International Journal of Science and Research (IJSR)
ISSN (Online): 2319-7064
Index Copernicus Value (2013): 6.14 | Impact Factor (2015): 6.391

A Study Analysis on Various Image Segmentation Techniques and Concerns with Distinct Images

M. Kalpana Devi[1], S. Divya Meena[2]

[1, 2]Assistant Professor, Department of Computer Science and Engineering, Jansons Institute of Technology, Karumathampatti, Coimbatore - 641 659

Abstract: ***Image processing involves changing the nature of an image, in order to either improve its pictorial information for human interpretation or render it to a more suitable form for autonomous machine perception. Image segmentation refers to the operation of partitioning an image into component parts or into separate objects. Physical segmentation of an image is not only a tiresome and time consuming process, but also not exceptionally accurate particularly with the increasing imaging modalities and uncontrollable quantity of images that need to be observed. Therefore it becomes essential to examine current methodologies of image segmentation using computerized algorithms that are precise and entail as little user interaction as probable in particular for images. A number of algorithms have been proposed due to the importance of image segmentation. This paper presents a brief outline on some of the most common segmentation techniques like Region based; Edge based, Thresholding based and color based mentioning its advantages as well as the drawbacks.***

Keywords: Region based, Histogram based, Region Transformation based, Edge detection, Thresholding, Color based Segmentations.

1. Introduction

In computer vision, 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 analyse. Image segmentation is typically used to locate objects and boundaries (lines, curves, etc.) in images. More precisely, image segmentation is the process of assigning a label to every pixel in an image such that pixels with the same label share certain characteristics. The result of image segmentation is a set of segments that collectively cover the entire image, or a set of contours extracted from the image. Each of the pixels in a region is similar with respect to some characteristic or computed property, such as color, intensity, or texture. Adjacent regions are significantly different with respect to the same characteristic. The goal of image segmentation is to cluster pixels into salient image regions, i.e., regions corresponding to individual surfaces, objects, or natural parts of objects.

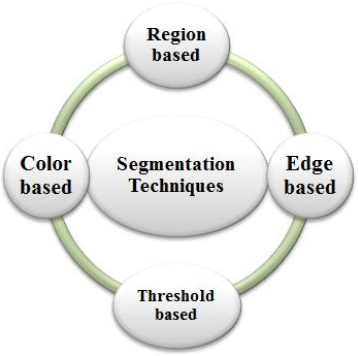

Figure 1: Segmentation Techniques

2. Threshold Based Segmentation

The segmentation of images by using thresholding is a very powerful technique used to segment foreground or an object from a specific background. This technique depends on the characteristics of an image. The foreground is lighter than the background for proper detection or vice versa. The separation of the objects from the background is generally done by selecting a value T which is known as the thresholding value according to the thresholding algorithm. Two categories of threshold based segmentation are "Set level and multilevel threshold using Otsu's method".

Following are the steps to perform threshold based segmentation;

1) Segment Image Into Two Regions
2) Segment Image into Three Levels Using Two Thresholds
3) Compare Thresholding Entire Image Versus Plane-by-Plane Thresholding
4) Check Results Using the Metric Output Argument

Figure 2: Set level threshold

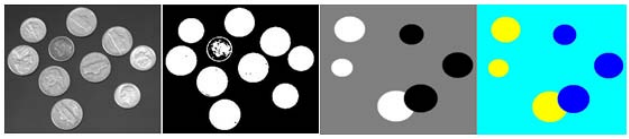

Figure 3: Multilevel threshold using Otsu's method

3. Edge Based Segmentation

Edge detection is used to identify the edges in an image. The most powerful edge-detection method is the canny method. The Canny method differs from the other edge-detection methods in that it uses two different thresholds (to detect strong and weak edges), and includes the weak edges in the output only if they are connected to strong edges. There are

three categories of edge detection and they are Sobel method, canny method and Fuzzy logic method.

1) Sobel and Canny Method

The Sobel and canny methods are more efficient, in that they are less likely to be fooled by noise, and more likely to smoothen the edges.Following are the steps to detect edges of an image using Sobel and canny method;

a) Start by reading the Image.
b) Detect the individual objects in the image.
c) Dilate the image
d) Fill interior gaps
e) Remove objects connected to the segmented object, on the border
f) Smoothen the object, in order to make the segmented object look natural.

