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IMAGE OBJECT DETECTION USING ACTIVE CONTOURS VIA LEVELSET EVOLUTION FOR SEGMENTATION

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Abstract- Image segmentation has a long tradition as one of the fundamental problems in computer vision. Active contour models are widely used in image Segmentation problems. In these models, curves are evolved in an image from initial locations, in response to information derived from the image, to detect object boundaries , active contours that forces the level set function to be close to a signed distance function, and therefore completely eliminates the need of the costly re-initialization procedure and an external energy term that drives the motion of the zero level set toward the desired image features, such as object boundaries, represented by the zero level set of continuous level set functions. Instead, interfaces be represented by discontinuities of piecewise constant level set functions. Each level set function can at convergence only take two values, i.e., it can only be 1 or -1. The resulting evolution of the level set function minimizes the overall energy functional, thus the level set method is a versatile tool for tracing interfaces separating a domain into sub-domains.
Keywords- Active contour, level set method shape model, energy minimization, object detection, segmentation, region scalable fitting energy, intensity inhomogenity.

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Introduction

Active contours are being used for image segmentation, either explicitly as snakes, or implicitly through the level set approach. A level set method with shape model is proposed for image segmentation. Using level set method to correctly take semantic object (region and boundary information) into account a mixture of Gaussian is used to model pixels of the background image and those of the semantic object. In order to overcome the difficulties caused by intensity inhomogeneities, we proposed a region-based active contour model that draws upon intensity information in local region at a controllable scale. Level set energy minimization method used while kernel density estimation in image segmentation to find out regions into images. Due to kernel function in the data fitting term intensity information in local regions is extracted to guide the motion of the contour. The regularity of the level set function is intrinsically preserved by the level set regularization term to accurate computation. To compute Heaviside function using kernel method, to find with homogeneous and inhomogeneous active region in image.

Active Contour Method

Active contour models can achieve sub-pixel accuracy of object boundaries. Can be easily formulated under a principled energy minimization framework, and allow incorporation of various prior knowledge, such as shape and intensity distribution, for robust image segmentation [4]. Active contour Method Can provide smooth and closed contours as segmentation results, which are necessary and can be readily used for further applications, such as shape analysis and recognition ,also Intensity inhomogeneities often occurs in real world images, cause difficulty in active contour Method.

Level set method

Overcome the difficulties caused by intensity inhomogeneities.

Segment images with intensity inhomogeneity, and has desirable performance for Images with weak object boundaries .Regularity of the level set function is intrinsically preserved to ensure accurate computation and avoid expensive reinitialization procedures but more complicated to extend this idea to handle non-simple curves, and multiple phases. Hard to solve the problem at hand in obtaining a reasonable equality without excessive complexity. Hard to solve problem of multiple phases, for higher co dimensions and for open Curves, and for localization level set framework, level set framework focus on the boundary-value problem of a close contour C deforming with a speed V along its normal direction.Osher and Sethian focused on motion under mean curvature flow with speed term since its introduction, the concept of deformable models for image segmentation defined in a level set framework has motivated the development of several families of method that include: geometric active contours based on mean curvature flow, gradient-based implicit active contours and geodesic active contours. It become convenient to refer to the height of the level set at a specific point as the value of the level set at a particular pixel, or Ø(x, y) [7,8,9].The implicit hyper-surface is just a curve that exists in the two-dimensional support of the image. This curve will be called the zero level set, C which is defined as the set of all pixels on the level set function.As shown in figure.1 [11] level set method defined on base of surface Ø, if the surface Ø > 0 is outside contour and Ø < 0 is inside contour.

C = {(x, y) |Ø(x, y) =0}

Thus, the zero level set divides the image into two regions, R+ and R-, which consist of the positive and negative values of the level set function respectively. The zero level set will sometimes be referred to as simply "the curve" as it solely determines the final segmentation [11].

Ø(x, y) < 0 inside the contour
Ø(x, y) = 0 contour
Ø(x, y) > 0 outside the contour

In above equation, the inside and the outside region of the curve are explicitly defined. Shown in Figure.1

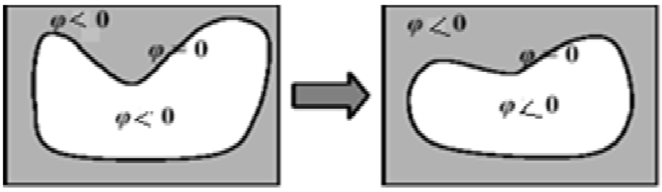

Fig. 1- Level set method and the contour specification

Sign Distance Function [8, 9, 13]
To start the process of evolving a level set function. A signed distance function has the property that absolute value at each pixel is the minimum distance to the zero level set, C. the sign at each pixel depends on which region that pixel belongs to [13,12]. If the pixel belongs to R- , the sign is negative, and if the pixel is belongs to R+, the sign is positive.

