Volume 5, Issue 9, September 2015 ISSN: 2277 128X
International Journal of Advanced Research in Computer Science and Software Engineering
Research Paper
Available online at: www.ijarcsse.com

An Optimized New Iterative Otsu's Method in Image Segmentation

M. Srujana Rani, G. Vijayadeep
Dept. of Computer Science & Engineering, Gudlavalleru Enginering College,
Andhra Pradesh, India

Abstract--In this article a novel algorithm for color image segmentation has been developed. The proposed algorithm based on combining two existing methods in such a novel way to obtain a significant method to partition the color image into significant regions. On the first phase, the traditional Otsu method for gray channel image segmentation were applied for each of the R,G, and B channels separately to determine the suitable automatic threshold for each channel. After that, the new modified channels are integrated again to formulate a new color image. The resulted image suffers from some kind of distortion. To get rid of this distortion, the second phase is arise which is the median filter to smooth the image and increase the segmented regions. Experimental results were presented on a variety of test images to support the proposed algorithm.

***Keywords---Binirization, segmentation, Otsu's Method, Distortions and Thresholding*.**

I. INTRODUCTION

One of the most important problems in color image analysis is that of segmentation. The fundamental idea in color image segmentation is to consider color uniformity as a relevant criterion to partition an image into significant regions [9]. The first task of any image processing tasks is usually Segmentation. All subsequent tasks depend surely on the nature of segmentation. For this reason, a worthwhile attention is taken to improve the quality of segmentation [10]. Most care to image segmentation has been concentrated on gray level images. A common problem in the segmentation of gray scale images occurs when an image has a varying gray level background. One of these problems is the progressively varying shadows, or when the image contains a wide range of gray levels. This is an inveterate intensity problem in grayscale images. According to [10], the detection procedure for the human in a high detail image can be done for one or two dozen intensity levels at any point due to luminosity accommodation. On the other hand, thousands of color, shadows and intensities could be distinguished by the human eye can.

Nowadays, there is no robust mathematical theory of image segmentation. Consequently, no solitary typical method of image segmentation has originated. Therefore, there are a variety of solo methods that have been somewhat popular according to its success [10]. Generally, most of the segmentation techniques for grayscale images such as histogram thresholding, edge detection, feature clustering, fuzzy methods, and region based methods, and neural networks have been extended for color image segmentation by using the RGB color space system or other color space like CYM, HSI, etc. Anyway, recently, there is a shortage in the comprehensive surveys on color image segmentation [7]. Color images can convey more information than gray scale images [4]. Color image segmentation is a method of mining one or more unified region that is homogenous. This may be obtained from the region's spectral elements [10]. Recently, there are a large number of color image segmentation techniques. They can be classified into four general categories: pixel-based, edge-based, region-based, and model-based techniques. Actually, the basic behavior of these techniques can be divided into three concepts. The first concept is the similarity concept like edge-based techniques. Alternatively, the second concept is based on the discontinuity of pixel values like pixel-based and region-based techniques. Finally, a completely different approach is the third concept which is based on a statistical approach like Model-based techniques. In the third concept, segmentation is implemented as an optimization problem.

Segmentation subdivides an image into its constituent region or object. Image segmentation methods are categorized on the basis of two properties discontinuity and similarity [1].Based on this property image segmentation is categorized as Edged based segmentation and region based segmentation. The segmentation methods that are based on a discontinuity property of pixels are considered as boundary or edges based techniques. The edge based segmentation method attempts to resolve image segmentation by detecting the edges or pixels between different regions that have rapid transition in intensity and are extracted and linked to form closed object boundaries. The result is a binary image. Based on theory there are two main edge based segmentation methods, gray histogram based and gradient based method [2]. Region based segmentation partitions an image into regions that are similar according to a set of predefined criteria.

