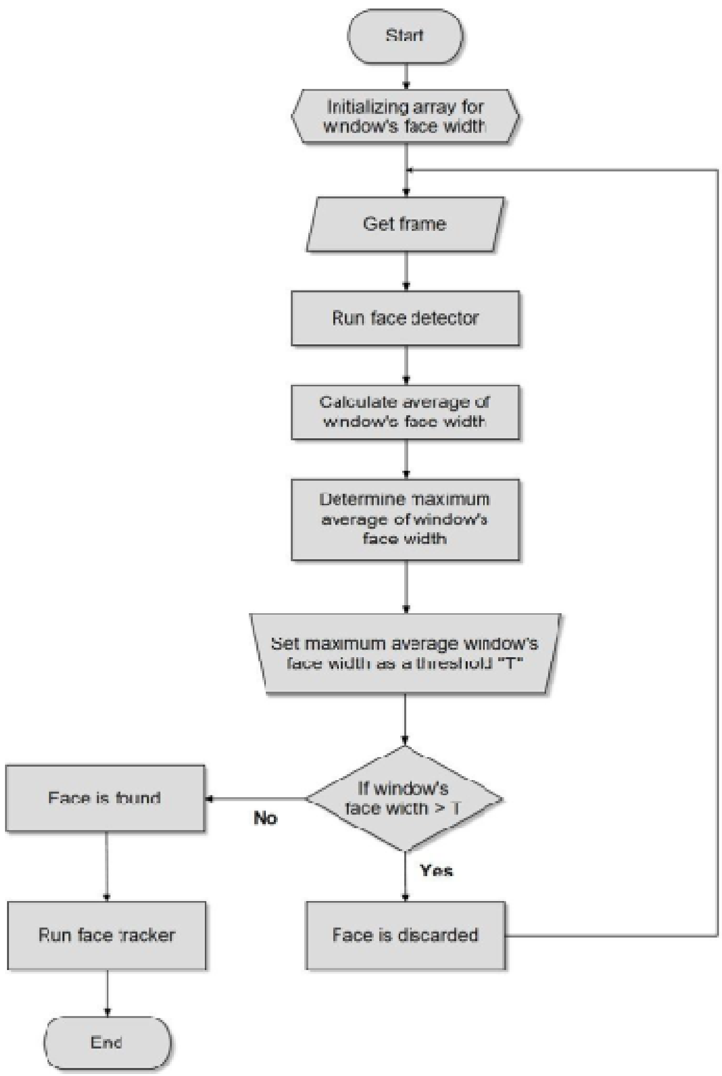

Figure 1 Threshold Algorithm

But this above algorithm is unable to reduce false positive completely. Thus they proposed another algorithm known as Dynamic Thresholding Algorithm which is as follows:

Step 1: Get frame.
Step 2: Run face detector.
Step 3: Apply manual Thresholding as mentioned in manual threshold algorithm
Step 4: Determine the center of the detected face.
Step 5: Get next frame.
Step 6: Run face tracker.
Step 7: Determine the center of the tracked face.
Step 8: Determine Euclidian distance between the centers of the detected and tracked faces.
Step 9: Accumulate five values of the obtaining distance and find the median of them.
Step 10: Normalize the distance by dividing the distance over the face width.
Step 11: Find a threshold. If the normalized distance is greater than ten times of the median value, the last tracked face is tracked by the tracker otherwise the last detected face is tracked.
Step 12: Visualize the face.

They also proposed another algorithm for reduction of the false negative alarms of the undetected faces between frames. The template matching based on Square Difference Matching metric is used to implement the face tracker.

There are several advantages of this proposed method which are as follows:

a. Reduction of false positive and negative alarms.
b. Reduction of time complexity by using ROI.
c. Proposed FDM can be considered as a simple detector for frontal face recognition.

Sarbajit Pal and P.K.Biswas described in their paper [5] the application of Digital Signal Processing or DSP in visual tracking of moving objects. They have depicted an automated correlation based tracking approach using edge strength and Hausdroff Distance Transform (HDT) technique for tracking of moving targets. In this proposed system there are three states viz. Locking, Tracking and Recovery State. The tracking of the objects are done by camera which can be classified into two types such as stationary camera which are static in its position and another is moving camera which are moving with respect to object motion. The moving camera may be controlled by manually or automatically. When object motion between consecutive video frames is a small fraction of the camera field-of view (FOV) then manually controlled of moving camera is working satisfactory but in case of high speed objects such as tracking aircraft at the time of landing, manual tracking is not working properly due to move out of the camera FOV. In this case automatic camera control mechanism will be required. During the locking state dense motion estimation, segmentation and scene cut detection are performed. To avoid false motion indication each individual frame is low pass filtered to remove noise before difference image frame is carried out. For computing an alternative template Modified HDT is applied on a small region around the previously (Auto/Manual) located target. The HDT is computed to improve the quality of match between target object and detected target template obtained from previous image frame. The last state or recovery state is applied for auto/manual detection and localization of the moving target in video sequences. The application of deterministic template matching technique is responsible for automatic detection of the target where template is generated from the detected object in the every previous image frame. They applied this proposed system successfully with various real video sequences.

III. CONCLUSION

The video frame mainly consists of foreground and background objects. For effective detection and tracking of moving objects background subtraction is a very important part of surveillance applications for successful segmentation of objects from video sequences. The accuracy, computational complexity, and memory requirements of the initial background extraction are crucial in any background subtraction method.

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