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Tracking System For Real Time Video Surveillance Applications

Kalaiselvan C.* and Sivanantha Raja A.**

ABSTRACT

Video surveillance applications have attracted commercial interest due to increased mobility of different surveillance applications. Tracking of such real time video surveillance could be done easily through multiple cameras. However, the complexity increases depending on the surveillance area, camera handoff, shadow detection etc. Number of objects to be focused within the coverage limit is one another challenge to be addressed. Multi object tracking is done through k-means clustering technique extracting the consecutive frames. The surveillance area is broadly classified as indoor or outdoor, while our investigation relies on indoor surveillance sequences. The study illustrations based on the proposed technique tracks the objects effectively in video sequences much effectively.

Keywords: Multi-camera, Segmentation, camera, frames, video surveillance, tracking.

1. INTRODUCTION

Real time video surveillance applications have emerged as one of the key areas of research in recent years due to increased automation of all scientific applications in real world. Such surveillance systems are much needed in several areas like traffic monitoring, automated systems involving interaction with human and machines, number plate recognition, health care etc [1, 2, 3, 16]. Video-based visual tracking is a complex task, consisting of identification of exact position of single or multiple objects and visualizing them. Several approaches have been proposed to tackle the problem of visual tracking [4] using different algorithms to tack objects of either nature. Both of them have their own complex illustrations like intensity, luminescence, movement, shadow detection etc [26]. More interestingly these surveillance applications are also helpful in improving the energy [27], resource management [14]. Object tracking is automatic hand gesture recognition [10] identifies objects based on position, speed, and acceleration to conclude the meaning of this movement.

Likewise, complexity of tracking systems depends on fixed or moving cameras multiple camera tracking systems as proposed in the literature study [5, 7]. The principle behind static cameras is that a foreground region is to be extracted from the video segment and its corresponding to the moving objects from the background. Background subtraction technique is a popular approach for foreground segmentation in a still scene [8]. Background subtraction is a popular foreground/background segmentation approach, which detects the foreground based on the threshold difference between the current video frame and the modeled background analyzing the pixels [9]. Background maintenance is itself a more successful approach which enables the system to update the background model (i.e background statistics). Simulationstudy using MATLAB for detecting and tracking objects was proved to be much effective using adaptive background subtraction. The first step uses median filter to achieve the back ground image of the video and denoise the sequence of video. Then adaptive background subtraction algorithm is used to detect and track the moving objects [20]. Modeling the features of the objects being tracked (i.e. colour, texture, shape, etc.) is another

* Deptartment of Electronics and Communication Engineeering, Pavendar Bharathidasan College of Engineering & Technology, Tamilnadu, India, *Email: kalaiaswath@gmail.com*

** Department of Electronics and Communication Engineering, Alagappa Chettiar College of Engineering & Technology, Tamilnadu, India, *Email: sivanantharaja@yahoo.com*

key and interesting aspect that could be investigated indepth for easy identification of objects. Manual analysis of video is labour intensive [17] due to increased volume of video data. Such existing digital video-surveillance systems capture the sequences from video, process them, stores and finally perform the tracking of video trajectory sequences. As said earlier, detecting single tasks is itself a complex one, multiple activities in real-time video feeds is currently performed by assigning multiple analysts to simultaneously watch the same video stream. If the latter is to be taken into account, then each one is assigned a portion of the video to look at and objects are spotted on [22]. A framework for detecting robust people in low resolution image sequences of dynamic scenes with non-stationary background is presented [25]. We have presented some of our investigations in the experimental sections containing video sequences using single and multiple object video trajectories, static and dynamic scenes in section 3.

In general the approaches mentioned below needs attention for effective object tracking and detection, of which we have focused on the first issue in this paper.

- Frame detection
- Camera handoff
- Shadow detection

The paper is organized as follows. Section 2 presents some literature review on video surveillance. Section 3 presents the proposed continuous tracking system for video surveillance applications with experimental setup, illustrations and discussions. Section 4 concludes the paper with further research directions.