At present, the use of image segmentation technology of infrared image to electric power equipment for processing to determine the fault equipment has been widely applied [1]. Fuzzy C-means clustering algorithm is an unsupervised classification method and can automatically partition the set of classification data in the absence of training samples [2]. It has been widely used in the field of image segmentation, but this algorithm has some shortcomings: the cluster number and center initialization is random, which affects the degree of segmentation accuracy. In addition, the calculation on all the pixels in image segmentation takes a longer time. This paper presents a FCM image segmentation method based on wavelet decomposition by using the multi-scale characteristic of wavelet and redundancy of wavelet decomposition to reduce the amount of data after wavelet segmentation, then to determine clustering center num by two-dimensional histogram and clustering segmentation on the infrared image wavelet decomposition by the FCM clustering method. Due to the introduction of wavelet pyramid image decomposition, the FCM clustering algorithm is improved.

II. LITERATURE SURVEY

OTSU METHOD PRELIMINARIES

Otsu method is one of the oldest methods in image segmentation [10]. It is treated as a statistical method according to its probabilistic implementation. It must be mentioned that the Otsu method is one of the best automatic thresholding methods [3]. The basic principle in Otsu method is to split the image into two classes which are the objects and the background. The automatic threshold is obtained through finding the maximum variance between the two classes [10]. Practically speaking, let I= [1, L] is the range of grayscale levels of image f(x, y) and pi is the probability of each level. The number of pixels with gray level i is denoted fi, giving a probability of gray level i in an image as:

$$p_i = \frac{f_i}{N}$$

For color images with RGB representation, the color of a pixel is a mixture of the three primitive colors red, green, and blue. By applying a segmentation technique to the red, green or blue color, features, in this case, a region can be recognized in one of the three components but is not identified by the other components. This shows the high correlation among the R, G, and B components [4] [6] [8]. By high correlation, we mean that if the intensity changes, all the three components will change accordingly. In this context, color image segmentation using data fusion techniques appears to be an interesting method. The segmentation method, proposed in this paper, is conceptually different and explores a new strategy. In fact, instead of considering an elaborate segmentation procedure, our technique rather explores the possibility of combining several approaches. This method is a hybrid image segmentation technique which integrates the results of the automatic thresholding algorithm and data fusion technique, in which the thresholding technique is used to select the optimal threshold in each image to be combined.

Fuzzy C Means Clustering Algorithm is applied for MRI brain tumor image segmentation. It is fast with lower segmentation accuracy. The ant colony algorithm is applied for performance enhancement of Fuzzy C Means clustering algorithm. It results in improved segmentation accuracy at the cost of computational time. The proposed Modified Fuzzy C Means with Optimized Ant Colony Algorithm with Min Max Ant System reduces the computational time of FCM with Ant Colony Algorithm.

Based on this, there are two types of thresholding methods.

1) Global thresholding: When T depends only on f (x, y) (in other words, only on gray-level values) and the value of T solely relates to the character of pixels, this thresholding technique is called global thresholding.

2) Local thresholding: If threshold T depends on f (x, y) and p (x, y), this thresholding is called local thresholding. This method divides an original image into several sub regions, and chooses various thresholds T for each sub region reasonably [3]. Otsu's method is a type of global thresholding in which it depends only gray value of the image. Otsu method was proposed by Scholar Otsu in 1979. Otsu method is a global thresholding selection method, which is widely used because it is simple and effective [4]. Many techniques have been developed for MRI segmentation. The four major classes are threshold-based techniques [1-2], region-based [3-6], pixel classification, and model-based techniques [7, 8]. In thresholding, the intensities of the objects in the image are compared with one or many intensity thresholds and are classified. These thresholds are global and local. These segmentation methods cannot exploit all the information in MRI. Region-based segmentation techniques predefine some similarity criterion. It examines pixels and forms disjoint regions.Neighboring pixels with homogeneous properties are merged together based on some predefined method. It segments the regions of similar properties and generates connected regions.