2) Fuzzy Logic Method

The fuzzy logic approach for image processing allows you to use membership functions to define the degree to which a pixel belongs to an edge or a uniform region. Following are the steps to detect edges of an image using Fuzzy logic based image segmentation method;

a) Import a RGB image and convert it to Grayscale
b) Convert image to double-precision data
c) Obtain image gradient
d) Define Fuzzy Inference System (FIS) for edge detection
e) Specify FIS rulesfor edge detection
f) Evaluate FIS and plot results

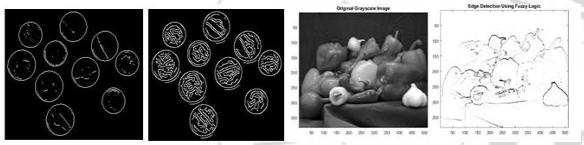

Figure 4: Sobel, Canny, Fuzzy logic method

4. Region Based Segmentation

Region based methods are based on continuity. In this technique, the entire image is divided into sub regions depending on some rules like all the pixels in one region must have the same gray level. The thresholding technique is bound with region based segmentation. The area that is discovered for segmentation should be closed. It is also known as "Similarity Based Segmentation". Two major types of region based segmentation are Region transformation based and Histogram based.

1) Histogram based

Histogram consists of its gray level i.e., it is a graph indicating the number of times each gray level occurs in the image. The main idea is to individually select each specific histogram mode, and then select the corresponding area by thresholding. The following steps are used in histogram based segmentation.

a) Extraction of a specific mode of the histogram
b) Detection of the corresponding area by thresholding
c) Among the different area in the mode, select the biggest connected region from high level tools (by using mathematical morphology)
d) Apply this scheme for each histogram mode

Figure 5: Mathematical morphology

The first image is the original image. Second image represents the selection of pixel mode, followed by the region erosion in third image. Fourth image represents the filling of holes and the final image, the region closing. All these five steps are represented as mathematical morphology. The following chart is the histogram for the image considered.

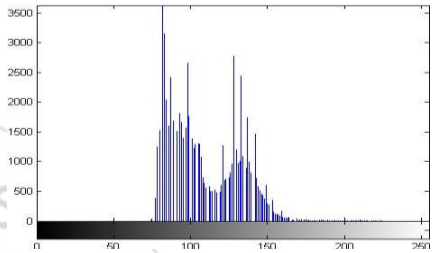

Figure 6: Histogram for the original image

2) Region transformation

In region transformation, step that consists of splitting an image into subsets R_i called regions. There are three main groups in region transformation and they are Region growing method, Splitting region method (quad tree) and Adjacency graph method.

Figure 7: Original and region transformed image

3) Region growing method

In region growing method, the first step is the initialization of a region R0 with one or more pixels. Then, we perform Clustering to R0 of all the neighbouring pixels which verify a specific assumption. Finally, iteration continues until image converges.

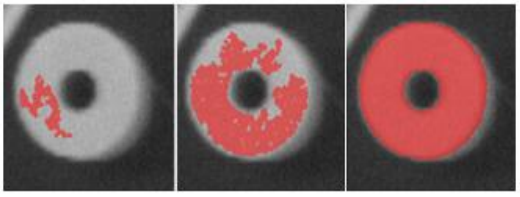

Figure 8: Region growing method

4) Splitting region method (quad-tree)

In this method, an image is split into a set of regions that verifies a specific assumption. Initially, Start from the whole image, called R. Then, apply several splitting δ which creates new sub-regions R_i δ. For each R_i, test the assumption P and

keep the best sub-region δ, i.e., the one where each sub-region verifies P and the one where there are the more sub-regions that verify P. Each sub-region that does not verify P becomes a new region R that can be processed as above.

