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General Study on Moving Object Segmentation Methods for Video

S.Arun Inigo, P.Suresh

Abstract

Moving object segmentation is an important process for many computer vision applications. In video surveillance area, especially for humans and vehicles segmentation, is currently one of the most active research topics in computer vision. Object segmentation is very useful for tracking the object and recognition the object in a video. The motion segmentation problem is studied and reviewing the most important techniques. We describe some common methods for segmenting the moving objects including background subtraction, temporal segmentation, edge detection, optical flow and the combination of temporal-spatial segmentation. These methods are widely exploited for moving object segmentation in many applications, such as traffic monitoring, human motion capture and video surveillance.

Key Terms – Object Segmentation, background subtraction, temporal, Tracking, and object detection.

I. Introduction

Key purpose of video segmentation is to enable content-based representation by extracting objects of interest from a series of consecutive video frames. Mainly, it is required for high-level image understanding and scene explanation such as spotting and tracking of special events in surveillance video. For example, pedestrian and highway traffic can be regularized using density evaluations obtained by segmenting people and vehicles. By object segmentation, speeding and suspicious moving cars, road obstacles, strange activities can be detected [1]. Tracking and recognition the object in a video can be done easily with the help of the segmentation methods such us background subtraction, temporal segmentation, edge detection, spatial segmentation and optical flow.

Background subtraction is a commonly used method for segmenting out objects of interest in a scene for applications such as investigation. The name "background subtraction" comes from the simple technique of subtracting the observed image from the estimated image and threshold the result to generate the objects of interest [2]. Temporal video segmentation is the first step towards automatic explanation of digital video sequences. Its goal is to divide the image stream into a set of significant and manageable segments (shots) that are used as basic fundamentals for indexing. Each shot is `represented by selecting Key frames and indexed by extracting spatial and temporal features [3]. Edge information based video segmentation, first apply canny edge detector to find edge information of each frame and then keep tracking these edges [4].

This study paper has been organized as follows. Section II presents the Main Features of Motion Segmentation. Section III presents the classification of segmentation. Section IV presents about Description about Different Motion Segmentation Methods. Section V presents the conclusion.

II. Main Features of Motion Segmentation

Segmentation of objects in video is very essential in many aspects of multimedia applications, such as traffic monitoring, human motion capture and video surveillance. There are several issues need to be solved in motion segmentation particularly on noise, missing data and lack of a priori knowledge [5]. One of the main problems is the presence of noise. For some applications the noise level can become serious. Some of the common issues that segmentation algorithm looks are rapid light attenuation, strong reflections; back-scattering, non-uniform lighting and dynamic lighting that dramatically degrade the quality of the images [5]. Blurring is also a common issue particularly when motion is

involved Another common difficulty is caused by the fact that moving objects can create occlusions, or even worst, the whole object can disappear and reappear in the scene [5].For example camera under surveillance, particularly on crowded area, we can segment the suspicious things separately with the help of these segmentation methods. Segmenting objects can be based on color, movement of the object, pixel value.

The important attributes of a motion segmentation algorithm:

(i) Ability to deal with occlusions.

(ii) Ability to deal with missing data.

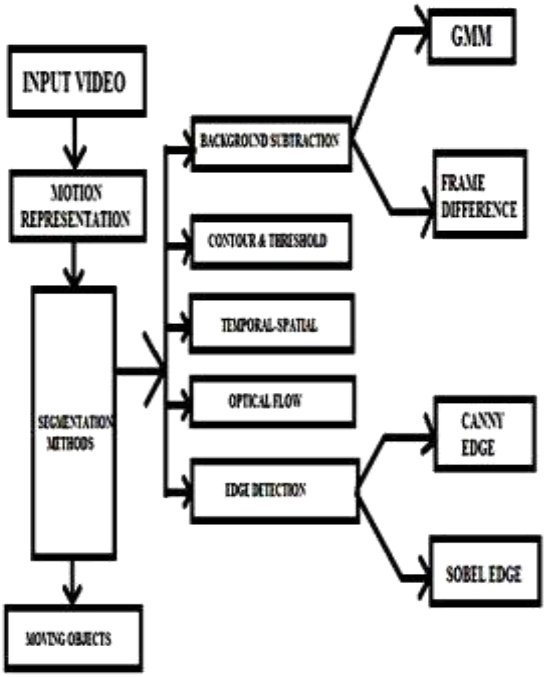
(iii) Ability to deal with multiple objects in the scene.

