Advanced Maximal Similarity Based Region Merging By User Interactions

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ABSTRACT

Image segmentation is a popular method for dividing the image into various segments so as to change the representation of an image into something that is more meaningful and easier to analyze[12]. This paper presents a new region merging based interactive image segmentation method. A novel maximal-similarity based region merging mechanism is proposed to guide the merging process with the help of markers in which the user only need to mark the object desired to be extracted. The sample image taken for analysis is initially segmented using multi level thresholding technique[1]. This technique is used as it provides very good segmentation results than any other method. The regions are merged based on the similarity criteria depending upon comparing the mean values of both the regions to be merged. So, the similar regions are then merged and the dissimilar regions are merged together. Thus the merged object regions are then extracted from the complex background. The results of the proposed method has been compared with the results of the previous methods and it is observed that this method provides very promising results and degree of accuracy for extracting the desired object is better in this case.

Key Words- Image Segmentation, MSRM, Multi level Thresholding, Euclidean distance.

I.   INTRODUCTION

Images are considered as one of the important medium of conveying information in the field of computer vision. By understanding images, the information extracted from them can be used for other tasks for example, navigation of robots, extracting malign tissues from the body scans, detection of cancerous cells and identification of an airport from remote sensing data. Now there is need of a method. With the help of which, we can understand images and extract information or objects. Image segmentation is used to fulfill the above requirements[1]. The objective is used to extract the object from the background. In general, the color and texture features in a natural image are very complex so that the fully automatic segmentation of the object from the background is very hard. Extensive research has been done in

many different approaches and algorithms for image segmentation, but it is difficult to assess whether one algorithm produce more accurate segmentations than another, whether it be for a particular image or set of images, or more generally for a whole class of images.

Therefore, semi-automatic segmentation methods incorporating user interactions have been proposed and are becoming more and more popular. The low level image segmentation methods such as mean shift, watershed, level set and super-pixel usually divide the image into very small regions. Although they may have severe over segmentation, these low level segmentation methods provide a good basis for the subsequent high level operations, such as region merging.

In this paper, we proposed a novel interactive region merging method based on the initial segmentation of multi level thresholding. This technique provides no over segmentation as in other methods, while preserving well the edge information of the object. Because of no over segmentation, the statistic features of each region, which will be exploited by the proposed region merging method, can be more robustly calculated and then can be used in guiding the region merging process. In the proposed scheme, the interactive information is introduced as markers which are input by the users to roughly indicate the position and main features of the object and background. The markers are simple lines (e.g. Green color). Then the proposed method will calculate the similarity of different regions and merge them based on the proposed maximal similarity rule with the help of these markers. The object will then be extracted from the background when the merging process ends. Although the idea of introducing markers into interactive segmentation was used in Mean Shift's scheme. With this scheme the non marker regions if not find similarity with the marked regions are merged and the marked regions are merged with the similar unmarked regions.

II.   ADVANCED MAXIMAL SIMILARITY BASED REGION MERGING.

In our method, to divide the image into various homogeneous regions, an initial segmentation is required. There are many low level segmentation methods, such as super-pixel, mean shift; watershed and level set, any one of them can

be used for this step. In this paper we have choose to use multi level thresholding method for initial segmentation because it has no over segmentation which means the boundaries of the object remain preserved. Segmentation is done in Matlab(7.13).

2.1 REPRESENTATION OF THE REGIONS.

After the initial segmentation is done, we have many small regions available. We need to represent these regions using some descriptor so as to guide the region merging process. In many aspects the regions can be defined such as color, edge, texture, shape and size of the regions. Among them the best descriptor is the color feature to represent the object color feature statistics and is widely used in object tracking and pattern recognition. In Segmentation based on region merging, the color feature is more robust than any other feature descriptors. This is because the initially segmented small regions of the desired object often vary a lot in size and shape, while the colors of different regions from the same object will have high similarity[1]. Therefore, we use the color histogram to represent each region in this paper.

