A SURVEY OF VIDEO MOVING OBJECT DETECTION

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Abstract: Moving object detection is the main research hotspots in the field of computer vision. Moving objects can be correctly tracked and classified depend on correct detection and segmentation results, good detection and tracking effect are the guarantee of correct behavior recognition, therefore it is important subject for video surveillance. This paper discusses from three aspects: time segmentation, space segmentation, spatio-temporal union and expound the research status of the technology, suitability of some commonly used algorithms are described, comparison and analysis of algorithms are done, Finally the research prospect of video moving object is discussed.

Keywords: object detection; time segmentation; space segmentation.

1. Introduction

Moving object detection is a center subject in computer's vision field. It is also a critical bottom technology for video surveillance system. The basic duty of detecting object is detecting moving information from image sequences, simplifying process of image, obtaining motion vector what it needs, so it can recognize and track object.

In order to detect moving object, the first thing need to do is extracting the object area, but the extraction of the target area is usually relying on the analysis and the extraction of the object characteristics. Commonly used methods of object detection are divided into types: One is achieving the extraction of object area in terms of the movement of target in video information, the main means are optical flow method, background subtraction method and frame difference method. Another is to segment based on object shape and contour information, it's mainly to divide moving object in terms of the area or edge information of the image, there are mainly active contour model and edge detection operator, etc. It can be found by comparing the two that the former is focused on spatial and temporal variations of object pixel patterns, but the latter is only focused on spatial distribution patterns of object itself. In practical application, we realizes that the method based on target space-time evolution patterns is applied for the static under the background of moving object detection,

it's much faster; and the algorithm based on object space distribution patterns is simultaneously applied for the background of static and dynamic, but its calculated amount is much larger. The effect is not ideal for the segmentation of complicated object under the complex background.

Video segmentation algorithm is divided into time division and space division. Time division is generally motion segmentation, using the difference of sequence image pixel point to judge. Space division is a kind of static segmentation, it only processes for the single image. Because space-time joint moving object segmentation technology take advantage of both temporal motion information and airspace grayscale distribution information of the video image sequence. Compared to using time division or space division alone, space-time joint segmentation algorithm attains the moving object of more accurate position and finer edge profile. Firstly, the approach of space-time joint obtains general prospect image by the method of time division, then processes the image by the method of space division, obtaining the prospect object.

2 Time Division

Temporal segmentation is the video moving object and background motion characteristics of different, determine the image sequence in each pixel belongs to the area of the moving object or belong to the background region and to distinguish the foreground and the background, to be separated from the time angle, the moving target detection based on the relationship between the target and the camera can be divided into static background moving target detection and dynamic background moving target detection. There are three methods of moving object detection in static background: optical flow method, frame difference method and background subtraction method. Optical flow method [1,2] was first proposed by Gibson in 1950, it can be used for target detection, and can also be applied to target tracking. Optical flow method in the case of camera motion, still can detect moving objects, but the computation is complex, anti noise performance is poor, if there is no specific hardware support, it is difficult to meet the requirements of real-time processing; Frame difference method [3,4] is to distinguish two consecutive frames, and extract the information of moving object, it's usually difficult to obtain complete moving object, and "empty hole" phenomenon is existed, but it's less sensitive to the changes of light scenes and so on, it's able to adapt to all kinds of dynamic environment and has well stability; background subtraction method   is

simple in processing, its operating speed is faster, and it can fully extract the target point, however, it is more sensitive to the dynamic changes of scenes, such as light shadow or the changes of scenes caused by external conditions. Aiming at three kinds of defects in the static background, research scholars at home and abroad put forward a series of improvement approaches. The approach of combining background subtraction method with frame difference method put forward by Kim and others obtains better effects, but some questions are still existed, such as the imperfect of object contour detection and less target related points are remained. A new approach of moving object detection combining fusion frame difference method proposed by document literature provides a more robust differential strategy. For the question of the center of background difference method is background modeling and updating, R.T. Colin and others put forward establishing single Gauss background model, Stauffer and Gribson proposed adaptive hybrid Gauss method, etc. Popular techniques for the computation of optical flow include Horn, Schunck [10], Lucas and Kanade [11], and document literature [12] put forward a kind of comparable approach for the computation of optical flow. A moving object detection method [13] (based on the computation of frame difference area optical flow) proposed by Deng huibin, etc.