2. RELATED WORK

Intelligent monitoring systems can be broadly fitted into two parts as detection and tracking of the video sequences. There exist several algorithms and operators like canny's operator, frame differencing, SVM (Support Vector Machine), Prewitt's operator, sobel's operator, kernel density estimation [23] which uses the matching trajectory to realize the target tracking. The steps involved here are extraction of background knowledge, features like color, position and shape information. The work adopts modified Hough arithmetic are used to find the matching trajectory. Results obtain shows that the method has shorter matching time based on the good detection rate in target detection and based on Gaussian mixture model [11].

Detection of moving objects in an image sequence is more important for target tracking, activity recognition and behavior understanding. Background subtraction approach is adopted since it would be able to adopt for illumination changes [12]. A scheme named as Independent Component Analysis (ICA) was introduced for monitoring indoor surveillance applications. The proposed method is tolerant to room lighting and is computationally faster as compared to other schemes like FastICA. The work was able to separate two highly correlated images.

Tracking surveillance area, if it is larger then, the object detection is challengeable. The area to be focused is called as Field of View (FOV). FOV is correlated with multiple cameras like PTZ leading to better performance. An automatic, efficient continuous tracking system to determine the decision criteria for hand-off using Sight Quality Indication (SQI) (which includes information on the position of the object and the proportion of the front of object faces the camera) was introduced.Experimental results reveal that the proposed algorithm can be efficiently executed, and the handoff method for feasible and continuously tracking active objects under real-time surveillance [13].

Tracking and recognition of rigid and non-rigid interacting objects in complex scenes from a static camera was discussed [18]. The authors have proposed an approach which uses an empty reference image for object extraction through image difference and the reference frame is updated continuously by a high level background updating module combined with classification tag. The tracking module is responsible to preserve objects identity even when an occlusion occurs on the image plane between different objects.

Object classification in video is an important factor for improving the reliability of various automatic applications in video surveillance systems [19]. The existing system failed to perform in real time constraints and further degrades in multi-class classification problems (in both low and high resolution images). The work leverages the distinction between various classes taking into account several features. Consequently, feature-selection procedure based on entropy gain which screens out superfluous features is presented.

An effective and flexible real-time video analysis system aiming to provide robust detection and tracking objects of outdoor surveillance and monitoring scenarios is presented. The approach employed addresses the challenges found in typical outdoor scenes such as localized and global lighting changes, variations in object size and views, occlusions, and complex object motion and so on. Investigations illustrate that real-time constraint renders most complex tracking algorithms less attractive [21].

3. CONTINUOUS TRACKING SYSTEM

3.1. Video Surveillance Process

Video surveillance system requires video streams to be tracked continuously. The major tasks involved are extracting foreground/background information from video sequences which could be names as objects, pre-processing and analysis. It is assumed that the tracking system consists of video sequences containing running upto several minutes depending on the dataset, which may be synthetic or standardized dataset which is openly accessible (see section 3.2 for details).