The user will mark some regions as object in the interactive image segmentation. The key issue in region merging is how to determine the similarity between the unmarked regions with the marked

regions so that the similar regions can be merged with some logic control. Therefore, we need to define a similarity measure between two regions R and Q to accommodate the comparison between various regions. There are some well-known goodness-of-fit statistical metrics such as the Euclidean distance, Bhattacharyya coefficient and the log likelihood ratio statistic. Here, we choose to use the Euclidean distance to measure the similarity between R and Q. The RGB color space is used to compute the Mean value of different regions. We uniformly calculate the mean value of the object under consideration, let it be 'and the mean value of its neighbor, let it be 'Q'. If the mean value if less than or equal to the pre defined threshold value than the R will gets merged with Q otherwise not.

$$E.D = | (R-Ri)| + |(G-Gi)| + |(B-Bi)|.$$

Where, E.D is the Euclidean distance, and R,G,B are the color values of region R, and Ri,Gi,Bi are the color values of region Q. If two regions have similar contents, their mean values will be nearly similar. The RGB descriptor is a very simple yet efficient way to represent the regions and measure their similarity.
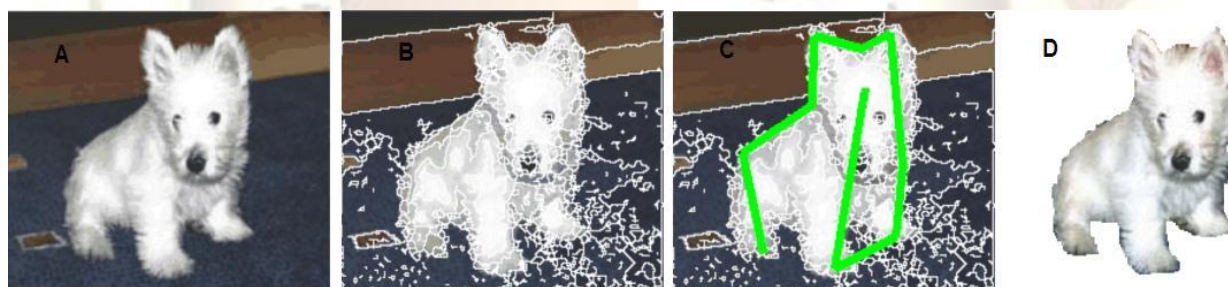

Fig 1 (a)Original image (b) Initial mean shift segmentation,(c)the interactive input by the user,(d) Segmentation result by the proposed region merging method.

2.2 OBJECT MARKING.

The user need to specify the object in the interactive image segmentation, the users can input interactive information by drawing markers, which could be lines, curves and strokes on the image. The regions that have pixels inside the object markers are thus called object marker regions. Fig. 1c shows examples of the object markers by using simple green lines.

The marker regions cover only a small part of the object. Those object regions that are not marked by the user, i.e. the non-marker object regions, should be identified and not be merged with the background.

2.3 MERGING RULE FOR MAXIMAL SIMILARITY.

After object marking, it is still a challenging problem to extract accurately the object contour from the background because only a portion of the object is marked by the user. The proposed region merging method merge
Two adjacent regions whose similarity is above a preset threshold. These methods have difficulties in adaptive threshold selection. A big threshold will lead to incomplete merging of the regions belonging to the object, while a small threshold can easily cause over-merging, i.e. some object regions are merged into the background. Moreover, it is difficult to judge when the region merging stops. Therefore a proper threshold has to be selected for proper region merging.

2.4 THE MERGING PROCESS

The whole MSRM process can be divided into two stages, which are repeatedly executed until no new merging occurs.

'Firstly, the marked object regions are merged with the unmarked object regions until no similar object region left.

Secondly, the left unmarked regions are then merged together, and thus the object can be successfully extracted from the complex background.

In fig 2.1 The process of object extraction is shown.

Fig 2 The merging process.

1. Original Image with complex background.
2. Image is converted into gray scale and segmented.
3. Segmented gray image is overlapped with the original RGB Image.

4. Object regions are marked using simple green lines.
5. The object after filling morphological operation is compared with the original ground truth.

