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Active Contour-Based Visual Tracking by Integrating Colors, Shapes, and Motions Using Level Sets

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Abstract: ***Using a camera, the visual object tracking is one of the most important process in searching the spot of moving object over the time. In the case of the object moves fast relative to the frame rate, the visual object tracking is difficult task. The active contour evolution algorithm which is used for the tracking of object in a given frame of an image sequence. Active contour based visual object tracking using the level sets is proposed which does not consider the camera either stationary or moving. We present a framework for active contour-based visual object tracking using the level sets. The main components of our framework consist of the contour-based tracking initialization, color-based contour evolution, the adaptive shape-based contour evolution for the non-periodic motions, the dynamic shape-based contour evolution for the periodic motions and handling of the abrupt motions. For the contour-based tracking initialization, we use an optical flow-based algorithm for the automatically initializing contours at the first frame. In the color-based contour evolution, we use Markov random field theory to measure correlations between values of the neighboring pixels for the posterior probability estimation. In the adaptive shape-based contour evolution, we combined the global shape information and the local color information to hierarchically develop gradually the contour, and a flexible shape updating model is made. In the dynamic shape based contour evolution, a shape mode transition matrix is gain to characterize the temporal correlations of the object shapes. In the handling of abrupt motions, particle swarm optimization (PSO) is used to capture the global motion which are applied to this contour in the current frame to produce an initial contour in the next frame.***

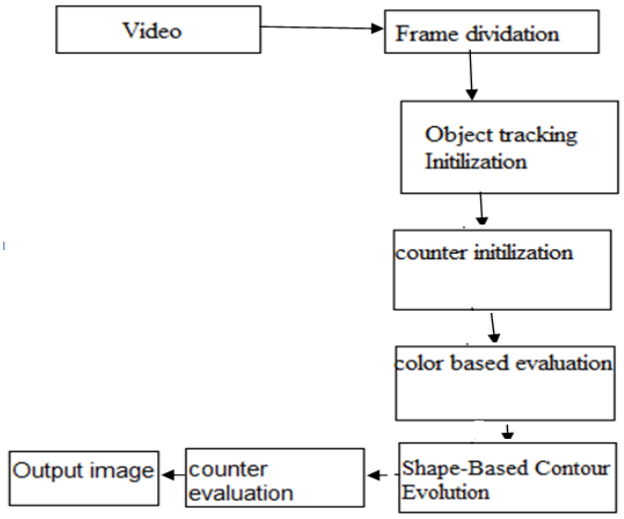
Keywords: Abrupt motion, active contour-based tracking, adaptive shape model, dynamic shape model.

1. Introduction

Visual object tracking is a lively research topic in the computer application. In the general method of visual object tracking, objects are represent using predefined common shape models such as rectangles or ellipses but active contour based tracking [16] which provides more detailed information about object shape. But in general, active contour-based tracking is more difficult than general tracking of the same object in the same real-world condition. Due to the active contour-based tracking aims to pick up finer details of the object i.e. the boundary of the object and the extract object from the background disturbances. In videos taken by the stationary camera, regions of object motion can often be extracted using background subtraction and the object contours can be produced by tracing the edges of the object motion regions. However in videos taken by the moving camera, the background subtraction cannot be used to extract regions of object motion, producing the contour-based tracking more complicated than in the videos taken by stationary cameras. Active contour-based object tracking, not think about whether the camera is stationary or moving, has concerned much more attention in recent years.

A. System Architecture and Design

At the first, we get the video. Then, video is divided into number of frame i.e. frame extraction. At the first frame, using optical flow at each pixel ,regions of one or more motion are detect. The borders of these motion regions are used as the initial contours. After that, these initial contours are evolved by using color information. Base on the result of color-based contour evolution, the ICA technique based on shape prior is used to contract with noise or partial occlusion etc. to achieve more exact contours. The abrupt motion is check with the first frame, while there is no abrupt motion, the growth result in the current frame is use as the initial contour of the object in the next frame. But there is abrupt motion, the parameters of affine motion are estimated by using a stochastic algorithm, and then applied to the contour in the current frame to acquire the initial contour for the next frame.