So, for that two dimensional Otsu algorithms was proposed which works on both gray-level threshold of each pixel as well as its Spatial correlation information within the neighborhood. So Otsu algorithm can obtain satisfactory segmentation results when it is applied to the noisy images [8]. Many techniques thus were proposed to reduce time spent on computation and still maintain reasonable thresholding results. In [9], proposed a fast recursive technique that can efficiently reduce the computational time. The Otsu's method was one of the better threshold selection methods for general real world images with regard to uniformity and shape measures.However, the Otsu's method uses an exhaustive search to evaluate the criterion for maximizing the between-class variance. As the number of classes of an image increases, the Otsu's method takes too much time to be practical for multilevel threshold selection [10].

PROPOSED ALGORITHM

Step 1: Partition the image into two classes $Class_1$ and $Class_2$ with the image mean value T such that

$Class_1 = \{0,1,2...Thres\}$ And $Class_2 = \{Thres+1, Thres+2, Thres+3...\mathrm{N}-1\}$

Where N = the level count.

$T = \sum_{i=0}^{N-1} i^2 * probability_i$ Where $probability_i = v_i / |\mathrm{v}|$

$$probability_i \geq 0,$$

$$\sum_{i=0}^{N-1} probability_i = 1$$

Step 2: Computing the lower threshold of the image as

The variance of $Class_1 = \{0,1,2...Thres\}$ is

$$T_1 = \sum_{i=0}^{Th} probability_i * (\sum_{i=0}^{Th} (i * probability^2{}_i - i^2 * probability) / |\mathrm{N}|$$

Step 3: Computing the highest Threshold of the image.

$$T_2 = \sum_{i=Th+1}^{N-1} probability_i * \sum_{i=Th+1}^{N-1} (i * probability^2{}_i - i^2 * probability) / |\mathrm{N}|$$

Step 4: Compute the inter-class and intra-class variation as

$$Variance(\sigma^2_{inter-class_1}) = \sum_{in=0}^{Thres} (in - (\sum_{in=0}^{Thres} in * n_{in} / |\mathrm{n}_{in}|) * \sum_{in=0}^{Thres} n_{in} / |\mathrm{n}_{in}|)$$

$$\mathrm{var}\,iance(\sigma^2_{inter-class_2}) = \sum_{i=Th+1}^{N-1} (i - (\sum_{it=Thres+1}^{N-1} it * n_{it} / |\mathrm{n}_{it}|) * \sum_{it=Thres+1}^{N-1} n_{it} / |\mathrm{n}_{it}|)$$

Step 5: Intraclass variation of the image can be computed using

$$Variance(\sigma^2_{inter-class_1}) = \sum_{in=0}^{Thres} (in - (\sum_{in=0}^{Thres} in * n_{in} / |\mathrm{n}_{in}|) * \sum_{in=0}^{Thres} n_{in} / |\mathrm{n}_{in}|) +$$

$$\mathrm{var}\,iance(\sigma^2_{inter-class_2}) = \sum_{i=Th+1}^{N-1} (i - (\sum_{it=Thres+1}^{N-1} it * n_{it} / |\mathrm{n}_{it}|) * \sum_{it=Thres+1}^{N-1} n_{it} / |\mathrm{n}_{it}|)$$

III. EXPERIMENTAL RESULTS

The proposed thresholding segmentation is implemented by using Matlab 7.9. The experimental results are tested in Intel i3 processor with 1GB RAM.