Original and extracted image is shown in figure below. The tumor in shown with back
Ground and the extracted image of the tum-
-or only is shown below.
Thus, image segmentation can be used in Medical field also.
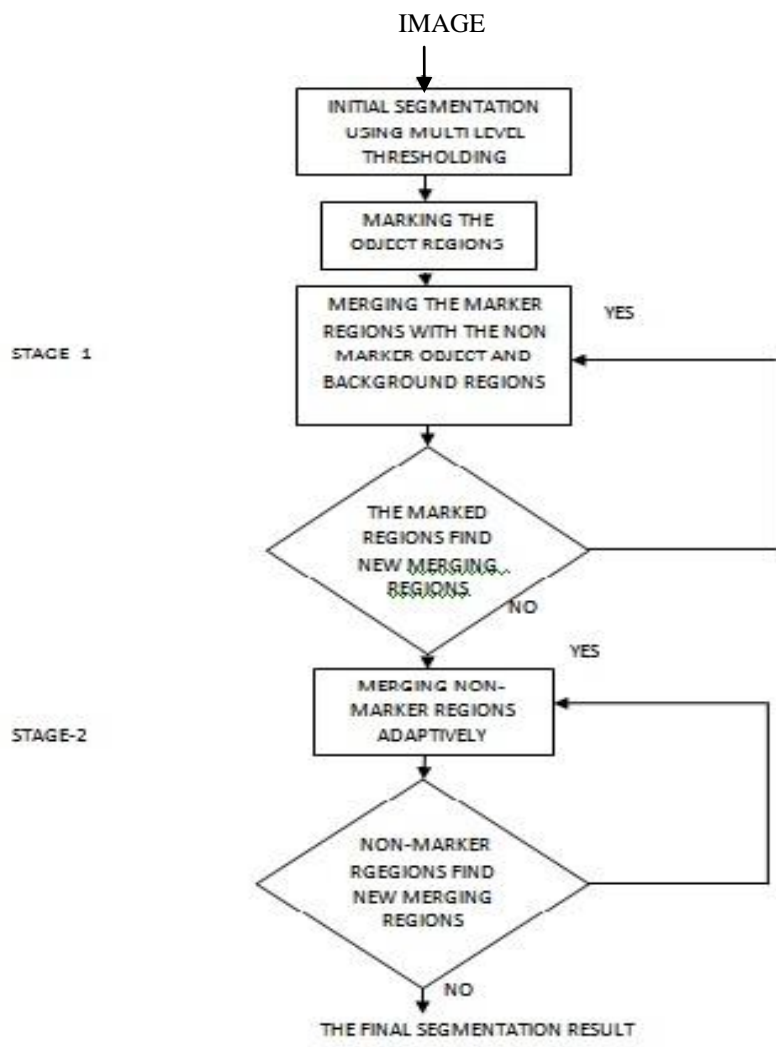6. The desired object is then successfully extracted from the complex background.

III. PROPOSED WORK

IMAGE

INITIAL SEGMENTATION USING MULTI LEVEL THRESHOLDING

MARKING THE OBJECT REGIONS

STAGE 1

MERGING THE MARKER REGIONS WITH THE NON MARKER OBJECT AND BACKGROUND REGIONS

YES

THE MARKED REGIONS FIND NEW MERGING REGIONS.