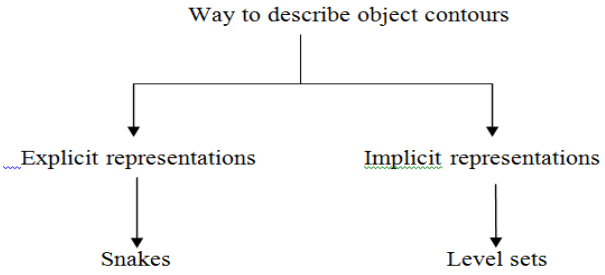
2. Literature Survey

In general, there are two ways to describe object contours:

1) Explicit representations which are characterized by parameterized curves such as snakes [1].

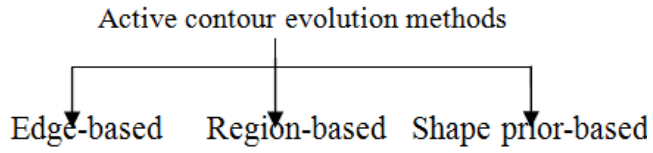
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2) Implicit representations which used to represent a contour using a signed distance map such as level set[2].



The implicit representation is more popular than the explicit representation because it provides a stable numerical solution and it is able of handling topological changes. Active contour evolution methods are divided into three categories:

1) Edge-based
2) Region-based
3) Shape prior-based.



1) Edge-Based Methods:

The edge-based methods generally think about the local information near contours, for example the grey level gradient. Kass *et al.* [1] suggest the snake model which is the best well-known edge-based active contour evolution method.Paragios and Deriche [13] develop the geodesic model in [12] which using level sets to explain contours and by using a gradient descent algorithm to optimize contours.The qualities of edge-based methods are their straightforwardness, intuitiveness, and usefulness for determine the contours with significant gradient. They have the following boundaries: a) They simply think about the local information close to a contour, and therefore the original contour must be close to the object. b) The Contour sections untruthful in uniform regions of an image could not be optimize. c) Therefore,they are very sensitive to image noise.

2) Region-Based Methods:

The region-based methods typically partition an image into background and object regions by using statistical quantities, for example mean, variance, or histograms of the pixel values in each of the region. Chan and Vese [9] estimated an image via a mean image with regions whose boundaries are treated as object edges. . Yilmaz *et al.* [16] assume the features of both background and object regions in the level-set active contour evolution model. Mansouri [32] suggest an algorithm for formulating contour tracking as a Bayesian estimation difficulty. For the region-based cotour evolution methods, prior knowledge of color and texture of object may be integrated into the contour evolution procedure. Color prior knowledge of object is typically represented by using object look models such as color histograms. The Qualities of the region-based methods is that statistical Information of regions, collectively with the prior knowledge of color and texture of object, can raise the toughness and correctness of contour evolution. The drawback of the current region-based contour evolution methods is that the value of pixels are treated as if they were self-determining for the posterior probability estimation [36]. This self-determining assumption makes the gain contour sensitive to turbulence cause by similarities of color or texture among the object and the background.

3) Shape Prior-Based Methods:

The Shape prior-based contour evolution methods statistically form priors of object shape which are use to improve bothered, occluded, or unclear contour sections. Leventon *et al.* [18] increase orthogonally a set of united training shape samples which are represented by using the signed distance maps into a subspace by using the Principal Component Analysis (PCA). Paragios and Rousson [20] build a pixel-wise shape representation in which variability of local shape can be accounted. Cootes *et al.* [21] offer an active shape-based model for the unusual rigid objects aspects in formulation of a shape prior.Fussenegger *et al.* [22] advise an online active shape-based model to carry out region segmentation. The PCA algorithm in [23] is use to fill in the active shape-based model. Cremers [19] propose a linear dynamical shape-based model stand on an autoregressive model for track a person with the periodic motions by using level sets. The good point of the shape prior-based contour evolution methods is that the troubled, occluded, or unclear edges can be improved. Though, the current adaptive shape-based contour-evolution methods [20] may deform uninterrupted contour sections which can be create exactly by using color features without help, even as they internationally get better the disturbed contour sections. it is necessary to inform the active shape-based model in real world applications continuously in sequence to adjust to shape changes. On the other hand, the current shape-based method [22] for update the shape model does not at the same time handle the numerous new shape samples, and fail to calculate the sample eigenbasis with sample mean update. The earlier dynamical shape model in [19] for the periodic motions of the non-rigid objects is a easy data appropriate process with no high-level considerate of shape change. The model assume that the causal motion is personally approximated by the periodic motion, but human motion is hardly ever accurately periodic.