Because the moving objects detecting and tracking under the dynamic background exists the complex relative movement between vidicon and moving objects, its algorithm is more complicated than static's. The commonly used algorithms of video moving objects detection under the dynamic background are light flow estimation method, a block matching method global motion estimation and image matching method, etc.

3 Space Division

Space segmentation is segmenting each frame image into different color area by using the information of gray scale, color, edge, texture, etc, to obtain precise target outline. At present, the spatial segmentation algorithm commonly used are image segmentation based on threshold value、harmony segmentation based on region、edge detection and water image segmentation method, etc. These methods have their own features, but these methods only utilize some of the bottom information in the process of image segmentation, it can not simulate the intelligent of human visual system. When the image information is insufficient, these segmentation model only based on data driven can't obtain the satisfying consequences. A sort of specific method of image segmentation can't meet all image segmentation, but

image segmentation is a process which segment images into meaningful and expected area, making use of useful high-rise and rock-bottom information as much as possible.

Image segmentation based on Active contour model is modeling images as continuous function, which has the strict mathematical theory framework. So we can take advantage of mathematical tools to analyze, understand and expand the segmentation methods Active contour model preferably. Active contour model has the feature of combing rock-bottom image information with high-rise **prior** knowledge, specific prior knowledge and Active contour model will be a effective combination to make u insufficient or false rock-bottom image information, in order to make Active contour segmentation model has more intelligent, image 1.1 is the comparative pictures of traditional segmentation method and Active contour model.
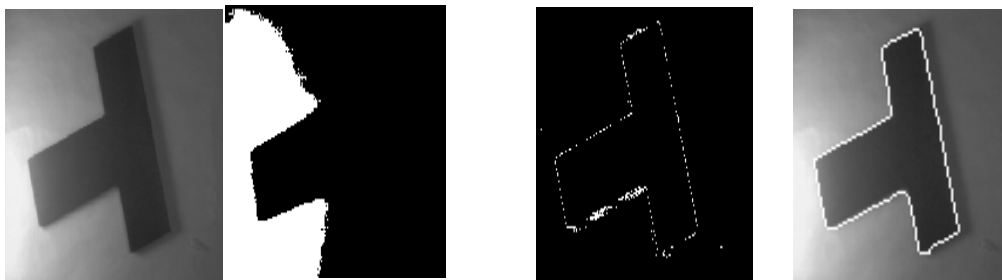
(a) original image (b) thresholding method (c) edge detection (d)active contour model method
Pic 1.1 comparison between the traditional segmentation method and active contour model method

Active contour model can be divided into parameterization model and geometric model. The paper [14] "Snake: Active Contours" put forward by Kass in 1987, firstly proposed Active contour model, it's also called as Snake model initially. First, the model defines the parameterization model has great imperfection: the sensitiveness to the initial position, the unsatisfactory of the effect for cavity convergence, and automatic topology changes (the curve of the split and merge) haven't featured. Geometric active contour model put forward by Caselles [15] and Malladi [16] respectively, based on the geometric measurement of curves (such as normal vector、the curvature, etc), but it is convenient to show these measures using level set method. Profile is expressed for the ero level set of the level set function, then embed the level set function into curve evolution equation, through evolution level set function and tracking its zero level set to obtain the curve evolution, it can not only handle

the topology changes neatly, but also easy to expand from lower dimension to higher dimension to higher dimension.
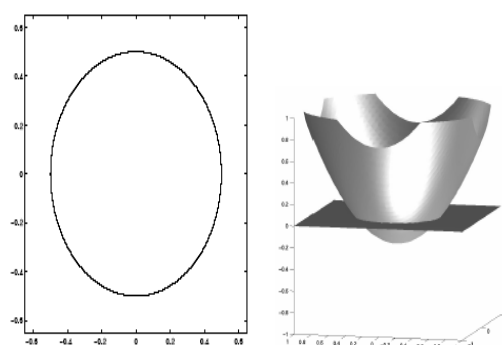
(a) outline   (b) level set function

Pic 1.2 the level set function diagram

A new level set method put forward by Zhao HK [19], named as variational level set method, it's relative simple for the numerical implementation plan. Geodesic active contour model[20,21] put forward by Casellos and Yezzi is more application, it utilize variational method [22] to minimization energy function which is structured by the geodesic line, the model can settle the question of "boundary leakage" to some extent. A active contour model put forward by Chan and Verse based on a simplified Mumford-Shah model, is CV model [23]. The model takes advantage of the character that background and objects is consistent in gray level in images, construct energy function in terms of regional statistical information of pixel gray, then minimize the energy function by variational method and obtain evolution equation of outline. Due to the regional statistical information of pixel gray is used by the model, weak boundary object and discrete boundary object can be segmented effectively. CVmodel approximates contour value of internal and external image data by constant, so it's only applied to the images segmentation that objects and background has the same density characteristics respectively, but in practice because of the influence of beam illumination、 imaging device and noise, objects and background could the region of uneven distribution of gray level, rather than the same density region. Under this circumstance, CV model can't attain satisfactory consequence.