Velocity Extension- Energy minimization [8, 9, 12]
Samples of extension constructions which are using in energy minimization in level set methods is as shown in Figure 2.

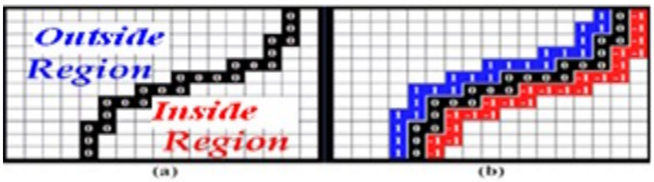

Fig. 2- Established distance map by using extension construction to the contour of the shape a) contour of shape b) dilation operation (extension construction).

Stepwise design- implementation for Localized Segmentation
Stepwise implementation and execution Localized Segmentation procedure is shown in Figure.3 Localized Segmentation is one of the methods used in hard segmentation procedure. In this procedure image domain is divided into two parts: foreground and background image information. Complete procedure for image segmentation using hard segmentation method is dividing in two steps. Step 1: Image preprocessing Step 2: Image computation for segmentation

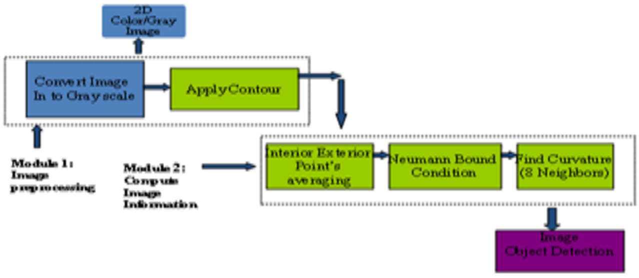

Fig. 3- Module Architecture Diagram for Segmentation using Localized Segmentation

Step 1: Image preprocessing
Input Image: color or gray scale input image converted into 8-bit grayscale image information. Same information is described into 3x3 matrixes.
Image Preprocessing: input image computed according to color or grayscale input. Gaussian filter is used with some specified threshold parameter for smoothing the image intensity levels in image domain. After image preprocessing apply a mask on image. Mask having initial position in x-y co-ordinates of image statistical information samples. Define mask with white intensity value, to make easy in computation of background and foreground image pixels information. With predefined image pixels intensity level in foreground values of given mask it become useful to compute image segments in specified area of mask. Mask could be a bound in finding image segments into image. This is one of the drawbacks of hard segmentation method. To avoid drawback of finding segments and detecting objects in image, using kernel method for computing image segmentation is semi-supervised method.

Step 2: Image computation for segmentation
Interior and exterior image information: image preprocessing is initial important method for computing complete information of image. The boundaries of applied mask for background and foreground information of pixels define the interior and exterior pixel into image. In object detection using segmentation method need to

compute averaging of interior and exterior pixels needed. This is nothing but complete details of image. Pixels indexing into x-y co-ordinates computed using eight-neighbor method of image pixels positions. According to need of finding image segments it need to computes four diagonal co-ordinates of pixel.

Curvature and Neumann bound condition

Curve shape in image segmentation is computed using center derivation of eight-neighbor pixels. In image segmentation convergence condition is used as a Neumann bound with threshold factor. Which apply boundary conditions for getting desired objects segmentation find out appropriate segments in image

Algorithm 2: Level set evolution (Soft Segmentation method)

Stepwise implementation and execution procedure is shown in Figure 4. As shown in block diagram. Level set evolution is one of the methods used in Soft segmentation [1] procedure. In this procedure image domain is divided on the basis of region separation.

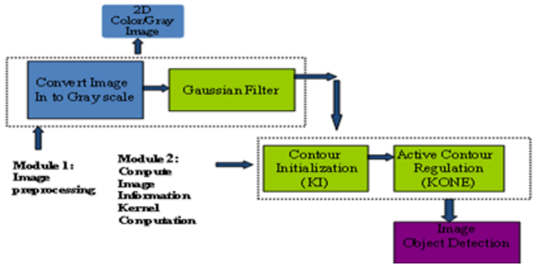

Fig. 4- Module Architecture Diagram for Segmentation using Level Set Evolution

Stepwise design - implementation for Level set Evolution

Complete procedure for image segmentation using soft segmentation method is dividing in two steps. Step 1: Image preprocessing Step 2: Image computation for segmentation

Step 1- Image preprocessing

Input Image: color or gray scale input image converted into 8-bit grayscale image information. Same information is described into 3x3 matrixes.

