Volume 3, Issue 2, February 2013 ISSN: 2277 128X
International Journal of Advanced Research in Computer Science and Software Engineering
Research Paper
Available online at: www.ijarcsse.com

A Study of Automatic Image Segmentation Methods

Gurjeet kaur Seerha
M.Tech Student
Department of Computer Science and Engineering
Sri Guru Granth Sahib World University
Fatehgarh Sahib, Punjab, India

Rajneet Kaur
Assistant Professor
Department of Computer Science and Engineering
Sri Guru Granth Sahib World University
Fatehgarh Sahib, Punjab, India

Abstract - Image segmentation is an initial and vital step in a series of processes and aimed at overall image understanding. In recent years, automatic image segmentation has become a prominent objective in image analysis and a computer vision. The work presented in this letter focus on study of recent automatic image segmentation algorithms.

***Keywords*: segmentation, threshold, region merging, level set, Fuzzy.**

I. INTRODUCTION

Image segmentation is a classic inverse problem which consists of achieving a compact region-based description of the image scene by decomposing it into meaningful or spatially coherent regions sharing similar attributes. This low-level vision task is often the preliminary (and also crucial) step in many video and computer vision applications, such as object localization or recognition, data compression, tracking, image retrieval, or understanding.[3] Segmentation is typically coupled with pattern recognition problems. It can be considered the first phase of a pattern recognition process and is sometimes also referred to as object isolation. Segmentation is a challenging task for a poor or low contrast image that results in diffusing tissue boundaries. This task involves incorporating as much prior information as possible e.g. texture, shape etc. [5]Application of image segmentation consists of airport security system, object recognition, criminal investigation, computer graphics, medical imaging, MPEG-4 video object (VO) segmentation, satellite images (roads, forests, etc.) [6].Different Segmentation Techniques or algorithms have been proposed in the literature. Selection of a particular technique or algorithm over another is based on the image type and nature of the problem.
Remainder of this letter is organized as below; Section II describes study of automatic segmentation algorithms Section III concludes the study.

II. AUTOMATIC IMAGE SEGMENTATION METHODS

Automatic image segmentation can be applied in object recognition, image compression, image editing, image searching and other tasks of machine vision. In industry and daily life, the applications of image segmentation lie in different aspects suchas disease diagnosis, including localization of tumors and other pathologies, measuring tissue volumes, and computer-guided surgery, etc. In remote sensing interpretation image segmentation is being used to locate objects in satellite images (roads, forests, etc.). In order to maintain security, face recognition fingerprint recognition technique can be helpful.On the other hand, traffic control systems, such as brake light detection, is anotherapplication of automatic image segmentation in practice. Some recently proposed methods are as follows:

A. Dynamic region merging

Classical category of segmentation algorithms is based on the similarities among the pixels within a region, termed as region based algorithms. Bo peng *et al.* [2] provides an automatic image segmentation method in a region merging style for its merit of efficiency, where similar regions are iteratively merged according to a novel merging predicate. With an initially over segmentedimage, in which super pixels with homogeneous color are detected and segmentation is done by iteratively merging regions according to defined predicate.

*1)Region merging predicate:*Predicate is based on measuring the dissimilarity between pixels along the boundary of two regions. Definition of region adjacency graph (RAG) is used to represent an image. Consider G= (V,E) be an undirected graph ,where $v_i \in$ V is a set of nodes corresponding to image elements .E is edge $(v_i, v_j) \in$ E having corresponding weights
$w((v_i, v_j))$ to measure the dissimilarity of the two nodes connected by that edge. Region is represented by $(R \subseteq V)$ .Dissimilarity between two regions R_1 and $R_2 \subseteq V$ is defined as the minimum weight edge connecting them i.e
$S(R_1, R_2) = min_{v_i \in R_1, v_j \in R_2, (v_i, v_j) \in E}\ w((v_i, v_j))$.(1)

Merging predicate involves two aspects: a dissimilarity measure used to determine the candidate region for merging and the consistency property which checks if the regions are homogeneous. Merging predicate is defined as follows:

$$P(R_1, R_2) = \begin{cases} true\ if\ (a)\ S(R_1, R_2) = min_{R_i \in \Omega_1} S(R_1, R_i) = min_{R_j \in \Omega_2} S(R_2, R_j);\ and \\ \quad (b) R_1\ and\ R_2\ are\ consistent \\ False\ Otherwise \end{cases} \quad (2)$$

