ISSN 2319-7595

International Journal of Information Systems and Computer Sciences, Vol.7. No.1, Pages : 72-79 (2017)
Special Issue of ICSIC 2017 - Held during 23-24 September 2017 in Amman Arab University, Amman-Jordan
http://www.warse.org/IJISCS/static/pdf/Issue/icsic2017sp25.pdf

Simulation of Image Segmentation Algorithms Using Open Source Tools

Ahmed Ziadeh, and Prof. Dr. Mohammed Otair
Amman Arab University,
ahmed.Ziadeh@gmail.com

Abstract

Segmentation is considered as one of the most important image processing steps, because it will effect on the rest steps (such as: representation and recognition) that mainly belongs to computer vision field and has wide range implementation. The study will test and analyze the well-known image segmentation algorithms in order to find the optimal parameters, conditions and recommendations in the image processing fields. Additionally, this study will try to enhance and propose a new segmentation algorithm. The objectives of this work will be achieved by simulation study on the segmentation algorithms using several open source segmentation tools such as: MITK, Interactive Segmentation Tool-Box and Matlab. Specific set of images were used to test the three tools and they tested multiple times to make sure of the accuracy of the results. The time required for image segmentation was measured using a stopwatch. The taken time to segment an image in Matlab was approximately 0.15 second; whereas, in both Interactive Segmentation Tool-Box and MITK the taken time was 0.10 second. Finally, we find out that Interactive Segmentation Tool-Box is the most accurate among the other tools in image segmentation process based on the predefined criteria.

Keywords: Image Processing, Image Segmentation, and Open Source Tools.

1. Introduction

The third step in image analysis and computer vision that comes after image acquisition and preprocessing is called image segmentation. It is a process that separate and extract different sections of the image according to specific threshold or their properties. The final step in image analysis and computer vision dependents heavily on the quality of the segmented image.

The aim of this work was to study and compare three deferent applications to assess the quality of the 2D image segmentation images; namely MITK, Interactive Segmentation Tool-Box and Matlab and thus identify the advantages and disadvantages of each application to try to find out the most appropriate technique for a specific application. The study experiments the studied segmentation tools according a well know images in the image processing field as in Appendix-A. Most of the advances technologies in image segmentation field are achieved by the commercial companies not by the academic researchers. Moreover, most of the related academic studies are too old and outdated. So, this study will be pioneer to reach closed results to the commercial packages. Develop a framework to optimally implement any segmentation algorithm. Study analysis of segmentation algorithms using the mostly used open source segmentation tools.

This paper also considered the processing time of the different methods and techniques. Comparison was conducted in two way; the human naked eye all the results pointed out that, Interactive Segmentation Tool-Box was the best quality regarding the segmentation process due to advantage over the other remaining applications

2. Related Studies

Actually, there are many scientific and commercial researches in this field. Moreover, most of the related academic studies are not comprehensive or too old and outdated [1, 2, 3, 4, 5, 6, and 7]. However, the mostly related studies as follow:

Colour Image Segmentation - A Survey [8]: The study is carried out a comprehensive survey on color image

ISSN 2319-7595

International Journal of Information Systems and Computer Sciences, Vol.7. No.1, Pages : 72-79 (2017)
Special Issue of ICSIC 2017 - Held during 23-24 September 2017 in Amman Arab University, Amman-Jordan
http://www.warse.org/IJISCS/static/pdf/Issue/icsic2017sp25.pdf

segmentation algorithms. They categorized them based on well-known list of attributes, improvements suggestions, and descriptions of some new approaches. The main purpose of this study is to supply a preview of mathematical morphology and criticize several morphological filters which are broadly used in image processing field.

Objective Evaluation Parameters of Image Segmentation Algorithms [9]: Evaluation of segmentation algorithms is mainly subjective, and to judge the effectiveness of a technique could be based only on intuition and results in the form of few example segmented images. This paper presents 13 performance evaluation parameters that can be used to perform a quantitative comparison between image segmentation.

