Research Paper

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A study on Image Segmentation and its methods

Computer Science

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Dr.Chandrashekar.M.B Guest Lecturer, Department of Commerce, Gulbarga University Gulbarga, Gulbarga. Karnataka, India

ABSTRACT

In the world of Digital Image Processing(DIP) image segmentation playing a vital role in processing of the images. It has got its own significant features where we can extract the point of interest from the images. image segmentation is the process of partitioning a digital image into multiple segments (sets of pixels, also known as super pixels). The goal of segmentation is to simplify and/or change the representation of an image into something that is more meaningful and easier to analyze.[1] Image segmentation is typically used to locate objects and boundaries (lines, curves, etc.) in images(1). By using a various methods and types of segmentation we can achieve numerous tasks in application like (Machine Vision, Medical Imaging, object detection and etc.)

Introduction:

Image segmentation refers to a process of dividing theimage into disjoint regions that are meaningful. Thisprocess is fundamental in computer vision in that manyapplications, such as image retrieval, visual summary, andimage based modeling can benefit from it. This process is alsochallenging because segmentation is usually subjective andcomputation is highly costly. Image is simply a collection ofpixels. It is quite difficult to extract the knowledge (the high level information) directly from the low-level pixel collection.properties as well as local spatial relationships, and results in aregion map that is ready for further processing, e.g. regionmerging or labeling.

Itis an old research topic, which started around 1970, but there is still no robust solutiontoward it. There are two main reasons, the first is that the content variety of images istoo large, and the second one is that there is no benchmark standard to judge theperformance. For example, in figure 1.1, we show an original image and twosegmented images based on different kinds of image segmentation methods. The oneof figure 1.1 (b) separates the sky into several parts while the figure 1.1 (c) missessome detail in the original image. Every technique has its own advantages alsodisadvantages, so it's hard to tell which one is better[(2)].



Fig 1.1(a) is the original image.

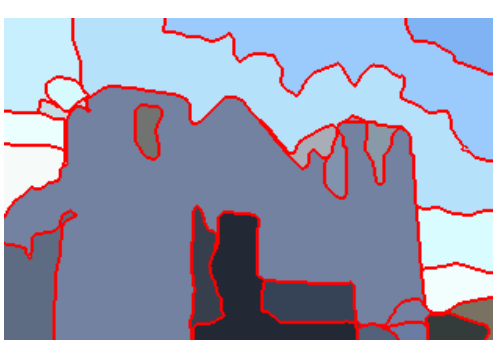

Fig 1.1(b) is the segmentation result based

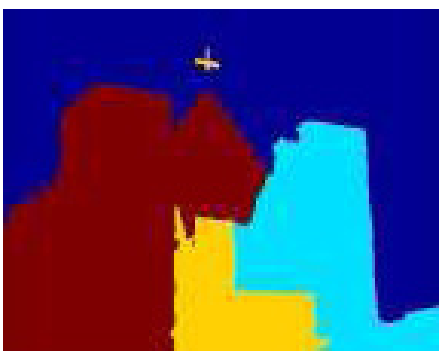

Fig 1.1(c) is the result from previous image

There are tons of previous works about image segmentation, great survey resources could be found in [3, 4, 5].

Methods: From these surveys, we could simply separate the imagesegmentation techniques into three different classes (1) **feature-space based** method,(2) **image-domain based method**, and (3) **edge-based method**. The feature-spacebased method is composed of two steps, feature extraction and clustering. Featureextraction is the process to find some characteristics of each pixel or of the regionaround each pixel, for example, pixel value, pixel color component, windowedaverage pixel value, windowed variance, Law's filter feature, Tamura feature, andGabor wavelet feature, etc.. After we get some symbolic properties around each pixel,clustering process is executed to separate the image into several "meaningful" partsbased on these properties. This is just like what we have tried from DIP homework 4,where we used Law's feature combined with K-means clustering algorithm. There arealso many kinds of clustering algorithms, for example, Gaussian mixture model, meanshift, and the one of our project, "normalized cut".

Image-domain based method goes through the image and finds the boundary between segments by some rules. The main consideration to separate two pixels into different segments is the pixel valuedifference, so this kind of methods couldn't dealwith textures very well. Split and merge, region growing, and watershed are the mostpopular methods in this class. The third class is edge-based image segmentationmethod, which consists of edge detection and edge linking(2). There are another few methods are also reported towards the image segmentation. Those are

1. Clustering methods
2. Compression-based methods
3. Histogram-based methods.
4. Region-growing methods.
5. Partial differential equation-based methods.
6. Graph partitioning methods.