A variational level set method put forward by C.M.Li [24], which can avoid level set function to re initialize: by adding the constraint level set function as the energy term of the signed distance function, to attain the effective control of the level set function deviation, this means is widely used in geometric active contour model controlled by energy function. Li put

forward a Distance Regularized level set Evolution (DRLSE) model [25] in 2010, the model against that bound term may cause adverse side effect for level set contour to the desired position by constructing a distance regularization term and external energy term. The level set method base on region put forward by YangLi [26], combining multiple information organically, realizing the segmentation of multiple rigid bodies or non-rigid objects. By narrow width algorithm based on inter frame motion information, MaBo [27] is devoted to objects detection and tracking.

Yu Huimin [28] is devoted to settle the objects detection and tracking in the sports background, proposed that establishing an energy function based on temporal and spatial domain by optical constraint Equation and Background model, this function can be used in the estimation of background motion velocity and the segmentation and tracking of moving objects, but optical flow has poor resistance to dry and its calculation is complicated.

4. Space-time joint segmentation

Among object detection algorithm based in object-shape and profile information, geometric active contour model can adapt to the change of target topology、obtain closed and complete target profile information, which is applied for the segmentation of rigid bodies or non-rigid objects, but its main defect is large calculation. The detection algorithm that simply adopts one attribute without the introduction result, but patio-temporal union detection method can be used to determine the approximate area of the foreground object roughly in terms of the method for detecting attribute of division order, then orientate the object edge precisely in the results of the corresponding spatial attribute detection algorithm.

A technology of segmentation based on changes, put forward by Gao Li [29], is to segment moving object and static background by detecting the change area and no change area in successive frames of image sequences, avoiding the defects existed in optic flow field, and its calculation is simple and effective. Video tracking and extraction algorithm based on temporal information put forward by Wang Ying [30], firstly extracting the contour information of the current frame object by using the frame difference information for three consecutive frames then by using the previous frame to extract the object region, denoising and filling of the contour information of the current object combining the relative among frame of video sequence and frame difference information, the segmentation results of the current frame object are obtained. Continuous use of this method, the segmentation results of

the whole video sequence can be obtained. The algorithm is simple and effective, which can better extract the object from the background of the movement, and attain tracking.

A kind of infrared object motion extraction algorithm of patio-temporal union put forward by Yang Wei [31], first of all to determine the separation for the changes of frame difference maps of two consecutive frames of Infrared sequences, mark the approximate position of the moving object, determining the constraint region of Infrared object. Then the spatial segmentation of infrared region can accurately extracting the moving object in the sequence image. A approach of inter frame difference and improved CV model put forward by Zhao Haiyong [32], obtained closed and complete moving object contour. The video segmentation method of patio-temporal union put forward by Huang Bo, the segmentation method based on mathematical morphology [33] theory is applied for space segmentation, the estimation method of hierarchical block matching motion is proposed in the motion of time domain, this method has the features of good robustness and pretty fast segmentation speed. Wei Zifu [34] put forward a new method of background difference and level set, the level set algorithm without re initialization is used for segmentation respectively for all moving target zone block.

CONCLUSION

Moving object detection has been a challenge question in research of computer vision, many theories and practical technology's troubles need to be settled. The paper analyses the commonly moving object detection methods firstly, at present. Then analyses the applicable conditions of various algorithms from a perspective of time segmentation, space segmentation and patio-temporal union segmentation.

Moving object detection algorithm has not matured in complex scenes just yet, complex scenes including rain, smog, shadow, mist, the leaves that sway in the wind and camera shake, moving background, fast moving object, target pose, measure, apparent and light changes, object occlusion or mutual occlusion, causing great challenges for moving object detection. How to develop a robust detection algorithm for all kinds of complex scenes will be a direction needed further research in the future.

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