A Survey on Clustering Based Image Segmentation [10]: Clustering can be defined as a grouping of similar images from the database. Clustering is achieved according to different attributes of an image such as: texture, color, and size. The goal of clustering is to extract meaningful result, effective storage and fast retrieval. This paper is a survey on several clustering techniques to accomplish image segmentation.

A Study on the Different Image Segmentation Technique [11]: This paper presents an overview of some well-known image segmentation techniques. The main goal of this study is to recognize several image segmentation algorithms. This study considered the segmentation algorithms based on the clustering techniques. The study shed light on the limitations of available segmentation algorithms and also their potential solutions.

3. Interactive Segmentation Tool (IST)

In Interactive Segmentation Tool-Box, a region-based segmentation module called “GrabCut” is used. In short, borders were selected in seeds before applying the GrabCutfunction. The tool calculated the rough borders of the segmented bits and presented this as colored areas on the images as in table 1 (http://www.cs.cmu.edu/~mohitg/segmentation.htm).

Table 1: Features of Interactive Segmentation Tool-Box

Algorithm/function used	• Lazy Snapping • GrabCut
Manual segmentation	• Yes • Lazy Snapping requires the user to specify foreground and background seeds, and performs 2D segmentation with the seeds
Automated segmentation	• Simi-automated • GrabCutuses iterated graph cutsand the user interaction required is a bounding box of the foreground object.

Interactive Segmentation Tool is used with its four main methods:

- Binary partition tree segmenter,
- Seeded region growing segmenter
- Interactive graph cuts segmenter
- Siox segmenter

Interactive graph cuts segmenter is chosen, which contains six possible views:

- Combined
- Original
- Markup
- Mask
- Foreground only
- Outline overlaid

In this study two views were implemented: mask and foreground only. The results after applying selected methods and views on the image set were as in figure 1.

ISSN 2319-7595

International Journal of Information Systems and Computer Sciences, Vol.7. No.1, Pages : 72-79 (2017)
Special Issue of ICSIC 2017 - Held during 23-24 September 2017 in Amman Arab University, Amman-Jordan
http://www.warse.org/IJISCS/static/pdf/Issue/icsic2017sp25.pdf