(iv) Ability to deal with noisy images.

(v) Ability to deal with temporary stop of the objects.

III. Classification of Motion Segmentation Methods

The arrangement of segmentation of moving objects:



Motion Segmentation in General:

Description:

Motion segmentation aims at decaying a video in moving objects and background. In many computer vision procedures this decomposition is the first needed step. Segmentation of objects in image sequence plays an important role in image sequence processing and analysis. Once the moving objects are detected or extracted out, they can serve for varieties of purposes [6]. A motion-based segmentation algorithm generally involves three main issues. The first issue is data primitives or region of support, the data primitives can be individual pixels, corners, lines, blocks or regions. The second problem is motion models or motion representations. The third issue is segmentation criteria. Motion plays such a crucial role in motion segmentation [6]. Video-based segmentation algorithms can be categorized either based on their motion representations or based on their clustering criteria.

Under this we have some important segmentation methods:

(1.1) Background Subtraction method.

(1.2) Contour and Threshold.

(1.3) Temporal and Spatial

(1.4) Optical Flow

(1.5) Edge Detection

IV. Description about Different Motion Segmentation Methods

(1.1) Background Subtraction Method:

Description:

Background subtraction is a commonly used class of techniques for segmenting out foreground objects from the background in a sequence of video frames. The name “background subtraction" comes from the simple procedure of subtracting the experimental image from the estimated image and threshold the result to generate the foreground objects [2].This method is useful for detecting the moving objects in a surveillance camera. By using this method we can track or recognize the object perfectly. We have four steps under this background subtraction method:

1. Pre-processing
2. Background modeling
3. Foreground detection and
4. Data validation

Under this method we are using some logic to segment the foreground objects from background in a sequence of video frames. Some of the logics are:

1. Gaussian Mixture Model.
2. Frame Difference.

(1.1.1) Gaussian Mixture Model [7]:

Background modeling is important for all background subtraction algorithm. Background model is that against sudden changes in the background, but it’s enough to identify all moving objects in a sequence of video frames. The values

of a particular pixel are showed as a mixture of Gaussians. At each Iteration Gaussians are evaluated, determine which one is mostly likely compared to the background. Pixels that don't not match "background Gaussians" are classified as foreground object.

(1.1.2) Frame Difference:

Identifying the moving objects from the current frame and a reference frame, called background image and this method is known as Frame differencing [7]. The projected background image is just the previous frame i.e. "|framen–framesn-1|>Th". It's Very sensitive to the Threshold(TH) [8].

Advantages:

1. We can select different threshold for each pixel.
2. Time adapting.
3. Provides fast recovery.

(1.2) Contour and Threshold Method:

(1.2.1) Contour Method:

Description:

Active contour model, also called snakes, is a framework for delineating an object outline in a video sequence of frames. It will have a representation of bounding contour that is updated over time [9]. Initial ACM (active contour model) investigation is an important step of moving target segmentation, and image difference method is used for this purpose. After the moving regions in the scene are found out, the edges of moving regions can be used as the initial ACM [10]. Active contour algorithms have been used for contour extraction of moving objects [11]. This contour method is useful for many segmentation algorithms to get moving object clearly. For example: contours are used in background subtraction method to get the foreground object clearly.

Advantages:

1. We can segment object with clear background.
2. Used to track dynamic objects in spatial dimensions.

(1.2.2) Threshold method:

The simplest method of Object segmentation is called the thresholding method. The key of this method is to select the threshold value [12]. The threshold algorithm is to segment the motion objects from the background pixels according to their gray value differences. The easy way is to make pixel-by-pixel variance between frame by frame real-time images and image with no moving object and same background with above real-time image i.e. the gray value of each real-time image's pixel minus the gray value g(i,j)of corresponding pixel of the background image, so that the image of white background is obtained. If the threshold value is too high, the overmuch target spots will be wrongly classified as background; if the threshold is too low, it acts in the reverse way [13].

Advantage:

1. It's good in under perfect condition.
2. Can segment moving object clearly.

(1.3) Temporal and Spatial:

Description:

Image segmentation provides a powerful semantic explanation of video imagery important in image understanding and efficient manipulation of image data. Spatial-temporal segmentation is to create a layered image representation of the video for image coding applications whereby video data is just described as a set of moving layers [14].