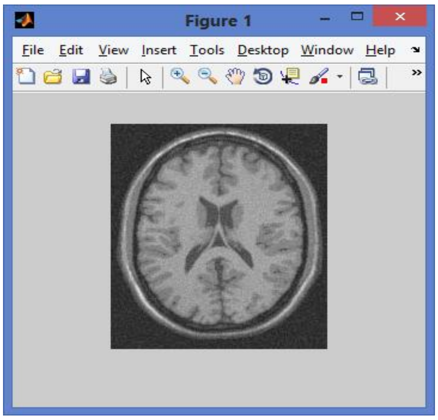

Fig 1: Original Source Image

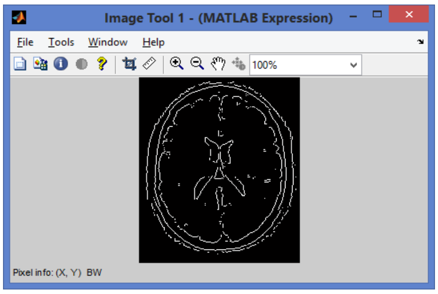

Fig 2: Initial Edge Detector

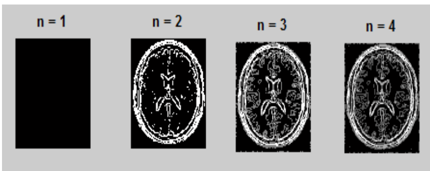

Fig 3: Otsu's Method with n value

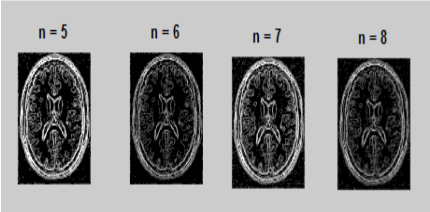

Fig 4: Otsu's Method with n value

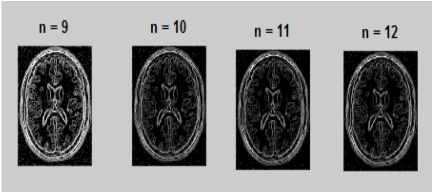

Fig 5: Otsu's Method with n value

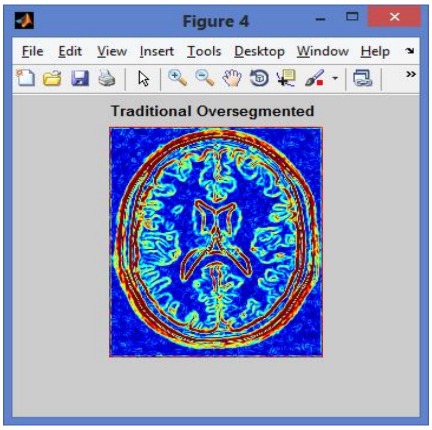

Fig6: Traditional Otsu's Method

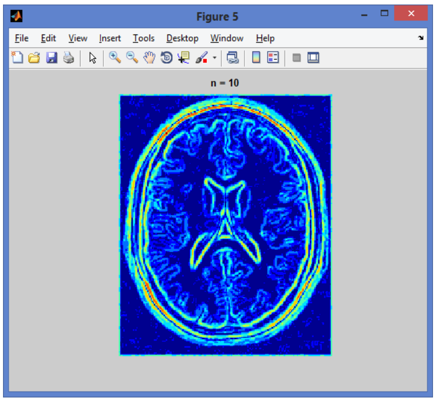

Fig 7: Proposed n=10

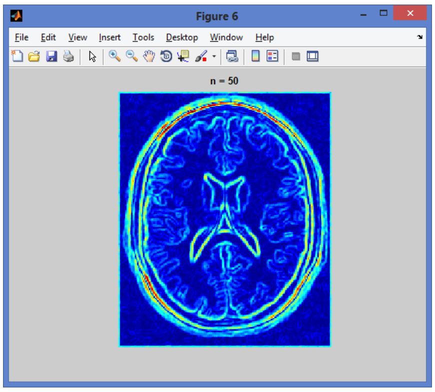

Fig 8: Proposed n=50

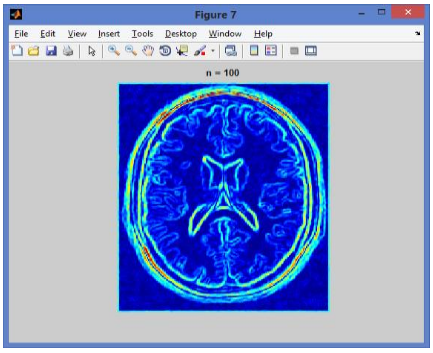

Fig 9: Proposed n=100

Table 1: Proposed Execution time vs number of segemnets

Model	Numberofsegments	ExecutionTime(secs)
Iterativeotsu	15	8.2
ProposedModel	8	5.7