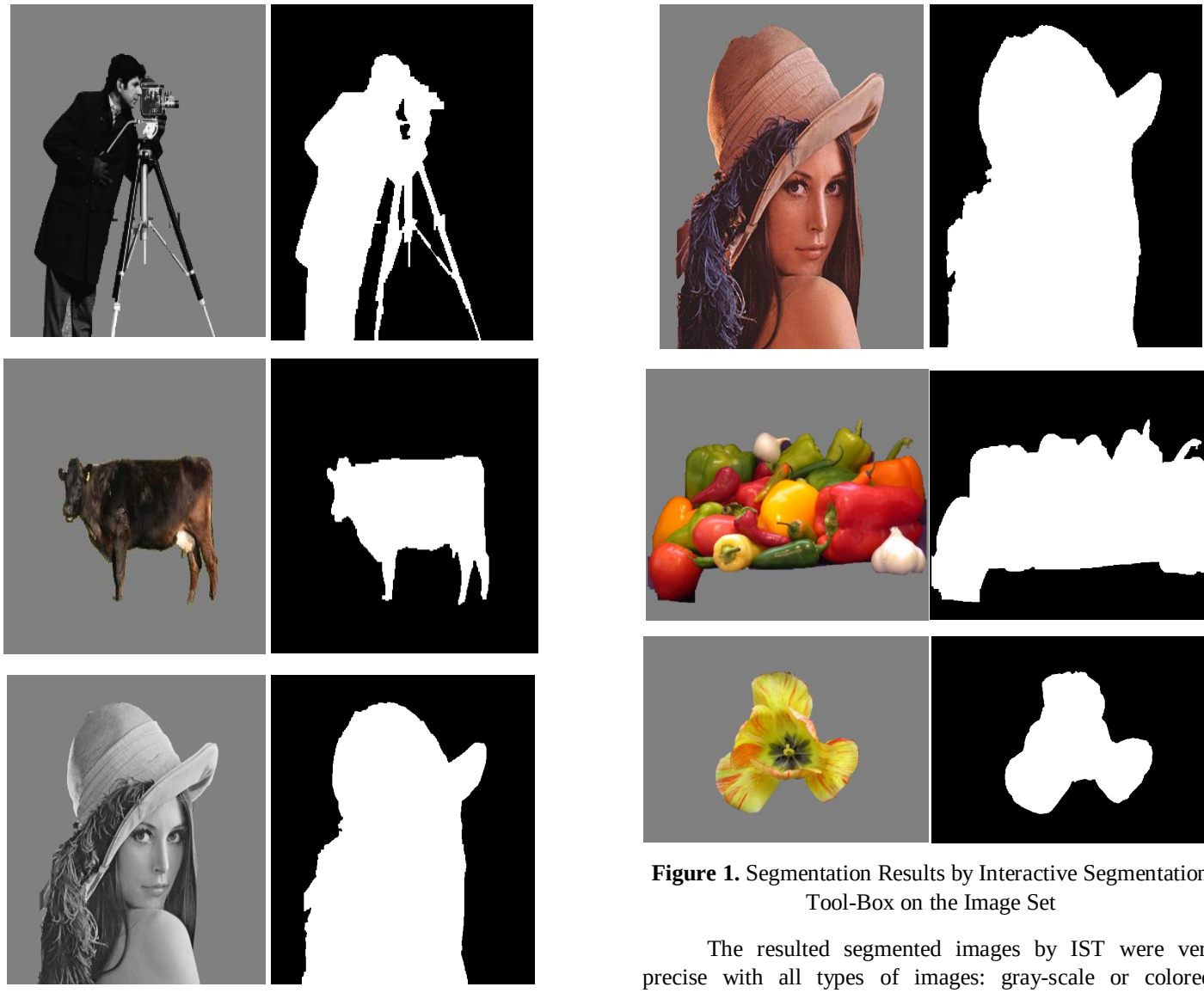


Figure 1. Segmentation Results by Interactive Segmentation Tool-Box on the Image Set

The resulted segmented images by IST were very precise with all types of images: gray-scale or colored. Moreover, the nature of the images does not effect on the precision of the segmentation process.

4. Medical Imaging Interaction Toolkit (MITK)

The Medical Imaging Interaction Toolkit (MITK) is a free open-source software system for development of interactive medical image processing software, it has a very good features as in table 2 (http://mitk.org). MITK combines the Insight Toolkit (ITK) and the Visualization Toolkit (VTK) with an application framework.

ISSN 2319-7595

International Journal of Information Systems and Computer Sciences, Vol.7. No.1, Pages : 72-79 (2017)
Special Issue of ICSIC 2017 - Held during 23-24 September 2017 in Amman Arab University, Amman-Jordan
http://www.warse.org/IJISCS/static/pdf/Issue/icsic2017sp25.pdf

Table 2: Features of MITK

	Supported	Not supported
Managing segmentations (New, Delete, Load, Save)	• segmentations by thresholding the image • changing color, opacity for each segmentation	• Undo of New, Delete, Load, Save
3D Segmentation of gray value images	• Yes (rotated images is supported)	• only the three "natural" image slice directions are supported
Manual segmentation	• Yes • Six tools work on single 2D slices of the image. • Full undo support for all tools	
Interpolation of missing segmentation slices from neighboring slices	• supported in all three image directions • Full undo support	
Software design feature	• easy to extend with your own tools	
Automated segmentation	• yes	
Algorithm/function used	SliceBasedSegmentation	

Figure 2 shows the results after applying MITK on two images of the image set that are: Lena and Cameraman, respectively.