For example Recognizing and quantifying human movement requires spatial segmentation followed by temporal segmentation. The spatial segmentation is effectively a tracking process which determines a motion vector encapsulating a set of joint angles for each frame. The temporal segmentation is a CHMR (Continuous Human Movement Recognition) system which attempts to infer the movement skill that could have produced the observed sequence of motion vectors [15]. The standard approaches to temporal segmentation cut the video sequence into "scenes or shots", mainly by drastic changes in image appearance. Other approaches are behaviour based and segment the video into sub-sequences capturing deferent events or actions. A shot is defined as an unbroken sequence of frames taken from one camera. There are two basic types of shot transitions:

1. Abrupt
2. Gradual

Spatial segmentation deals with the help of contour based methods such as canny and sobel edge detector [5]. Temporal segmentation deals with the help of clustering points in the moving object.

Advantages:

1. Useful for tracking and identify the moving object.
2. Segmented objects will be dirt-free.

(1.4) Optical Flow Segmentation method [5]:

Description:

Segmentation of moving objects from a video sequence is an essential task whose applications cover up domains such like video compression, video surveillance or object recognition. Optical flow to determine, for each point in the image, how that point is moving relation to the image plane, i.e. its noticeable motion. This motion is a result both of how the corresponding 3D point is moving in the scene and how the camera is moving relative to the scene. Optical Flow (OF) is a vector motion field which describes the distribution of the apparent velocities of brightness patterns in a sequence. In the past the main limitations of such methods were the high sensitivity to noise and the high computational cost. Currently, the high process speed of computers and to improvements made by research, Optical Flow is broadly used. Motion estimation and video compression have developed as a key aspect of optical flow research. While the optical flow field is apparently similar to a dense motion field derived from the techniques of motion estimation, optical flow is the study of not only the determination of the optical flow field itself, but also it is use in robotics researchers in many areas such as: object detection and tracking, image dominant plane extraction, movement detection, robot navigation. Finally optical flow is theoretically a fine clue in order to segment motion. However, optical flow alone it is not enough since it cannot help to solve occlusions and sequential stopping. Moreover, these methods are highly responsive to noise and light changes. It describes coherent motion of points or features between image frames Segmentation done by grouping motion vectors into groups having coherent motion. It can't be done in real-time without hardware [9].

Advantage:

1. Its good in under Light condition.
2. Can track moving object clearly.

(1.5) Edge Detection:

Description:

Edge detection is a well-developed field in computer vision. Region boundaries and edges are closely related, since there is often a spiky adjustment in intensity at the region boundaries. Edge detection techniques have therefore been used as the base of another segmentation technique. To segment an object from a video however, one needs closed region boundaries. The looked-for edges are the boundaries between such objects [12]. Segmentation methods can also be applied to edges obtained from edge detectors.

Edge information plays a key role in the segmentation process. For tracking and recognizing the object from the video we can use these methods with any segmentation technique. Segmenting moving objects is a challenging and important task in computer vision. It has many applications such as surveillance, video communication, traffic monitoring, people tracking, content-based image coding and image compression. There are many moving object segmentation methods which are based on moving-edge detection. We first review some of these techniques [17]:

(1.5.1) Canny edge detector.

(1.5.2) Sobel edge detector.

(1.5.1) Canny edge detection:

Description:

Moving-edge detection has fascinated attention for moving object segmentation. Moving-edge points are generated based on processing the frames difference edge map, current frame edge map, and background edge map. These spatial domain edge maps are obtained using the Canny edge detector, which involves Gaussian convolution to avoid noise [17].

The algorithm runs in 5 steps for image [16]:

1. Smoothing: Blurring of the image to take away the noise.

2. Finding gradients: The edges should be distinct where the gradient of the image has large magnitudes.

3. Non-maximum suppression: Only local maxima should be distinct as edges.

4. Double thresholding: Potential edges are indomitable by thresholding.

5. Edge tracking by hysteresis: Final edges are determined by suppressing all edges that are not connected to a very certain (strong) edge.

Advantage:

1. Noise can be removed cleanly.
2. Easy to track and match the moving objects.

(1.5.2) Sobel edge detection:

Description:

For contour based segmentation, edge detection techniques are the most generally adopted. Canny and Sobel operator are the commonly used edge detection methods due to the flexibility performance [6]. The 2-D Sobel operator was the most well-liked edge detection operator until the

development of edge detection techniques with a theoretical basis, such as Canny edge detection.