2)Consistency test: Predicate P defined in (2) checks the consistency of regions in order to obtain the homogeneous regions .region consistency is defined as a sequential test process. Region information is gathered by the cues extracted from the image like intensity, color, texture etc. parameter θ is related to the distribution of random cues x.Two hypothesis are considered in the task evaluation: a pair of regions is consistent denoted by null hypothesisH_0 :$\theta = \theta_0$ and inconsistent denoted by alternative hypothesis $H_1 = \theta = \theta_1$.Application of Sequential probability ratio test (SPRT) to the consistency test of cues is described as follows:

Observer the distribution of random cues x until a likelihood ratio δ goes out of the interval (B,A) for the first time by a random walk,where Aand B are real numbers and satisfy B < 0 < A

And successive likelihood ratio δ_i is defined as:

$$\delta_i = \log \frac{P_0(x_i|\theta_0)}{P_1(x_i|\theta_1)}, \ i=1, 2.......N \quad (3)$$

Where $P_0(x|\theta_0)$ and $P_1(x|\theta_1)$ are the distributions of cues. Gaussian distribution model is used to approximate the cue distribution. Two conditional probabilities are given as follows:

$$\begin{cases} P_0(x|\theta_0) = \lambda_1 \exp(-(I_b - I_{a+b})^T S_I^{-1} (I_b - I_{a+b})) \\ P_1(x|\theta_1) = 1 - \lambda_2 \exp(-(I_b - I_a)^T S_I^{-1} (I_b - I_a)) \end{cases} \quad (4)$$

Where I_a and I_b are the average color of sampled data in regions a andb,I_{a+b} is the average value of the sample union. S_IIs the covariance matrix of the regions andλ_1 ,λ_2 are the scalar parameters.

$p_0 = E\{\delta|\theta_0\}Andp_1 = E\{\delta|\theta_1\}$ where p_0 and p_1 are the conditionally expected number of trails from single test.

ALGORITHM 1: CONSISTENCY TEST

- Set the following values:
- Preset λ_1:
- Let λ_2= 1,α=0.05,β=0.05;
- N_0: be a constant greater then $\max\{E\{\delta|\theta_0\}, E\{\delta|\theta_1\}\}$, A=log$\frac{1-\beta}{\alpha}$, B=log$\beta(1-\alpha)$;
- Calculate value of $P_0(x|\theta_0)$,$P_1(x|\theta_1)$ using equation (4).
- Input: a pair of neighboring regions.

1. Set evidence accumulator δ and trails counter n to be 0.
2. Randomly choose m pixels in each of the pair of regions, where m equals the hale size of the region.
3. Calculate the distribution of visual cues x using Eq. (4) based on these pixels.
4. Update the evidence accumulatorδ.
5. If $n \le N_0$,
   If$\ge A$, consistent
   If $\le B$, inconsistent
   If $n > N_0$
   If≥ 0 , consistent
   If $\delta < 0$, inconsistent
6. Go back to step 2.

ALGORITHM 2: SEGMENTATION BY DYNAMIC REGION MERGING:

1. Set $i = 0$
2. For each region in segmentationS_i, use algorithm 1 for predicate P with respect to its neighboring regions.
3. Merge regions whose predicate P is true, such that segmentation S_{i+1} is constructed.
4. Go back to step 2 until S_{i+1}=S_i
5. Return S_i

B. Fuzzy algorithm

Among the clustering formulations based on minimizing formal objective functions, the most widely used and studied is the K-means(KM) clustering.KM is an exclusive clustering algorithm i.e data which belongs to a definite cluster could not be included in another cluster. Although it is the most favorable technique, it does have some weaknesses

1. It is dependent on initialization.
2. It is sensitive to outliers and skewed distributions.
3. It may converge to a local minimum.
4. It may miss a small cluster.