Figure 2. Segmentation Results by MITK on some images of the Image Set

5. Matlab

Fast segmentation of N-dimensional grayscale images Partition N-D grayscale image into c classes using efficient C-means and fuzzy C-means clustering (www.mathworks.com), its source code is listed in Appendix-B. Figure 3 and 4 show the segmentation results on Cameraman and Lena, respectively.

ISSN 2319-7595

International Journal of Information Systems and Computer Sciences, Vol.7. No.1, Pages : 72-79 (2017)
Special Issue of ICSIC 2017 - Held during 23-24 September 2017 in Amman Arab University, Amman-Jordan
http://www.warse.org/IJISCS/static/pdf/Issue/icsic2017sp25.pdf

Figure 3. Segmentation Results by Matlab on Cameraman image

Figure 4. Segmentation Results by Matlab on Lena image

6. Results and Discussions

Finally, the experiments resulted that Interactive Segmentation Tool-Box is the most accurate among the applications in image segmentation process according to previous criteria as in table 3.

Table 3. Comparative Analysis between IST, MITK, and Matlab

criterion	**IST**	**MITK**	**Matlab**
Type of images worked with	Worked with colored and grayscale images (JPG,PNG, TIFF,JPG)	Just with grayscale images (JPG)	grayscale
Easy to use	yes	No	Yes
Accuracy of objects separation	Very good	Good especially for medical images segmentation	Good
Disadvantages	Need more than one time segmentation to identify more regions	Doesn't fill the object	Can't be used for colored images

As shown from the previous table IST works with all types of images: gray-scale and colored, and it is easy to use and learn because it has a very user-friendly interfaces. Moreover, it is very good in segmentation in term of accuracy of objects separation. The only drawback of IST is time consuming, in order to provide a segmentation result.

7. Conclusion

In this study, we have found the Interactive Segmentation Tool to have the best performance in segmentation of a 2D images. Time required for processing the image was significantly longer in (IST) than in the two other segmentation tools. In addition, IST can accept most of image extensions and dealing with image colors comfortably better than other two applications.

ISSN 2319-7595

International Journal of Information Systems and Computer Sciences, Vol.7. No.1, Pages : 72-79 (2017)
Special Issue of ICSIC 2017 - Held during 23-24 September 2017 in Amman Arab University, Amman-Jordan
http://www.warse.org/IJISCS/static/pdf/Issue/icsic2017sp25.pdf

REFERENCES

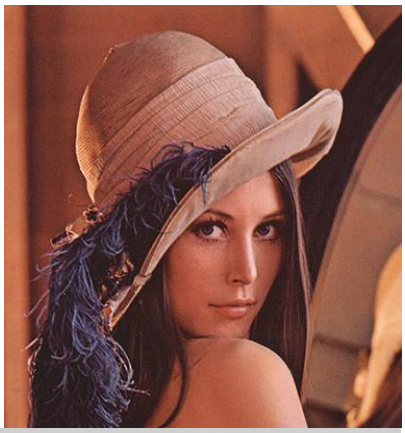
1. R. Unnikrishnan, C. Pantofaru, and M. Hebert. A Measure for Objective Evaluation of Image Segmentation Algorithms, Workshop on Empirical Evaluation Methods in Computer Vision, IEEE Conference on Computer Vision and Pattern Recognition (CVPR '05), June, 2005.
2. V. Mezaris, I. Kompatsiaris and M. G. Strintzis, Still Image Objective Segmentation Evaluation using Ground Truth, 5th COST 276 Workshop (2003), pp. 9–14.
3. A. M. Khan, Ravi. S, Image Segmentation Methods: A Comparative Study, International Journal of Soft Computing and Engineering (IJSCE), Vol. 3, No. 4, 2013, pp. 84-92.
4. Mark Everingham, Henk Muller, and Barry Thomas, Evaluating Image Segmentation Algorithms using the Pareto Front, ECCV '02 Proceedings of the 7th European Conference on Computer Vision-Part IV, 2002, pp. 34-48.
5. Santanu Bhowmik, Viki Datta, A Survey on Clustering Based Image Segmentation, International Journal of Advanced Research in Computer Engineering & Technology, Vol. 1, No. 5, 2012, pp. 280-284.
6. Gurjeet kaur Seerha, Rajneet kaur, Review on Recent Image Segmentation Techniques, International Journal on Computer Science and Engineering, Vol. 5 No. 02, 2013, pp. 109-112.
7. Jayaram K. Udupa et. al., A Methodology for Evaluating Image Segmentation Algorithms, Proceedings of SPIE, 2002.
8. Akshay Vartak, Vijay Mankar, Colour Image Segmentation - A Survey, International Journal of Emerging Technology and Advanced Engineering, Vol. 3, No. 2, 2013, pp. 681-688.
9. Manisha Sharma, Vandana Chouhan, Objective Evaluation Parameters of Image Segmentation Algorithms, International Journal of Engineering and Advanced Technology, Vol. 2, No. 2, 2012, pp. 84-87.
10. Santanu Bhowmik, Viki Datta, A Survey on Clustering Based Image Segmentation, International Journal of Advanced Research in Computer Engineering & Technology, Vol. 1, No. 5, 2012, pp. 280-284.
11. Rozy Kumari, Narinder Sharma, A Study on the Different Image Segmentation Technique, International Journal of Engineering and Innovative Technology (IJEIT) Vol. 4, No. 1, 2014, pp. 284-289.