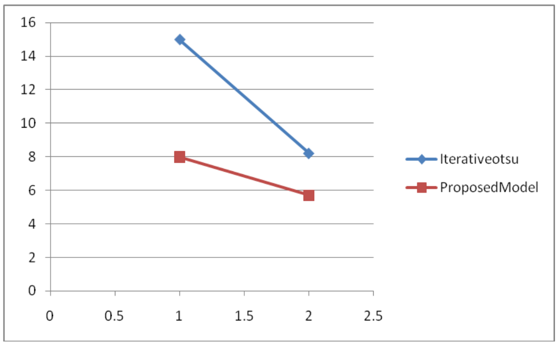

Fig 10: Proposed graph model

IV. CONCLUSION

The implementation of the traditional Otsu method to the R, B, G channels alone will produce some kind of noise and to get rid of this noise a new framework was proposed. The main conclusion comes here is that the increase in window size (k k) that was implemented in filtering process will increase the interior homogeneity of the regions and objects inside the image. Obviously, from the shown results it is clear that there is a direct proportional relation between increasing window size and a good clarity of segmentation results. But this increment in window size must be limited to avoid distortion in the reconstructed image at large window size.

REFERENCES

[1] S. Krinidis and V. Chatzis, *"A robust fuzzy local information C-meansclustering algorithm,"* IEEE Trans. Image Process., vol. 19, no. 5, pp.1328–1337, May 2010.

[2] X. Yin, S. Chen, E. Hu, and D. Zhang, *"Semi-supervised clustering with metric learning: An adaptive kernel method,"* Pattern Recognit., vol. 43, no. 4, pp. 1320–1333, Apr. 2010.

[3] L. Zhu, F. Chung, and S Wang, *"Generalized fuzzy C-means clustering algorithms with improved fuzzy partitions," IEEE* Trans. Syst. Man, Cybern. B, Cybern. vol. 39, no. 3, pp. 578–591 Jun. 2009.

[4] S. Tan and N. A. M. Isa, *"Color image segmentation using histogram thresholding fuzzy C-means hybrid approach,"* Pattern Recognit., vol. 44, no. 1, pp. 1–15, 2011.

[5] C. Li, R. Huang, Z. Ding, J. C. Gatenby, D. N. Metaxas, and J. C. Gore, *"A level set method for image segmentation in the presence of intensity inhomogeneities with application to MRI*," IEEE Trans. Image Process. vol. 20, no. 7, pp. 2007–2016, Jul. 2011.

[6] J. Dunn, *"A fuzzy relative of the ISODATA process and its use in detecting compact well-separated clusters,"* J. Cybern., vol. 3, no. 3, pp. 32–57, 1974.

[7] J. Bezdek,*" Pattern Recognition with Fuzzy Objective Function Algorithms."*New York: Plenum, 1981.

[8] M. Ahmed, S. Yamany, N. Mohamed, A. Farag, and T. Moriarty, *"A modified fuzzy C-means algorithm for bias field estimation and segmentation of MRI data,"* IEEE Trans. Med. Imag., vol. 21, no. 3, pp. 193–199, Mar. 2002.584.

[9] S. Chen and D. Zhang, *"Robust image segmentation using FCM with spatial constraints based on new kernel-induced distance measure,"* IEEE Trans. Syst., Man, Cybern., B, Cybern., vol. 34, no. 4, pp. 1907–1916, Aug. 2004.

[10] L. Dong, G. Yu, P. Ogunbona, and W. Li, *"An efficient iterative algorithm for image thresholding,"* Pattern Recognit. Lett. vol. 29, no. 9, pp. 1311–1316, Jul. 2008.