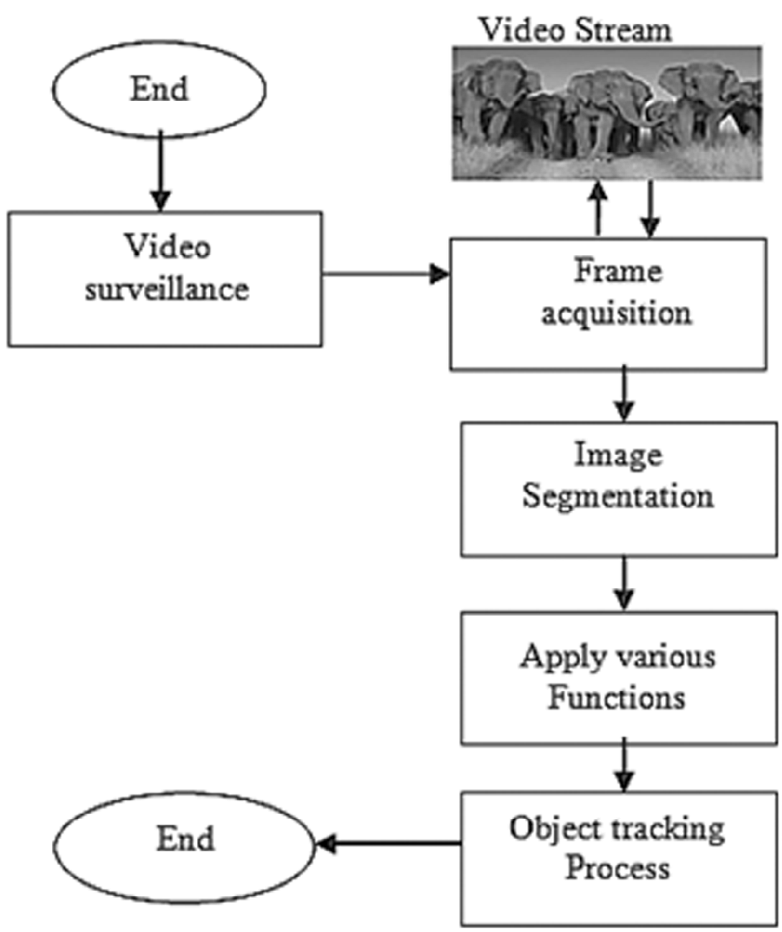

Figure 1: Continuous video surveillance process

Figure 1 presents the continuous surveillance process. The major task involves frame acquisition from video streams which yields images which were segmented. Then using MATLAB functions we extract the output for the given input source in grey scale image, binary image, inverted index image and outlier image which leads to object tracking.

3.2. Experimental setup and Dataset

The experimental investigations were performed using Intel Core i5-2520M, 2.50GHz processor speed, 4 GB RAM and GHz, operating in MATLAB software. Several investigations were performed by synthetic sequences and real sequences from the CAVIAR 2009 benchmark dataset [6], PETS 2006 data set [24]. We have extracted the data for experiments from video surveillance online repository (ViSOR-Video Surveillance Online Repository, 2007) [15]. ViSOR contains information related to video format, where in we have different categories like indoor, outdoor, videos with shadows etc. The full length video may is taken for surveillance testing using built-in MATLAB functions and the results were presented in next section.

3.3. Study results and investigations

We have performed investigations on tracking test using single and multiple objects (study 1), static and dynamic images (study2). Both the study was carried out under a fixed focus limit. Any objects out of this region will not come into our study and it would be eliminated from our surveillance task.

3.3.1. Study 1: Single and Multiple objects

Single and multiple objects have one or more objects in it. We have chosen objects which have high resolution as well as low resolution. Our goal is to identify them effectively using 50 data objects which we name here as synthetic dataset. The study performed takes single object and the output is presented in Figure 2. We have taken a static image where could find a man standing in a fixed position. The image representations could be annotated from left to right as given in brackets (original color image, grey scale image, binary image, inverted index image, outlier image). We have taken up several other cases pertaining to single objects and we were able to identify the image clearly for high resolution images as compared to low resolution. For high resolution the efficiency (number of objects correctly identified as compared to the expected output) is 100% where as this is inferior for low resolution leading to 98%.

Figure 3 presents multiple images and it is interpreted as grey scale, binary and outlier images respectively. While considering the multiple object detection, the images were clearly visible or identifiable when we apply bitmap function. Applying outlier function failed to give much better identity as compared to single object detection. The efficiency for high and low resolutions was 92% and 80% for multiple object detection.