3. Approach Framework and Design

A. Problem Statement

The limitation of the current region based methods is that the pixel values is treated as a independent for the posterior probability estimation. This independence assumption makes the obtained contour sensitive to this disturbances caused by similarities of color or texture between the object and the background.We propose two MRSE schemes based on the similarity measure of “coordinate matching” while meeting different privacy requirements in two different threat models.

Current contour-based tracking algorithms are subject to additional limitations as follows. Tracking initialization often relies on a manually drawn closed contour around the object. The existing system level is set based tracking methods fail

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to track the contour of an object when the object moves abruptly. Related work in, deals with the discontinuities induced by abrupt motion.

B. Proposed System

In this paper, analysis the main restrictions in contour tracking, and presented a framework is tracking object contours, no matter whether the camera is stationary or moving. The active contour based visual tracking system using level sets is proposed.

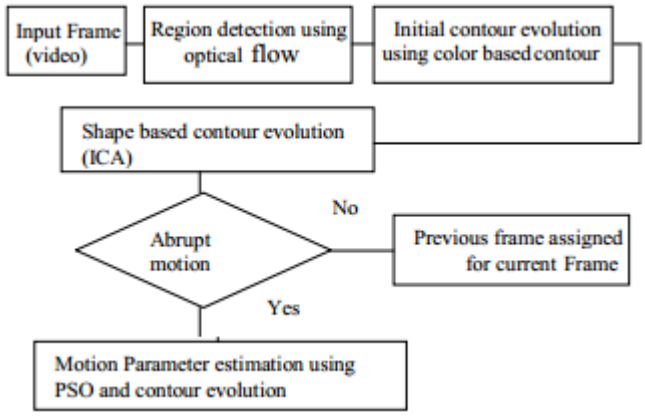


Figure 1: Proposed System Architecture

At the first frame, the ego motion compensation is used to compensate the camera motion and then the optical flow at each pixel are estimated in which one or more motion regions are detected. The boundaries of this motion regions is used to the initial contours. These initial contours are evolved using color information. Based on the color-based contour evolution result, the shape prior based ICA technique are used to deal with noise or partial occlusion etc to obtain more accurate contours. Abrupt motion is checked with first frame, when there is no abrupt motion, the progress result in the current frame is used as the initial contour of the object in the next frame. If there is abrupt motion, the affine motion parameters are estimated using a stochastic algorithm and applied to the contour in the current frame to obtain the initial contour for the next frame. The region based level sets include contour-based tracking initialization system. For the first frame we are using color-based contour evolution and shape-based contour evolution, and abrupt motion handling.

C. Mathematical Model

1. The level set function in our method is,

$$\phi(x,y) = \begin{cases} 0 & (x,y) \in C \\ d(x,y,C) & (x,y) \in R_{out} \\ -d(x,y,C) & (x,y) \in R_{in} \end{cases}$$

Where,
*R*in and *R*out denote, regions inside and outside C and d(x, y,C) is the smallest Euclidean distance from point (x, y) to C.

2. The overall initial counter is,

$$\phi^{n+1}(x,y) - \phi^{n}(x,y) / \Delta t + (F_{(x,y)} + F_{curv}) \phi(x,y) | = 0$$

Where,
F(x,y) is the external force reflecting the data attachment *F*curv = $-\varepsilon\kappa(x, y)$ is the internal force proportional to the curvature $\kappa(x, y).\varphi(x, y)$ is estimated as the gradient of the level set function at *(x, y).*Δ*t* is the evolution step.*F(x,y)* as well as the initialization of the contour.

3. The detection algorithm includes the following steps:

$$\zeta i = \beta \Sigma u^2_x + u^2_x / r_i - (1 |- \beta) \Omega_{arg(u,v)}$$

where ,
X is a pixel within M*i* ,$\Omega^2_{arg(u,v)}$ is the variance of the directions of the flow vectors of the pixels is the weight (ranging between 0 and 1)

4. The estimated probability density function at pixel X in the joint color-texture space is formulated as:

$$p(X \mid \omega, \mu^C, \Sigma^C, \mu^T, \Sigma^T)$$

$$= 1/k \Sigma \omega_j \, n \, (X^C, \boldsymbol{\mu}^{\mathbf{C}}_{\mathbf{j}}, \boldsymbol{\Sigma}^{\mathbf{C}}_{\mathbf{j}}) \, n \, (X^T, \mu^T_j, \Sigma^T_j)$$

Where,
$\{\omega_j\}_{j=1,2,.....k.}$ are the weight parameters of the GMM model.