Image Preprocessing: input image computed according to color or grayscale input. That input image need to convert into gray scale image if image is color. Gray scale is efficient to compute intensity homogeneity and inhomogenity of image pixels. Gaussian filter apply to gray scale image for maintains image pixel intensity smoothness [5]. Gaussian filter is used makeup intensity value into image. Smoothing factors multiply to total image pixels and avoid drastic change in intensity value of pixels.

Step 2- After image preprocessing method kernel method applies to Gaussian filtered image result and initialized the initial contour position for further evolution in active contour method. This initial contour is called as a zero level set method. Once zero level set contours is initializes, time space is apply to the Neumann bound convergence and compute geometric coordinates into image [6,13]. Centralized derivation method and curvature has to implement to find out segments of abrupt homogeneous intensity value into image.

The above procedure is denoted as KI in implementing step. Evaluate the active contour in image domain with time-space interval. In this method segments are going to find into inside and outside of the contour position. Kernel density estimation (KDE) is implemented to regulate the active contour method until convergence in segmentation. Kernel method execute in several iterations with convolution process. By convoluting image regions created into images. Each segment in image has been defined with color outline. Changes in pixel intensity indicate different segments into image. Complete process need to compute in all iteration of kernel method and for each pixel in image itself.

Active contour method using level set function is unsupervised process for finding segmentation and object detection in image. Heaviside function is used to regulate active contour with time space and evolutes segments. Heaviside function and Neumann bound constrain is convergence for image segmentation. Every step in kernel and centralized derivation with curvature computation is timely computed. Overall block diagram is important steps in active contour image segmentation and object detection [10], propose a new region-based active contour model in a variation level set formulation, define a region- scalable fitting (RSF) energy functional in terms of a contour and two fitting functions that locally approximate the image intensities on the two sides of the contour. The optimal fitting functions are shown to be the averages of local intensities on the two sides of the contour. Region scalability of the RSF energy is due to the kernel function with a scale parameter, which allows the use of intensity information in region at a controllable scale, from small neighborhoods to entire domain [3, 13]. This energy is then incorporated into a variation level set formulation with a level set regularization term. In the resulting curve evolution that minimizes the associated energy functional, intensity information in local regions at a certain scale used to compute the two fitting function and thus, guide the motion of the contour toward the boundaries. As a result, the proposed model can be used to segment images with intensity in homogeneity. Due to level set regularization term in the proposed level set formulation, the regularity of the level set function is intrinsically preserved to ensure accurate computation for level set evolution and final results. And avoid expensive reinitialization procedures.

Experimental result

Fig. 5- Binary segmentation masks applied on Image Bob Experimental result after applying Localized Segmentation

1)Result by applying binary segmentation mask (Localized Segmentation) Localized Segmentation prefers Binary segmentation mask used to regulate the active region method. As shown in fig. 5.

2) Result by after applying Level set Evolution

In the regulation process of level set function several iteration take place after several iteration shown in outcome snapshot in Fig.6

Fig. 6- Experimental results: Level set Evolution Level set regulation after 150 iterations

Effect of parameter tuning on Accuracy of Image Object Segmentation

Parameter are traditionally adjusted through a trial-and-error process and used with little or no justification [2], they are sensitive to the tuning of the parameters in the energy expression, can perform very well with suitable parameter settings, but otherwise may be unstable. Windows Showing Effect on percentage of accuracy using Localized Segmentation on image as shown in Fig.7.

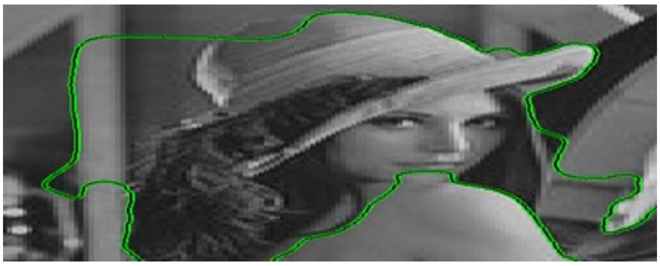

Fig. 7- Window showing effect on percentage of accuracy using Localized Segmentation with No. of iteration 500, α=0.6 and ρ=32

Result analysis for Algorithm 1- (Localized Segmentation)

The distance regularization term is defined with a potential function such that it forces the gradient magnitude of the level set function to one of its minimum points, thereby maintaining a desired shape, particularly a signed distance profile. In particular, provide a double-well potential for the distance regularization term, evolution is derived as a gradient flow that minimizes this energy functional. Here localized segmentation Method is applied image as shown in Fig. 7. As α value increases percentage of accuracy is also increasing. If Number of iteration=50, α=0 and ρ =32, 40 % accuracy is getting, while if α =100 contour remains as it is in position of zero level contour Where , No of iteration is number of Maximum iterations to run segmentation , Alpha is (optional) Weight of smoothing term higher value = smoother and default value is = 0.2 and ρ is precision value it's analysis is shown in Table-1 and plot is as Figure 8.