It proved popular because it gave, overall, a better performance than other contemporaneous edge detection operators, such as Prewitt operator. In our evaluation, there is no pre-processing or smoothing stage before the Sobel operation since we aim to observe performance of the operator with respect to increasing noise. The thresholds for the 2-D Sobel, to achieve the binary image, are also determined by a root mean square (RMS) estimate of the noise.

Advantage:

1. Easy to track 2D object and match the moving objects.
2. Used in many segmentation techniques to avoid the noise in the moving frames.

Table: 1 Comparative table for segmentation methods

METHODS	REFERENCE	IMPORTANT FEATURES
Background Subtraction: 1. GMM Method 2. Frame Differencing	[2,7,8]	1. We can select different threshold for each pixel. 2. Time adapting. 3. Provides fast recovery. 4. Using GMM method we can remove noise.
Temporal and Spatial	[14,15]	1. Useful for tracking and identify the moving object. 2. Segmented objects will be dirt-free.
Edge Detection: 1. Canny Edge Detection 2. Sobel Edge Detection[6]	[12,17,16]	1. Noise can be removed cleanly. 2. Easy to track and match the moving objects. 3. Used in many segmentation techniques to avoid the noise in the moving frames.
Contour	[10,11]	1. We can segment object with clear background. 2.Used to track dynamic objects in spatial dimensions
Threshold	[12,13]	1. Its good in under perfect condition. 2. Can segment moving object clearly.
Optical Flow	[5]	1. Its good in under Light condition. 2. Can track moving object clearly.

VI.CONCLUSION

In this paper, we present an widespread survey of object segmentation methods. Object recognition and tracking are mainly on the bases of object segmentation, and decisions about activities. We mainly classify object segmentation methods as Background subtraction, Temporal-spatial, Edge detection methods and optical flow method. For illustration, the background subtraction involves segmenting the foreground objects, while edge detection based segment or contours-based segment require only when the object first appears in the scene. We trust that, this article can give valued vision into this significant research topic and support for new research. The future work will be based on the above findings to develop a better optimized method for moving object segmentation.

References

[1]http://www.merl.com/areas/video-segmentation
[2]"Background Subtraction Techniques" Alan M.
[3]"Temporal video segmentation: A survey"Irena Koprinska!, Sergio Carrato",*
[4]"An efficient Video Segmentation Algorithm with Real time Adaptive Threshold Technique" Yasira Beevi
[5]"Motion Segmentation: a Review" Luca ZAPPELLA aXavier LLADÓa
[6]"Segmentation of Moving Objects in Image Sequence: A Review" Dengsheng Zhang and Guojun Lu Gippsland
[7]http://www.slideshare.net/ravi5raj_88/background-subtraction
[8]http://www.staff.it.uts.edu.au/~massimo/BackgroundSubtractionReview-Piccardi.pdf
[9]http://iselab.cvc.uab.es/tutorials_ise/PPTs/survey
[10] "Automatic Segmentation of Moving Objects By Fusing Multi-Information" Lin Zheng Chongzhao Han Dongguang Zuo Hongyan Zhu
[11]Accurate Segmentation of Moving Objects Using Object Contours Sang-Myoung Ye1 and Rae-Hong Park1,2

1 Department of Electronic Engineering, Sogang University
[12]http://en.wikipedia.org/wiki/Segmentation_(image_processing)#Semi-automatic_segmentation
[13]"Research on Threshold Segmentation in Tracking Technology of Moving Objects" Bonan Liu, Xiaoyu Chen, Chen Ma, Xiaochen Zhou, Yan He, Fangdun Zhang
[14]"Spatio-Temporal Segmentation of Video Data"John Y. A. Wangy and Edward H. Adelsonz
[15]"Spatial and Temporal Segmentation of Continuous Human Motion from Monocular Video Images" Richard D. Green
[16]http://www.cse.iitd.ernet.in/~pkalra/csl783/canny.pdf

Authors

S.Arun Inigo,
PG Scholar,
Department of Information Technology,
School of Computer Science and Technology,
Karunya University,
India.

P.Suresh,
Lecturer,
Department of Information Technology,
School of Computer Science and Technology,
Karunya University,
India.