5. The posterior probability and likelihood estimation, current methods assume that the pixel values in the object region or the background region are independent . Then, the following equation is obtained:

$$P(I \mid R(I)) = \prod P(v(X_i) \mid X_i \in R_{in}) \prod$$

$$P(I \mid R(I)) = \prod P(v(X_i) \mid X_i \in R_{in}) \prod$$

$$P(v(X_j)) \mid X_j \in R_{out}$$

where ,
*R*in and *R*out denote the regions inside and outside the contour corresponding to the partition R(I),

D. Hardware and Software Configuration

Hardware Requirements:
Processor : Pentium IV 2.6 GHz
Ram : 512 MB DD RAM
Hard Disk : 20 GB

Software Requirements:
Front End : Java
Tools Used : Net Beans
Operating System : Windows 7/8

4. Results



Figure 2: Browse Video

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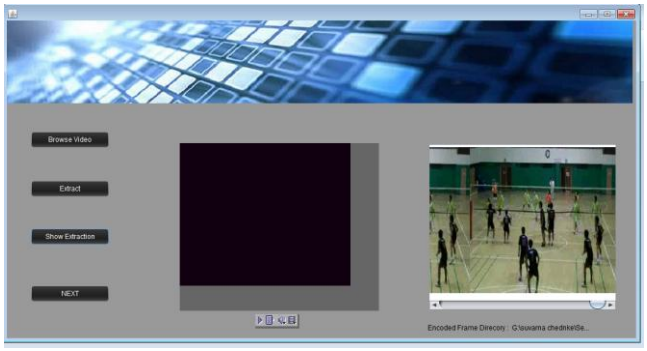


Figure 3: Video Extraction



Figure 4: Edge detection

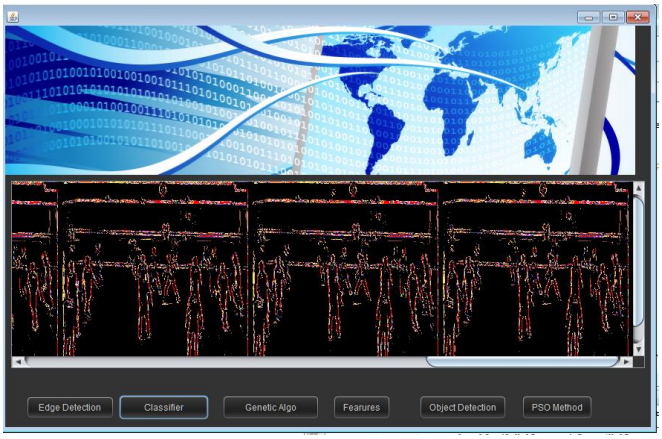


Figure 5: Classifier

Fig(5) shows more accurate contour of object



Figure 6: Genetic Algorithm

Fig(6) shows operation perform on each frame including tracking initialization,colourbased evolution,adaptive shape-based evolution.dynamic shape-based evolution.

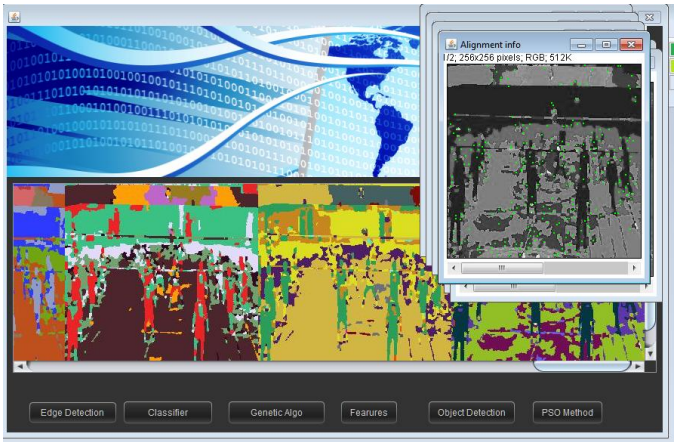


Figure 7: Feature

Figure 7: shows clear features of object like boundary of object ,corner of object etc.

5. Conclusion

We have presented an effective framework for tracking object contours.We have the following conclusions:

a. Our color-based contour evolution algorithm which applies the MRF theory to model the correlations between pixel values for posterior probability estimation is more robust to background disturbance than the region-based method which does not consider correlations between the values of neighboring pixels for posterior probability estimation.
b. We propose two MRSE schemes based on the similarity measure of coordinate matching while meeting different privacy requirements in two different threat models.
c. Our PSO-based algorithm can deal effectively with contour tracking for videos with abrupt motions, and it outperforms the particle filter-based algorithm.