Table 1- Effect of No of Iteration and Alfa (α) on accuracy of object detection

No of iteration	Alfa (α)	Precision value ((ρ)	Percentage of accuracy (%)
100	0.2	32	30
100	0.2	32	30
200	0.3	32	40
300	0.4	32	60
400	0.3	32	50
400	0.6	32	50
500	0.6	32	70
600	0.2	32	80

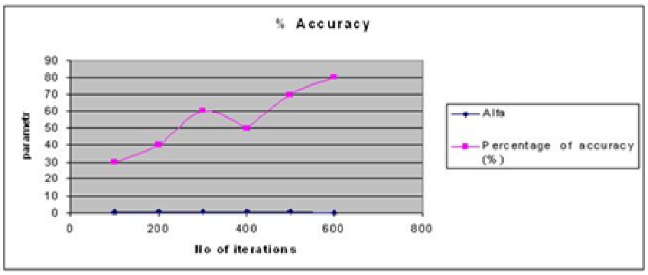

Fig. 8- Plot using Localized Segmentation for Effect of No of Iteration and Alfa (α) on accuracy of object detection

Image Object Segmentation Results without Reinitialization Using Level set Evolution

Level set methods have been widely used in image processing. In conventional level set formulations, the level set function typically develops irregularities during its evolution, which may cause numerical errors and eventually destroy the stability of the evolution. Therefore, a numerical remedy, called reinitialization, is typically applied to periodically replace the degraded level set function with a signed distance function. However, the practice of reinitialization not only raises serious problems as when and how it should be performed, but also affects numerical accuracy in an undesirable way regularity of the level set function is intrinsically maintained during the level set evolution Windows Showing Effect on percentage of accuracy using Level set Evolution Segmentation on image shown in Figure 9

Fig. 9- Window showing effect on percentage of accuracy using Level Set Evolution with No. of iteration 100, μ=0.04 and λ=1, σ=1.5, ε=1.5, α=1.5.

Result analysis for Algorithm 2- (Level Set Evolution)

Parameters, λ, μ, α time step is used for implementation. The model is not sensitive to the choice of and μ, which can be fixed for most of applications. Here Level set Method is applied on image as shown in Figure 9. Accuracy is depending on Mu (μ) and Iteration, but if Mu (μ) increasing and Number of iteration putting constant then accuracy is also going to increase. As μ=0, λ=5, σ=1.5, ε=1.5, α=1.5 Where, lambda, mu (u), Alfa, epsilon, delta, num of Iteration updates the level set function. If Number of iteration=50, contour is not evaluating, while if μ=100 contour remains as it is in position of zero level contour it's analysis is shown in Table-2 and plot is as Figure 10.

Table 2- Effect of Iteration and Mu (μ) on accuracy of Object Detection

No of Iteration	Mu (μ)	Lambda (λ)	Sigma (σ)	ε	Alfa (α)	Accuracy in Percentage (%)
100	0.01	5	1.5	1.5	1.5	70
200	0.02	5	1.5	1.5	1.5	80
600	0.05	5	1.5	1.5	1.5	85
200	0.07	5	1.5	1.5	1.5	70
700	0.07	5	1.5	1.5	1.5	85

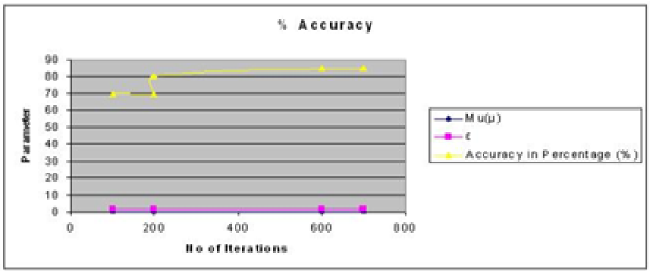

Fig. 10- Plot using Level set Evolution for Effect of Iteration and Mu (µ) on accuracy of object detection

Acknowledgement

The proposed model is able to segment images with in homogeneity, and had desirable performance for image with weak object boundaries. in the proposed experimental work active region based segments with and without heaviside function and regualrization is computed. Without heaviside function of regularization is not effective in region based segmentation. It has limits as per we are applying binary mask in that procedure.

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