NO

YES

STAGE-2

MERGING NON-MARKER REGIONS ADAPTIVELY

NON-MARKER RGEGIONS FIND NEW MERGING REGIONS

NO

THE FINAL SEGMENTATION RESULT

Fig 3 Flow Chart of MSRM

IV.   RESULTS
(COMPARISON WITH OTHER METHODS).

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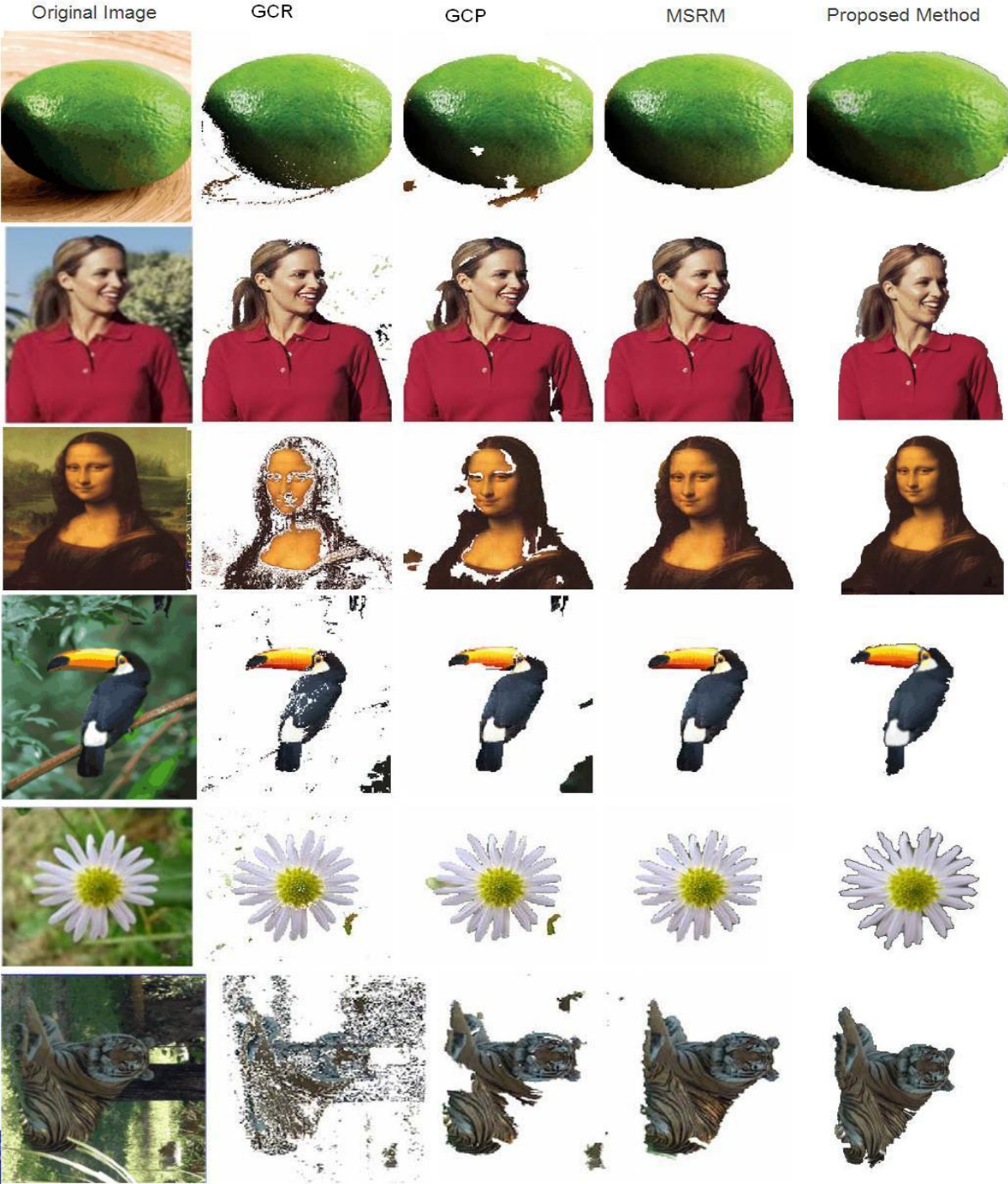
Fig 4 Comparison with other methods.

V.   DEGREE OF ACCURACY

Image	Method	TPR (%)	FPR (%)

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FRUIT	GCP	93.14	2.37
	GCR	96.56	3.37
	MSRM	98.97	0.37
	PROPOSED MSRM	99.30	0.12
WOMAN	GCP	97.58	2.99
	GCR	96.82	0.73
	MSRM	98.53	0.44
	PROPOSED MSRM	98.74	0.03
BIRD	GCP	87.49	3.64
	GCR	90.62	3.55
	MSRM	94.64	0.29
	PROPOSED MSRM	98.23	0.04
DOGS	GCP	66.79	0.68
	GCR	78.99	0.32
	MSRM	92.85	0.11
	PROPOSED MSRM	97.11	0.04
MONA LISA	GCP	54.08	2.02
	GCR	90.71	0.32
	MSRM	98.85	0.11
	PROPOSED MSRM	99.80	0.03
FLOWER	GCP	95.20	2.09
	GCR	96.67	2.46
	MSRM	97.59	1.08
	PROPOSED MSRM	97.30	0.95
TIGER	GCP	77.50	12.53
	GCR	87.42	2.66
	MSRM	90.25	0.66
	PROPOSED MSRM	94.89	0.03