The clustering methods using the K-means algorithm is an iterative technique that is used to partition an image into K clusters. Compression based methods postulate that the optimal segmentation is the one that minimizes, over all possible segmentations, the coding length of the data.The connection between these two concepts is that segmentation tries to find patterns in an image and any regularity in the image can be used to compress it. The method describes each segment by its texture and boundary shape. Histogram-based methods are very efficient when compared to other image segmentation methods because they typically require only one pass through the pixels. In this technique, a histogram is computed from all of the pixels in the image, and the peaks and valleys in the histogram are used to locate the clusters in the image. Color or intensity can be used as the measure. A refinement of this technique is to recursively apply the histogram-seeking method to clusters in the image in order to divide them into smaller clusters. This is repeated with smaller and smaller clusters until no more clusters are formed.The first region-growing method was the seeded region growing method. This method takes a set of seeds as input along with the image. The seeds mark each of the objects to be segmented. The regions are iteratively grown by comparing all unallocated neighboring pixels to the regions. The difference between a pixel's intensity value and the region's mean, δ, is used as a measure of similarity. The pixel with the smallest difference measured this way is allocated to the respective region. This process continues until all pixels are allocated to a region. Split-and-merge segmentation is based on a quadtree partition of an image. It is sometimes called quadtree segmentation. This method starts at the root of the tree that represents the whole image. If it is found non-uniform (not homogeneous), then it is split into four son-squares (the splitting process), and so on so forth. Conversely, if four son-squares are homogeneous, they can be merged as several connected components (the merging process). The node in the tree is a segmented node. This process continues recursively until no further splits or merges are possible. When a special data structure is involved in the implementation of the algorithm of the method, its time complexity can reach$O(n \log n)$, an optimal algorithm of the method.Partial differential equation (PDE)-based method and solving the PDE equation by a numerical scheme, one can segment the image. Curve propagation is a popular technique in this category, with numerous applications to object extraction, object tracking, stereo reconstruction, etc. The central idea is to evolve an initial curve towards the lowest potential of a cost function, where its definition reflects the task to be addressed. As for most inverse problems, the minimization of the cost functional is non-trivial and imposes certain smoothness constraints on the solution, which in the present case can be expressed as geometrical constraints on the evolving curve. Graph partitioning methods can effectively be used for image segmentation. In these methods, the image is modeled as a weighted, undirected graph. Usually a pixel or a group of pixels are associated with nodes and edge weights define the (dis)similarity between the neighborhood pixels. The graph (image) is then partitioned according to a criterion designed to model "good" clusters. Each partition of the nodes (pixels) output from these algorithms are considered an object segment in the image. Some popular algorithms of this category are normalized cuts, random walker, minimum cut, isoperimetric partitioning and minimum spanning tree-based segmentation (1).

Applications:

Some of the practical applications of image segmentation are:

- Content-based image retrieval
- Machine vision
- Medical imaging
  - Locate tumors and other pathologies
  - Measure tissue volumes
  - Diagnosis, study of anatomical structure
- Object detection
  - Pedestrian detection
  - Face detection
  - Brake light detection
  - Locate objects in satellite images (roads, forests, crops, etc.)
- Recognition Tasks
  - Face recognition
  - Fingerprint recognition
  - Iris recognition
- Traffic control systems
- Video surveillance.

Conclusion:

From this paper researcher can find the methods to make an image segmentation in various field of research which are listed and given the detailed information also.

REFERENCE

1. www.wikipedia.com/ Image segmentation | 2. Yu-Ning Liu, Chung-Han Huang, Wei-Lun Chao, " DIP: Final project report Image segmentation based on the normalized cut framework". | [3] W. K. Pratt, "Image Segmentation," in Digital image processing, 4nd ed. Wiley, 2008, pp. 579-622. | [4] L. Lucchese, S. Mitra, Color image segmentation: a state-of-the-art survey, in: Proceedings of the Indian National Science Academy, 2001. 2, 10. | [4] C. Pantofaru, M. Hebert, A comparison of image segmentation algorithms, Tech. Rep. CMU-RI-TR-05-40, CMU (2005). 2, 14. | [5] E. Sharon, M. Galun, D. Sharon, R. Basri, and A. Brandt, "Hierarchy and adaptivity in segmenting visual scenes," Nature, vol. 442, no. 7104, pp. 810–813, 2006. | [6] F. Sun, J. He, "The Remote-Sensing Image Segmentation Using Textons In The Normalized Cuts Framework," Proceedings ofthe 2009 IEEE International Conference on Mechatronics and Automation, August 9 - 12, Changchun, China. | [7] Allen Y. Yang, John Wright, Yi Ma, and Shankar Sastry. Unsupervised segmentation of natural images via lossy data compression. CVIU 2007 . | [8] F. Sun, J. He, " A Normalized Cuts Based Image Segmentation Method," 2009 Second International Conference on Information and Computing Science | [9] Shi. J, and Malik. J, "Normalized cuts and image segmentation", IEEE Transactions on Pattern Analysis and Machine Intelligence, IEEE Computer Society, vol.22(8), 2000, pp.888-905. | [10] Jitendra Malik, Serge Belongie, and Thomas Leung, "Contour and texture analysisfor image segmentation", International Journal of Computer Vision, KluwerAcademic Publishers, vol.43(1), 2001, pp.7-27. | [11] Julesz. B, "Textons, the elements of texture perception, and their interactions". Nature, vol.290(5802), 1981, pp.91-97