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Video Segmentation Using Global Motion Estimation and Compensation

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Abstract: ***Emerging multimedia applications demands content-based video processing. Video has to be segmented into objects for content-based processing. A number of video object segmentation algorithms have been proposed such as semiautomatic and automatic. Semiautomatic methods adds burden to users and also not suitable for some applications. Automatic segmentation systems are still a challenge, although they are required by many applications. The proposed work aims at contributing to develop a system to segment video objects automatically from the background given a sequence of video frames. The proposed work will identify and solve different problems in change detection like uncovered background, global motion of background, temporary poses. To improve the resulting change detection masks, a post-processing method will be used. This technique is used to fill open areas inside object regions with uniform intensity. To improve the boundary of segmentation masks, morphological operations will be used.***

Keywords: Automatic segmentation, global motion estimation and compensation, global motion of background, semantic video object

1. Introduction

Two methods are mostly used in video object segmentation, one is semi-automatic, in which some kind of user intervention is required to define the semantic object and other one is automatic, where segmentation is performed without user intervention, but usually with some a priori information. Automatic segmentation of video objects is required by most applications, especially those with real time requirements.

A number of Video object Segmentation algorithms have been proposed, most aiming to specific applications, and trying to fulfill specific requirements. Promising results have been obtained so far in semiautomatic methods, since there is also human assistance in the segmentation process. However, the human assistance involved in these methods is not required because it adds burden to users and also it is not suitable for some applications. On the other hand, fully Automatic Segmentation (AS) systems are still a challenge, although they are required by many applications.

Many automatic segmentation systems are designed for specific problems and with simplified assumptions like videos with fixed background. So it is necessary to have flexible automatic segmentation system for different types of videos. Most of the existing AS systems involves complex techniques. Also each stage of the segmentation process involves computationally intense operations to obtain good segmentation results Thus, reducing the complexity of the techniques involved is required while keeping accuracy of segmentation results. This can be done by selecting efficient algorithms with reduced computational intensity in each step of the segmentation process. Accuracy of segmentation can be improved by applying post-processing.

2. Related Work

A number of video segmentation algorithms have been proposed. Automatic video object segmentation algorithms developed are roughly classified into three types: the edge-feature based segmentation, spatial-temporal based segmentation, and change detection based segmentation. This section provides a critical review of the various approaches available for video segmentation.

[2] Kim and Hwang(2002) utilises Canny edge detector to find edge information of each frame and it can obtain correct segmentation object for stable moving-object, but this approach will require an absolute background from video sequence and involve a computation-intensive processing.

[3]Dailianas (2011) compared several segmentation methods and introduce a filtering algorithm in order to limit the false detections. Mandal (2011) focused on methods working in compressed domain.

[4] Guo J, Kim J and Kuo CCJ. (1999) combined colour and motion features for foreground and background separation. Global motion of background is done according to colour similarity using a non-parametric gradient-based iterative colour clustering algorithm called the mean shift algorithm. Moving regions are then identified by a motion detection method, which is developed based on frame intensity difference.

[5]Hoynck M, Unger M and Ohm J-R. (2004) presents automatic segmentation of MOs in natural video sequences. This approach utilizes global motion estimation and compensation in combination with spatial image segmentation and segment-based diffusion of local MI.

[6]Neri et al. (1998) proposed an algorithm based on change detection which separates potential foreground regions employing a higher order statistics (HOS) significance test to inter-frame differences. Comparison could be performed on a global level, so methods based on histograms were also proposed.

[7]Zhu, Liu and Xie (2011) proposed a dynamic video segmentation in which foreground is separated by simple background subtraction method firstly. And then, Bayes classifier is proposed to eliminate the misclassification points to refine the segmentation result. Frame difference is the simplest form of background subtraction. The current frame is subtracted from the previous frame. If the resultant difference in the pixel values is greater than a threshold Ts, the pixel is considered part of the foreground.

3. Proposed System

Proposed system is used for effective automatic SVO segmentation system. The design considers videos with fixed and moving backgrounds to make the system more flexible. Depending on whether there exists camera motion or not in video sequences, and whether there is an initial background, three cases are examined in the design of the segmentation system. Block diagram of the entire proposed system is shown in Figure and the description of overall working for each of the cases is given below:

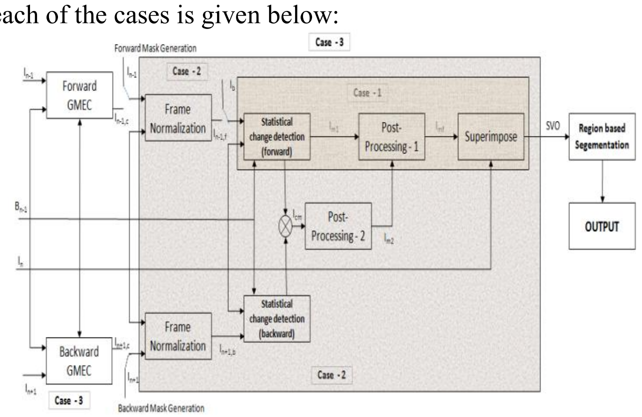

Figure 1: Block Diagram of Proposed System

1) Case1:NO GMOB, with Initial Background

This case considers applications where an initial background GMOB can be easily obtained. The system uses the background GMOB (Ib), the current frame (In), and the previous background frame Bn-1 to obtain the SVO in the current frame (the dark-gray shaded region Figure). First, an effective statistical change detection based on significance testing is applied between In and Ib to obtain a binary SVO mask Im1. The change detection algorithm uses the reference background frame (Bn-1) to estimate the background noise used in significance testing. Then, a post-processing stage – Post-processing-1 is applied to the output of the change detection block. The output of this stage is the final object mask, Imf. The final binary object mask is then superimposed on the original frame in the next stage to produce the final segmented SVO and background frames. Note that the result of Frame normalization step, In-1, f is not used in this case, instead, the system switches to using Ib.

A. Statistical Change Detection

Change detection is used in a number of applications including video surveillance, remote sensing, medical diagnosis, driver assistance and video segmentation. However, the application is limited to video segmentation in this discussion The goal here is to identify the set of pixels that are significantly different between an image and another reference image in video sequences. A comparison is applied between the image under concern and the reference image to detect those pixels. The changes may result from (1) camera movement, (2) appearance/disappearance of objects, (3) motion of object relative to background, (4) shape changes of objects, or (5) changes in illumination.

B Post-Processing

As mentioned in the above sections, the result of change detection algorithms is not accurate. Due to noise and uncovered background, there exist some noise regions in the initial object Mask in both background region and object region. Also object boundary is not very smooth. Therefore a post-processing step to eliminate these noise regions and filter out the ragged Boundary is necessary. The post-processing can be applied either to the binary mask only or to both the binary mask and original frame .Post-processing using binary mask only is the simplest approach to remove irregularities. It Preserves contours and reduces spurious regions of the mask. It does not use any information From the original image. It consists of simple morphological opening or closing or a more complex composition of morphological filters

2) Case 2:NO GMOB, without initial background:

In this case, the architecture of the system aims at removing uncovered background by integrating two change detection masks (obtained by forward and backward mask generation). These change detection masks are combined by a logical operator. The operator removes all areas except the foreground object detected which is the region that overlaps in the two change detection masks. This can be explained using Figure 2 as follows. Consider the two change detection masks (forward and backward) shown in Figure.2 a) and b).Region A is uncovered background revealed during forward mask generation, and region C is uncovered background revealed by backward mask generation. Region B is the object which is detected in both change detection masks. When these two masks are combined using a logical AND operator

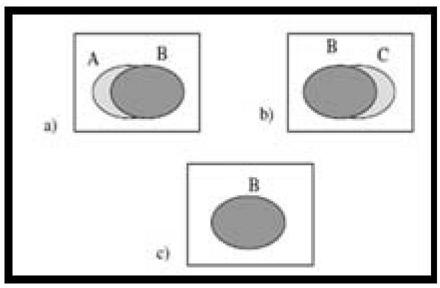

Figure 2: Removal of uncovered background by combining two change detection masks a) forward change detection mask; b) backward change detection mask; c) combination of a and b.

A. Frame Normalisation

Perhaps the most critical issue in comparison is selection of the GMOB. Two choices are possible: the previous frame relative to the current frame in the sequence, or an image representing background of the scene. The background frame can be fixed, or can be updated Periodically. Fixed background frames can be obtained from the sequence prior to entrance of MOs to the scene. Background can be updated periodically by temporal integration of previous and next frames, to produce large background image

3) Case 3: With GMOB:

For video sequences with moving backgrounds, the system first compensates the global motion. The rest of the segmentation process is just similar to Case-2. The forward and backward Global Motion Estimation and Compensation (GMEC) are applied to align previous and next frames, In-1 and In+1 respectively, towards the current frame In. These two blocks are the Forward GMEC and the Backward GMEC blocks. It is assumed that in video sequences with moving backgrounds, obtaining an initial reference background frame is very difficult and so the system combines three consecutive frames just similar to that of Case-2. For video sequences that contain camera motion, which causes GMOB, this global motion is compensated by the Motion estimation and compensation blocks. These are the Forward GMEC and Backward GMEC blocks in Figure 2. There are three phases of the motion estimation and compensation process proposed in this design: 1) Dense motion vector estimation 2) Parameter estimation 3) Motion Compensation or Frame warping

a)Dense Motion Vector Estimation:

For the dense motion vector estimation, a three-level Hierarchical block based algorithm is used for its compromised performance in computational complexity, speed and accuracy. Mean pyramids are constructed using the simple averaging equation .Then the pyramidal images are searched from top to bottom using MAD for block matching criterion. A full search within two pixels distance around the concerned block is done for better accuracy of matching block. The most commonly used 16x16 pixels block size is used at level-0 of the hierarchy. The process is shown in Figure

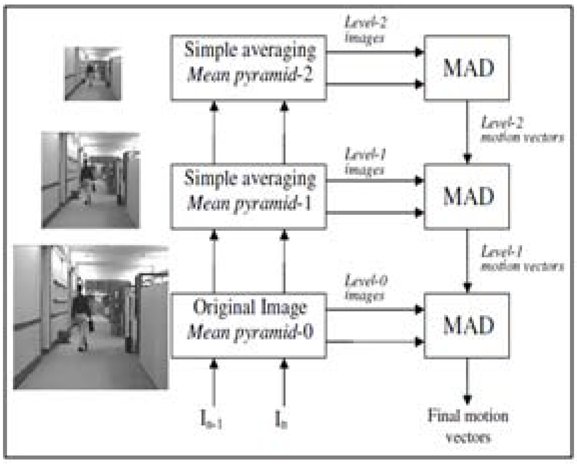

Figure 3: Three-level hierarchical mean pyramid based ME

b)Parameter Estimation

The six parameter motion model, the affine model is used for the global motion. For estimation of the affine parameters, the least squares minimization criterion over the background frame is used to minimize the error between the dense and parametric model motion vectors. The previous background mask Bn-1 is used to estimate the background part of the current frame where the global motion is valid.

c)Frame Warping

The parameters estimated from the above step are used to align the previous/next frame to the current frame. In this process, a new frame is calculated from previous frame by transforming the coordinates of the pixels of the previous frame into a new frame.

4) Region Based Segmentation

The Algorithm Partition the image into regions with common features suitable for further analysis. The Extracted Region Are Uniform with respect to some characteristic, such as intensity, color, texture.

4. Conclusion

This paper presents the video segmentation using global motion estimation and compensation. As in the previous methods there were many drawbacks. To overcome the drawbacks of previous methods for static background, new method is used which is based on moving camera i.e. affine motion model and also find the uniform features by using Region Based Segmentation.

References

[1] Shao-Yi Chien, Yu-Wen Huang, Bing-Yu Hsieh, Shyh-Yih Ma, and Liang-Gee Chen,"Fast Video Segmentation Algorithm with Shadow Cancellation, Global Motion Compensation, and Adaptive Threshold Techniques," *IEEE Trans. on Circuits and System for Video Technology*., vol. 6, pp. 732- 748, no. 5, Oct. 2004.

[2] C. Kim and J. N. Hwang, "Fast and Automatic Video Object Segmentation and Tracking for Content-Based Application," IEEE Transaction on Circuits and System for Video Technology, vol.12, no. 2, pp. 122-129, 2002.

[3] A. Dailianas, R.B. Allen, and P. England. "Comparison of automatic video segmentation algorithms". In SPIE Conference on Integration Issues in Large Commercial Media Delivery Systems, volume 2615, pages 2–16, Philadelphia, PA.

[4] Guo J, Kim J and Kuo CCJ. (1999) "Fast and Adaptive Semantic Object Extraction from Video." IEEE Transactions on Signals, Systems and Computers, vol. 2, pp. 1417-1421.

[5] Hoynck M, Unger M and Ohm J-R. (2004) "Robust Object Region Detection in Natural Video using Motion Estimation and Region-Based Diffusion." Institute of Communication Engineering (IENT) RWTH Aachen University D-52056 Aachen, Germany.

[6] Neri A., Colonnese S., Russo G., Talone P., "Automatic moving object and background separation" (Signal Processing), 66(2), 1998, 219-232.

[7] Qingsong Zhu, Guanzheng Liu, Yaoqin Xie "Dynamic Video Segmentation via a Novel Recursive Kernel Density Estimation" 2011 Sixth International Conference on Image and Graphics.

[8] Shao-Yi Chien, Shyh-Yih Ma, and Liang-Gee Chen, "Efficient Moving Object Segmentation Algorithm Using Background Registration Technique," *IEEE Trans. on Circuits Syst. Video Technol.*, vol. 12, no. 7, pp. 577-586, 2002.