Binary **Grey Scale** **Outlier** **Inverted Index** **Original**

Figure 2: Example for single object and different representations

3.3.2. Study 2: Static and Dynamic Videos

The problem of dynamic monitoring system is that a long video sequence is given as input and the output is extracted. Consider the first sequence as frame “N”, then the next consecutive sequence would be “N+1”. Here the study was further divided into indoor and outdoor. Static videos are those were objects are fixed in position. In contrary to this we have dynamic videos, where the objects will not be in static position and we need to monitor them closely. The sequences extracted changes time to time. Figure 3 presents the outdoor video surveillance example extracted from ViSOR dataset. The sample chosen for study 2 in Figure 4 is an Indoor surveillance application for people tracking with occlusions Width: 352, Height: 288, Frame Rate: 25, Frame Count: 551, compression: M-JPEG-M-JPEG including Huffman Tables. The camera is static and the object is moving at a slower rate. Figure 4 presents the random video sequences and its corresponding grey scale and binary image for Figure 3.

Figure 3: Example for multiple object and different representations

Figure 4: Indoor Video sequence extracted from ViSOR[15]

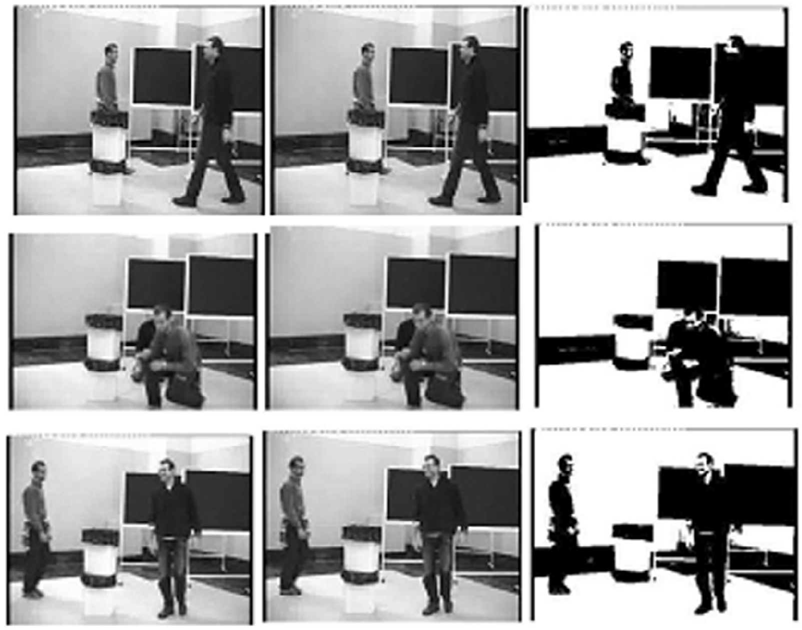

Figure 5: Random video sequences and its corresponding grey scale and binary image for Fig 3

Figure 6: Outdoor Video sequence extracted from ViSOR[15] and output using grey scale and binary function

For outdoor example presented in Figure 5, the illustrations are Width: 352, Height: 288, Frame Rate: 25, Frame Count: 551, Compression: M-JPEG-M-JPEG including Huffman Tables captured using static camera. The output using different functions is presented in Figure 6.

4. CONCLUSION AND FUTURE DIRECTIONS

In this paper, we have presented a robust visual tracking system for still images, static and dynamic video sequences. The output is obtained using MATLAB functions obtaining grey scale images, binary image, outlier function for study 1. Study 2 presented the same as we have done in study 1excluding outlier, since we were not able to track the objects effectively. It is concluded from the study that the efficiency is in the range of 95 to 100% for study 1 where as it has dropped down significantly to 60-70% for multiple objet detection.We plan to go for in depth analysis (pixel-by-pixel) and cluster the images or segregate them based on clustering algorithms which is our future task. It is also possible to eliminate the objects which were not similar to using distance functions like battacharya distance or using similarity functions like cosine functions.

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