As a result, it may lead to poor or wrong representation of data. There are several clustering algorithms proposed to overcome the above mentioned weaknesses. Fuzzy C-means (FCM) an overlapping clustering that employs yet another

fuzzy concept, allows each data belong to two or more clusters at different degrees of memberships [4].
E.A.Zanaty *et al*. presents automatic fuzzy algorithms with considering some spatial constraints on the objective function. The algorithms incorporate spatial information into the membership function and the validity procedure for clustering. Consider intra-cluster distance measure, which is simply the median distance between a point and its cluster center. The number of the cluster increases automatically according the value of intra-cluster, for example when a cluster is obtained, it uses this cluster to evaluate intracluster of the next cluster as input to the fuzzy method and so on, stop only when intra-cluster is smaller than a prescribe value.

C. Relay Level set method:

The level set function is defined as the closest distance between the pixels and a given closed curve in an image domain, and the distances of points inside the curve are assigned positive and are negative outside[7].it evolves according to partial differential equation[1] which sometimes can be derived from an energy function[4].
Level set method implicitly represents the planar closed curve C by the zero level set of the function $\phi(x,y,t)$, i.e $C(t) = \{(x,y)|\phi(x,y,t) = 0\}\phi$. In traditional level set methods, the general form of the evolution equation [7] can be written as:

$$\frac{\partial \phi}{\partial t} + F|\nabla\emptyset| = 0$$

Where $\emptyset$a level is set function and F denotes the velocity of the evolution .For image segmentation, F is the external force depending on the image information, e.g. pixel values and image gradient .This external force F [8] drives curves toward the boundaries of objects. F can be generally written as:

$$F = S(x,y)(F_A + F_G)$$

Where $S(x,y)$ known as the stop criterion is the multiplier of velocity and provides a stop criterion for the evaluation of level set function. The item F_A is an advection term independent of the geometrical features of a curve, and it makes F equal zero only when $S(x,y)$zero .The item isF_G is a force to smooth the curve. It is a geometrical constraint for the evolving curve, and it is often defined as the mean curvature of curve.
Xinbo Gao *et al*. provides a new level set method in which an edge based level set method is executed in a relay fashion until the area of the subregion equals zero.to make it works automatically, new subregions are created according to the boundaries detected in previous regionsand new level set functions are initialized by shifting the previous ones.

III. CONCLUSION

In this study, the overview of various segmentation methodologies applied for digital image processing is explain briefly and discuss main image segmentationalgorithms. Image segmentation has a promising future as the universal segmentation algorithm and has become the focus of contemporary research. In spite of several decades of research up to now to the knowledge of authors, there is no universally accepted method for image segmentation, as the result of image segmentation is affected by lots of factors, such as: homogeneity of images, spatial characteristics of the image continuity, texture, image content. The study also reviews the research on various automatic research methodologies applied for image segmentation and various research issues in this field of study. This study aims to provide a simple guide to the researcher for those carried out their research study in the image segmentation.

REFERENCES

[1] G.Sapiro,*Geometric partial differential Equations and Image Analysis*. Cambridge, U.K.: Cambridge Univ. Press, 2001, Ch. 2.
[2] Bo Peng, Lei Zhang , David Zhang, “Automatic Image Segmentation by Dynamic Region Merging”, *IEEE Transactions on imageprocessing*,Vol.20, No. 12 December 2011.
[3] Max Mignotte, “Segmentation by Fusion of Histogram-Based K-Means Clusters in Different Color Spaces”, *IEEE TRANSACTIONS ON IMAGE PROCESSING*, VOL. 17, NO. 5, MAY 2008.
[4] Siti Noraini Sulaiman and Nor Ashidi Mat Isa, “Adaptive Fuzzy-K-means Clustering Algorithm for Image Segmentation” 2010 IEEE.
[5] Dhirendra Pal Singh *et al.* , “Automatic Image Segmentation using Threshold Based Parameter and Genetic Algorithm” , *International Journal of Research and Reviews in Computer Science* , Vol. 3, No. 3, June 2012.
[6] Rajesh Dass, Priyanka, Swapna Devi, “Image Segmentation Techniques”, *IJECT* Vol.3, Issue 1, Jan-March 2012.
[7] S.Osher *et al*., “Fronts propagating with curvature-dependent speed: Algorithms based on Hamilton-Jacobi formulation”,*J.Comput. Phys.*, vol. 79, no. 1, pp.12-49, Nov.1988.
[8] J.A. Sethian, Level Set Methods and Fast Marching Methods. Cambridge, U.K.: Cambridge Univ.Press, 1999, Ch. 2.