[9] Mech R. and Wollborn M., "A Noise Robust Method for 2D Shape Estimation of Moving Objects in Video

Sequences Considering a Moving Camera" (Signal Processing), 66(2), 1998, 203-217.
[10] Urhan O., Ertürk S., "Video segmentation with block based change detection using numerous preceding image frames", New Trends in Computer Networks, Advances in Computer Science and Engineering Alan Conrad Bovik's book "The Essential guide to video processing".
[11] Tung-Chien Chen"Video Segmentation Based on Image Change Detection for SurveillanceSystems".
[12] Tung-Chien Chen"Video Segmentation Based on Image Change Detection for SurveillanceSystems
[13] S.-Y. Chien, S.-Y. Ma, and L.-G. Chen, "An efficient video segmentationalgorithm for real-time MPEG-4 camera system," in Proc. Visual Communication and Image Processing 2000, 2000, pp. 1087–1098.
[14] S.-Y. Chien, S.-Y. Ma, and L.-G. Chen, "An efficient video segmentationalgorithm for real-time MPEG-4 camera system," in Proc. Visual Communication and Image Processing 2000, 2000, pp. 1087–1098
[15] Thomas Meier, King N.Ngan, "Video Segmentation for Content-Based Coding," IEEE Trans. on Circuits and System for Video Technol., vol.9, no. 8, pp.119-1203, Dec. 1999.
[16] MunchurIkim, Jae Gark Choi, Daehee Kim, Hyung Lee, Myoung Ho Lee, ChieteukAhn and Yo-Sung Ho, "A VOP Generation Tool: Automatic Segmentation of Moving Object in Image Sequences Based on Spatio-Temporal Information," IEEE Trans. on Circuits Syst. Video Technol., vol.9, no. 8, pp. 1216-126, Dec. 2002.
[17] C. Stauffer and W. Grimson, "Learning Patterns of Activity using Real-time Tracking," IEEE Transactions on Pattern Analysis and Machine Intelligence, vol. 22(8), pp. 747-757, 2000.
[18] O.Tuzel, F. Porikli and P. Meer, "A Bayesian Approach to Background Modeling" CVPR, San Diego, CA, p. 58, 2005.
[19] Neri A., Colonnese S., Russo G., Talone P., "Automatic moving object and background separation" (Signal Processing), 66(2), 1998, 219-232.
[20] McFralane, N. J. B. and Schofield, C.P. "Segmentation and tracking of piglets in images". Machine Vision and Applications, Vol. 8, No. 3, 187-193. 2005.
[21] Ricardo Augusto Castellanos Jimenez "Event Detection In Surveillance Video" Florida Atlantic University Boca Raton, Florida May 2010.
[22] Lei Yang YimingGuoXiaoyu Wu Shaobin "An interactive video segmentation approach based on grabcut algorithm" 2011 4th International Congress on Image and Signal Processing IEEE Transactions On Circuits And Systems For Video Technology, Vol. 21, No. 8, August 2011 1163.
[23] H. Jiang, A.S. Helal, A.K. Elmagarmid, and A. Joshi. "Scene change detection techniques for video database systems". Multimedia Systems, 6(3):186–195
[24] M.K. Mandal, F. Idris, and S. Panchanathan" A critical evaluation of image and video indexing techniques in the compressed domain". Image and Vision Computing, 17(7):513–529.
[25] T. Meier and K.N. Ngan, "Automatic segmentation of moving objects for video object plane generation," IEEE Trans. Circuits Syst. Video Technol., vol. 8, Dec. 1998, Page(s): 525-538.
[26] T. Meier and K.N. Ngan, "Automatic segmentation of moving objects for video object plane generation," IEEE Trans. Circuits Syst. Video Technol., vol. 8, Dec. 1998, Page(s): 525-538.
[27] L. Vincent and P. Soille, "Watersheds in digital spaces: an efficient algorithm based on immersion simulations," IEEE Trans. Pattern Anal. Machine Intell., vol. 13, June 1991, Page(s) 583-598.
[28] E. R Dougherty, Ed., Mathematical Morphology in Image Processing. New York Marcel Dekker, 1993,ch.12, Page(s):433-481.
[29] A Moga, B. Cramriuc, and M. Gabbouj, "An efficient watershed segmentation algorithm suitable for parallel implementation," in Proc. Int. Conf Image Processing, 1995
[30] S. Y. Chien, Y. W. Huang, and L. G. Chen, "Predictive watershed: a fast watershed algorithm for video segmentation," IEEE Transactions on Circuits and Systems for Video Technology, vol. 13, May 2003.
[31] SebastienLefevre, Jerome Holler, Nicole Vincent "A review of real-time segmentation of uncompressed video sequences for content-based search and retrieval", Science Direct 2003.
[32] Ahmed M, Karmouch A, Abu-Hakima S. "Key frame extraction and indexing for multimedia databases". In: Vision Interface Confer