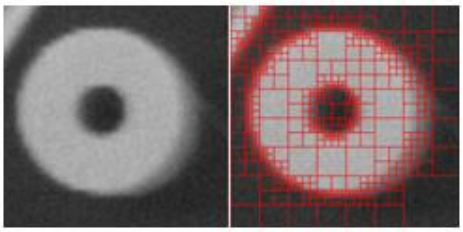

Figure 9: Splitting region method

5) Adjacency graph method

It expresses the result obtained from a segmentation procedure into a graph structure and then exploits the graph properties in order to perform merging steps. From an initial segmentation, in an adjacency graph, region is a node and an arc is an adjacency relation. Then, one has to define the similarity function between two nodes, sort each node and merge the two best candidates. Finally, update the list and iterate.

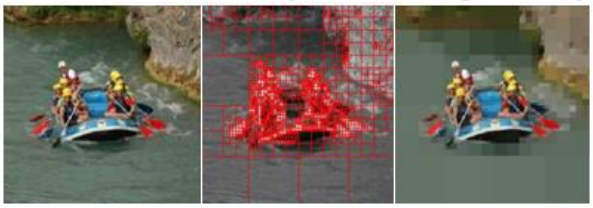

Figure 10: Adjacency graph method

5. Color Based Segmentation

The color image segmentation is also widely used in many multimedia applications, for example; in order to effectively scan large numbers of images and video data in digital libraries, they all need to be compiled directory, sorting and storage, the color and texture are two most important features of information retrieval based on its content in the images and video. Therefore, the color and texture segmentation often used for indexing and management of data; another example of multimedia applications is the dissemination of information in the network. Today, a large number of multimedia data streams sent on the Internet, However, due to the bandwidth limitations; we need to compress the data, and therefore it calls for image segmentation.Following are the steps to perform color based segmentation;

1) Read the image
2) Convert image from RGB color space to l*a*b* color space
3) Classify the Color in 'a*b*' Space Using K-Means Clustering
4) Label every pixel in the image using the results from K-Means
5) Create images that segment the H&E image by color.
6) Segment the nuclei into a separate Image

Figure 12: Color based segmentation

6. Comparative Study of Various Segmentation Techniques

This section briefly outlinesthe pros, cons and segmentation effects of Region based, Edge based, Threshold based and color based segmentation techniques.

Techniques	Pros	Cons	Segmentation Effects
Threshold	Segment the image from background effectively.	Sensitivity and Specificity is low	Average
Edge based	Detect strong & weak edges	Very noisy	Normal
Region based	Provides unique image with clear edges	Requires may iterations.	Good
Color based	Indicate the edges, boundaries and texture information.	Requires more number of clustering	Better

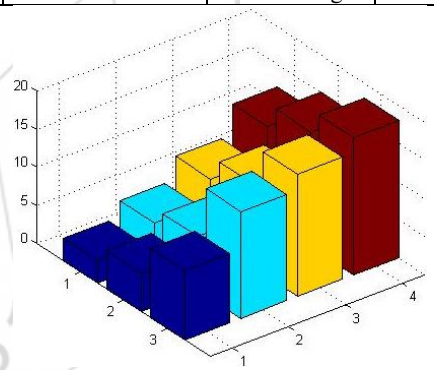

Figure 12: Comparative graph for segmentation techniques

7. Conclusion and Future Work

We have thoroughly discussed the useful methods of edge based, region based, threshold based and color based methods of image segmentation. This systematic comparison study is helpful for individual researchers to do research in the ground of image segmentation. Throughout this study of the various techniques, we conclude that the image segmentation is the crucial part of the image processing model. The segmentation technique of the image could be used as per the required application or the usage as image is segmented on the basis of different features. Opting a single technique or method would not provide better optimized results. Although various methods are available, each method works on specific concept hence it is important which image segmentation methods should be used as per application domain. In our future work, we will use the

watershed technique along with the edge detector operator to get the improved technique for the segmentation purpose. It would help to detect the segments in a quite simple and enhanced way.