Fig 5 Degree of Accuracy

For different techniques TPR and FPR is plotted for an extracted image. Considering the image of fruit, results are shown in figure below;
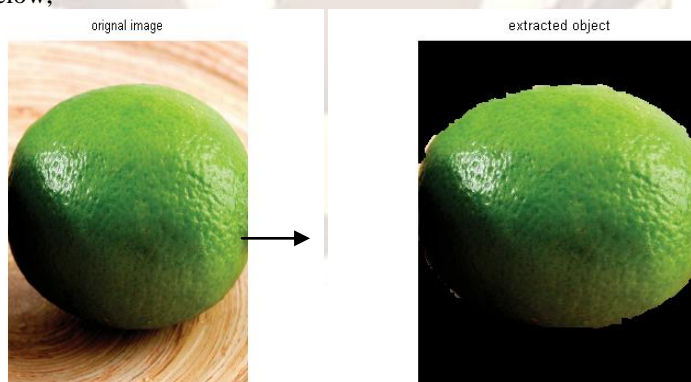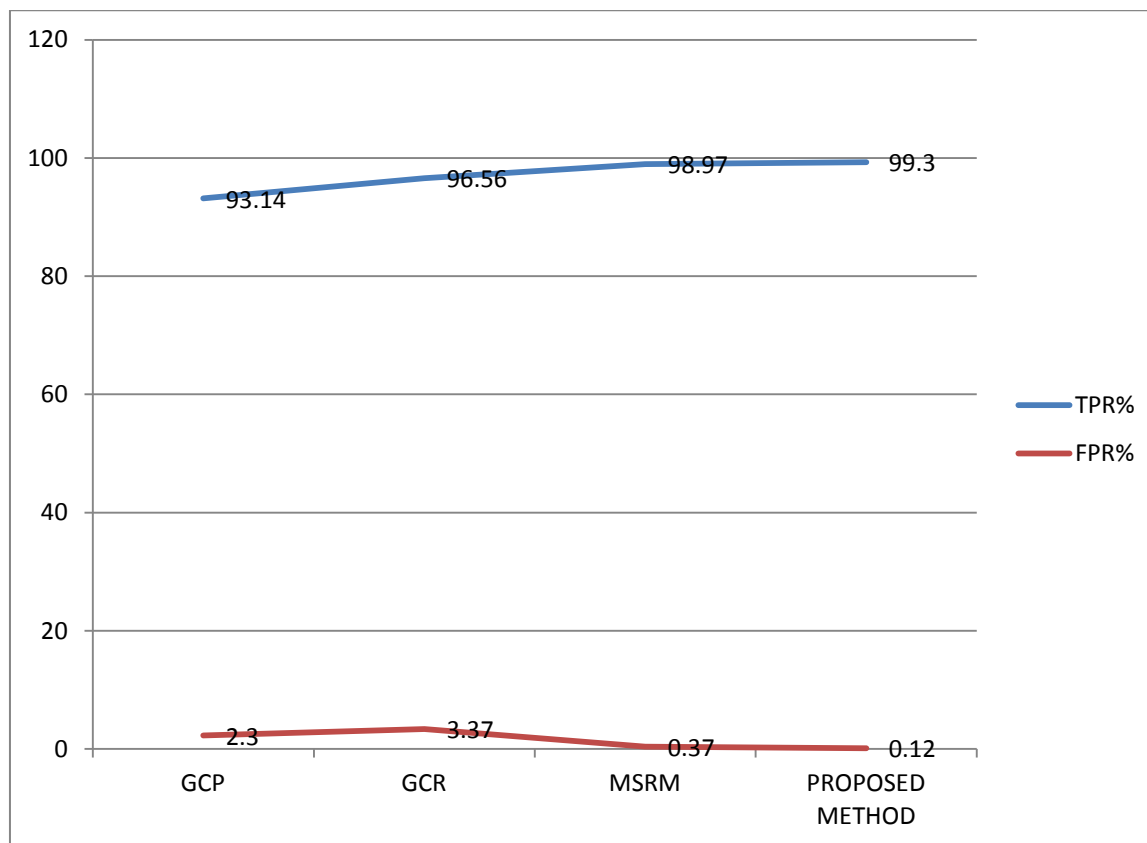
Fig 6 Plot for Sample Image- Fruit.

VI.   CONCLUSION

In this research work, the sample image which is used for analysis is subjected to initial segmentation. Since there are a lot of techniques for segmentation like mean shift, watershed, level set. In this case, multi-level thresholding is used, as it provides no over segmentation. The user was then able to interact with the image by marking on the object which is desired to be extracted. The merging process is then applied and the desired object is extracted from the background and it is proved that this methods provides very good results than previous techniques as the TPR (True positive rate) is maximum and FPR (False positive rate) is minimum which is desired.