Appendix-A: The Studied Image Set

cameraman.jpg
Cameraman.tiff lena1.jpg

ISSN 2319-7595

International Journal of Information Systems and Computer Sciences, Vol.7. No.1, Pages : 72-79 (2017)
Special Issue of ICSIC 2017 - Held during 23-24 September 2017 in Amman Arab University, Amman-Jordan
http://www.warse.org/IJISCS/static/pdf/Issue/icsic2017sp25.pdf



lena2.jpg

flowergold.png

Vegetables.jpg

cow.jpg

ISSN 2319-7595

International Journal of Information Systems and Computer Sciences, Vol.7. No.1, Pages : 72-79 (2017)
Special Issue of ICSIC 2017 - Held during 23-24 September 2017 in Amman Arab University, Amman-Jordan
http://www.warse.org/IJISCS/static/pdf/Issue/icsic2017sp25.pdf

Appendix-B: Source Code of DemoFCM function n Matlab

```
% Segment a sample 2D image into 3 classes using fuzzy c-means algorithm.
% Note that similar syntax would be used for c-means based segmentation.

im=imread('cameraman.tif'); % sample image
[L,C,U,LUT,H]=FastFCMeans(im,3); % perform segmentation

% Visualize the fuzzy membership functions
figure('color','w')
subplot(2,1,1)
I=double(min(im(:)):max(im(:)));
c={'-r' '-g' '-b'};
for i=1:3
   plot(I(:),U(:,i),c{i},'LineWidth',2)
   if i==1, hold on; end
   plot(C(i)*ones(1,2),[0 1],'--k')
end
xlabel('Intensity Value','FontSize',30)
ylabel('Class Memberships','FontSize',30)
set(gca,'XLim',[0 260],'FontSize',20)

subplot(2,1,2)
plot(I(:),LUT(:),'-k','LineWidth',2)
xlabel('Intensity Value','FontSize',30)
ylabel('Class Assignment','FontSize',30)
set(gca,'XLim',[0 260],'Ylim',[0 3.1],'YTick',1:3,'FontSize',20)

% Visualize the segmentation
figure('color','w')
subplot(1,2,1), imshow(im)
set(get(gca,'Title'),'String','ORIGINAL')

Lrgb=zeros([numel(L) 3],'uint8');
for i=1:3
   Lrgb(L(:)==i,i)=255;
end
Lrgb=reshape(Lrgb,[size(im) 3]);

subplot(1,2,2), imshow(Lrgb,[])
set(get(gca,'Title'),'String','FUZZY C-MEANS (C=3)')

% If necessary, you can also unpack the membership functions to produce
% membership maps
```