References

[1] R. Unnikrishnan, C. Pantofaru, M. Hebert, "A Measure for Objective Evaluation of Image Segmentation Algorithms", CVPR workshop on Empirical Evaluation Methods in Computer Vision, 2005.
[2] R. Unnikrishnan, M. Hebert, "Measures of Similarity", IEEE Workshop on Computer Vision Applications, 2005, pp. 394–400.
[3] M. Meila, J. Shi, "Learning segmentation by random walks", NIPS, 2000, pp. 873-879.
[4] J. Shi, J. Malik, "Normalized cuts and image segmentation", IEEE Transactions on Pattern Analysis and Machine Learning, 2000, pp. 888-905.
[5] D. Martin, "An Empirical Approach to Grouping and Segmentation", Ph.D. dissertation, 2002, University of California, Berkeley.
[6] Rafael C. Gonzalez, Richard E. Woods, ―Digital Image Processing‖, Second Edition, Pearson Education.
[7] DeeplaiKelkar and Surendra Gupta,‖ Improved Quadtree Method for Split Merge Image Segmentation‖, Emerging Trends in Engineering and Technology, 2008 ICETET.
[8] Zhang, Y. J, "An Overview of Image and Video Segmentation in the last 40 years", 6th International Symposium on Signal Processing and Its Applications Proceedings, Pages: 144-151, 2001.
[9] Shapiro L. G. and Stockman G. C., Computer Vision, Prentice-Hall Publications, New Jersey, 2001.
[10] S.K Somasundaram, P.Alli," A Review on Recent Research and Implementation Methodologies on Medical Image Segmentation", Journal of Computer Science 8(1): 170-174, 2012.
[11] K. K. Singh, A. Singh,"A Study of Image Segmentation Algorithms for Different Types of Images", International Journal of Computer Science Issues, Vol. 7, Issue 5, 2010.
[12] Rafael C. Gonzalez, Richard E. Woods, "Digital Image Processing", 2nd ed., Beijing: Publishing House of Electronics Industry, 2007.
[13] Edge Detection Techniques Evaluations and Comparisons. Ehsan Applied Mathematical Sciences, Vol. 2, 2008, no. 31, 1507 – 1520.
[14] Evaluating the effectiveness of region growing and edge detection segmentation algorithms.Ahmed R. Khalifa 2010.
[15] W. X. Kang, Q. Q. Yang, R. R. Liang,"The Comparative Research on Image Segmentation Algorithms", IEEE Conference on ETCS, pp. 703-707, 2009.
[16] S. S. Varshney, N. Rajpal, R. Purwar,"Comparative Study of Image Segmentation Techniques and Object Matching using Segmentation", Proceeding of International Conference on Methods and Models in Computer Science, pp. 1-6, 2009.
[17] V. K. Dehariya, S. K. Shrivastava, R. C. Jain,"Clustering of Image Data Set Using K-Means and Fuzzy K-Means Algorithms", International conference on CICN, pp. 386- 391, 2010.
[18] S. Naz, H. Majeed, H. Irshad,"Image Segmentation using Fuzzy Clustering: A Survey", International Conference on ICET, pp.181-186, 2010.
[19] Senthilkumaran N., Rajesh R. (2009) International Conference on Advances in Recent Technologies in Communication and Computing IEEE pp. 844-846.
[20] Krishna Kant Singh, Akansha Singh, A Study of Image Segmentation Procedures for Different Types Of Imageries. IJCSI International Journal of Computer Science Issues, Vol. 7, Issue 5, September 2010, ISSN (Online): 1694-0814
[21] Rupinder Singh, Jarnail Singh, Preetkamal Sharma, Sudhir Sharma., Edge Based Region Growing. IJCTA | July-August 2011
[22] W. X. Kang, Q. Q. Yang, R. R. Liang, "The Comparative Research on Image Segmentation Algorithms", IEEE Conference on ETCS, pp. 703-707, 2009.
[23] H. Zhang, J. E. Fritts, S. A. Goldman, "Image Segmentation Evaluation: A Survey of unsupervised methods", computer vision and image understanding, pp. 260-280, 2008.
[24] H. G. Kaganami, Z. Beij, "Region Based Detection versus Edge Detection", IEEE Transactions on Intelligent information hiding and multimedia signal processing, pp. 1217-1221, 2009.
[25] K. K. Singh, A. Singh, "A Study of Image Segmentation Algorithms for Different Types of Images", International Journal of Computer Science Issues, Vol. 7, Issue 5, 2010.