VII.   FUTURE SCOPE

The research has been limited to images only. It can further be extended on videos including videos in medical fields also like ECG, CT Scan etc. Therefore it is suggested that one should try to minimize the over segmentation in videos also as it has been done in images and have got very promising results.

REFERENCES

[1]   [1] Jifeng Ning, LeiZhang, DavidZhang, ChengkeWu   "Interactive image segmentation by maximal similarity based region merging" Elsevier, Pattern Recognition 43 (2010) 445 – 456.

[2]   Pedro F. Felzenszwalb, Daniel P. Huttenlocher "Efficient Graph Based Image Segmentation"

[3]   Toru Tamaki, Tsuyoshi Yamamura and Noboru Ohnishi "Image segmentation and object extraction based on geometric features of regions" SPIE Vol.3653, Part Two, 937-945.

[4]   Jun Tang, "A color image segmentation algorithm based on region growing," Computer Engineering and Technology (ICCET), 2010 2nd International Conference on, vol.6, no., pp.V6-634, V6-637, 2010.

[5]   Dewen Zhuang; Shoujue Wang, "Content-Based Image Retrieval Based on Integrating Region Segmentation and Relevance Feedback" Multimedia Technology (ICMT), 1,3,29-31,Oct2010.

[6]   Wenbing Tao; Hai Jin; Yimin Zhang , "Color Image Segmentation Based on Mean Shift and Normalized Cuts," Systems, Man, and Cybernetics, Part B: Cybernetics, IEEE Transactions on , vol.37, no.5, pp.1382,1389, Oct. 2007.

[7]   Sapna,Varshney, S, Rajpal,N; Purwar, R, "Comparitive study of image segmentation techniques and object matching using segmentation", Methods and models in computer science,2009.

[8]   Zhen Wang; Meng Yang, "A fast clustering algorithm in image segmentation,," Computer Engineering and Technology(ICCET),

[9]   Dhara, B.C.; Chanda, B., "A Fast Interactive Image Segmentation to Locate Multiple Similar-colored Objects," Computer Vision, Pattern Recognition, Image Processing and Graphics (NCVPRIPG), 2011 Third National Conference on , vol., no., pp.25,28, 15-17 Dec. 2011.

[10]   Qiang Chen; Benben Xue; Quansen Sun; Deshen Xia, "Interactive image segmentation based on object contour feature image," Image Processing (ICIP), 2010 17th IEEE International Conference on , vol., no., pp.3605,3608, 26-29 Sept. 2010.

[11]   Fric, M.; Kamencay, P.; Lukac, P., "Automatic segmentation and impact for retrieval images," Signal Processing Algorithms, Architectures, Arrangements, and Applications Conference Proceedings (SPA), 2011 , vol., no., pp.1,5, 29-30 Sept. 2011.

[12]   Toru Tamaki, Tsuyoshi Yamamura Noboru Ohnishi, "Image segmentation and object extraction based on geometric features of regions", pp 937-945,1999.

[13]   Reinhardt, J.M.; Higgins, W.E., "Automatic generation of image-segmentation processes," Image Processing, 1994. Proceedings. ICIP-94., IEEE International Conference , vol.3, no., pp.791,795 vol.3, 13-16 Nov 1994.

[14]   Pedro F. Felzenszwalb, Daniel P. Huttenlocher "Efficient Graph Based Image Segmentation".

[15]   Yong Xia; Dagan Feng, "A General Image Segmentation Model and its Application," Image and Graphics, 2009.ICIG '09. Fifth International Conference on , vol., no., pp.227,231, 20-23 Sept. 2009.

[16]   Shirakawa, S.; Nagao, T., "Evolutionary image segmentation based on multiobjective clustering," Evolutionary Computation, 2009. CEC '09. IEEE Congress on , vol., no., pp.2466,2473, 18-21 May 2009.

[17]   Shirakawa, S.; Nagao, T., "Evolutionary image segmentation based on multiobjective clustering," Evolutionary Computation, 2009. CEC '09. IEEE

Congress on , vol., no., pp.2466,2473, 18-21 May 2009.

[18]   Wenbing Tao; Hai Jin; YiminZhang , "Color Image Segmentation Based on Mean Shift and Normalized Cuts," Systems, Man, and Cybernetics, Part B: Cybernetics, IEEE Transactions on , vol.37, no.5, pp.1382,1389, Oct. 2007.