References

[1] M. Kass, A. Witkin and D. Terzopoulos, “Snakes: Active contour models,” Int. J. Comput. Vis., vol. 1, no. 4, pp. 321–331, 1988.
[2] D. Adalsteinsson and J. A. Sethian, “A fast level set method for propagating interfaces,” J. Comput. Phys., vol. 118, no. 2, pp. 269–277,1995.
[3] S. Osher and J. A. Sethian, “Fronts propagation with curvaturedependent speed: Algorithms based on Hamilton-Jacobi formulations,” J. Comput. Phys., vol. 79, no. 1, pp. 12–49, 1988.
[4] B. Horn and B. Schunck, “Determining optical flow,” Artif. Intell., vol. 17, pp. 185–203, Aug. 1981.
[5] X. Zhou, W. Hu, Y. Chen, and W. Hu, “Markov random field modeled level sets method for object tracking with moving cameras,” in Proc. Asian Conf. Comput. Vis., 2007, pp. 832–842.
[6] M. Partio, B. Cramariuc, M. Gabbou and A. Visa, “Rock texture retrieval using gray level co-occurrence matrix” , in Proc. Nordic signal process. symp., Oct. 2002, pp. 1–5.

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[7] C. Stauffe and W. E. L. Grimson "Adaptive background mixture models for real-time tracking," in Proc. IEEE Conf. Comput. Vis. Pattern Recognit, vol. 2. Jun. 1999, pp, 246–252.
[8] J. A. Sethian, "Level set methods and fast marching methods: Evolving interfaces in computational geometry," in Fluid Mechanics, Computer Vision, and Materials Science. Cambridge, U.K.: Cambridge Univ. Press in 1999.
[9] T. F. Chan and L. A. Vese, "Active contours without edges," IEEE Trans. Image Process, vol. 10, no. 2, pp. 266–277, Feb. 2001.
[10] D. X. Xu, J. N. Hwang, and C. Yuan, "Segmentation of multi-channel image with Markov random field based active contour model", J. VLSI Signal Process, vol. 31, no. 1, pp, 45–55, May 2002.
[11] B. Lucas and T. Kanade, "An iterative image registration technique with an application to stereo vision," in Proc. Int. Join Conf. Artif. Intell., 1981, pp, 674–679.
[12] V. Caselles, R. Kimmel and G. Sapiro, "Geodesic active contours," *Int. J. Comput. Vis.*, vol. 22, no. 1, pp. 61–79, Feb. 1997.
[13] N. Paragios, R. Deriche, "Geodesic active contours and level sets for the detection and tracking of moving objects," *IEEE Trans, Mach. Intell.*, vol. 22, no. 3, pp. 266–280, Mar. 2000.
[14] T. Bailloeul, "Active contours and prior knowledge for change analysis: Application to digital urban building map updating from optical highresolution remote sensing images," Ph.D. dissertation, National Laboratory of Pattern Recognition, Inst. Automation, Chinese Academy of Sciences, Bejing, China, Oct. 2005.
[15] S. C. Zhu and A. Yuille, "Region competition: Unifying snakes, region growing and bayes/MDL for multiband image segmentation," *IEEE Trans. Pattern Anal. Mach. Intell.*, vol. 18, no. 9, pp. 884–900, Sep. 1996.
[16] A. Yilmaz, X. Li, and M. Shah, "Object contour tracking using level sets", in *Proc. Asian Conf. Comput. Vis*, 2004, pp. 1–7.
[17] Y. Shi and W. C. Karl, "Real-time tracking using level sets," in *Proc. IEEE Conf. Comput. Vis Pattern Recognit*, vol 2, May 2005, pp, 34–41.
[18] M. Leventon, E. Grimson and O. Faugeras, "Statistical shape influence in geodesic active contours," in *Proc. IEEE Conf. Comput. Vis. Pattern Recognit.*, vol. 1. Jun. 2000, pp, 316–323.
[19] D. Cremers, "Dynamical statistical shape priors for level set based tracking", *IEEE Tran Patten Anal. Mach. Intell.*, vol. 28, no. 8, pp, 1262–1273, Aug 2006.
[20] N Paragios and M. Rousson, "Shape priors for level set representations," in *Proc. Eur. Conf. Comput. Vis.*, 2002, pp 78–92.

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