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Fuzzy Edge Detection Using Minimum Cross Entropy Thresholding for MRI Brain Image

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Abstract— In this paper, the aim is finding the accurate edge of the brain image. Edge detection is the most important task in medical applications. Edge detection is the boundary of the particular image. MRI brain analysis is used for visualizing, analyzing and measuring the brain parts. Thresholding is the basic tool for image segmentation. Thresholding generate the binary image from the grayscale image by using some threshold value. Segmentation is the process to assign the pixels in the image to two or more classes. Here, this paper threshold the MRI Brain image using Minimum Cross-Entropy Thresholding. The cross entropy is the computationally attracting algorithm and the cross entropy is formulated in pixel to pixel basis. Then the resulting thresholding image applied the Fuzzy interface system. The Fuzzy Interface System has the many rules. The thresholding image checks the each rule, then identify the edge. The experiment is using the MRI brain image.

Keywords— Minimum Cross Entropy Thresholding, Fuzzy Edge detection, Fuzzy interface system, MRI head scans

I. INTRODUCTION

In medical image analysis edge detection is the most active research area. Edges are changes of an image discontinuity. Edges are classified into three types' horizontal, vertical and diagonal. Edge detection is used to calculate the boundary of the extracted object.

MRI brain image analysis is the critical task in medical field. We need different processing step to find accurate result. When the manual segmentation it will not get more accurate so the computerized method will produce the accurate result and time consuming.

Image segmentation is the process of dividing a digital image into many segments. Pixels in a region are similar according to some homogeneity criteria such as color intensity or texture, so as locate and identify objects and boundary in an image [1]. The aim of segmentation is segment the region that is easier to analysis and it will be the most meaningful. Each pixel of a segment the partitions of an image with the similar attribute.

This paper, we have to use the Minimum Cross-Entropy for threshold the image. Entropy is "the measure of information content in probability distribution" [3]. Among them, Li and Lee (1993) introduced the minimum cross entropy thresholding algorithm that selects the threshold, which minimizes the cross entropy between the segmented image and the original image [2].

Fuzzy logic provides the methodology for human experience based knowledge to manipulating and implementing. Fuzzy logic control appears very useful when linearity and time invariance of the controlled process cannot be assumed, when the process lacks a well posed mathematical model, or when human understanding of the process is very different from its model [4].

Section I contains the introduction of Segmentation, Edge detection, Fuzzy, Minimum Cross-Entropy, Section II contain the image segmentation, Section III contain the algorithm of Minimum Cross-Entropy thresholding and FIS rules, Section IV contain the flow chart, section V is the result and discussion, Section VI is conclusion.

II SEGMENTATION OF THE IMAGE

EDGE DETECTION

In medical image processing edge detection is the low level operation. The goal of edge detection is the find the boundary of the object. These boundaries are used to identify objects for segmentation and matching purposes [5]. A wide range operators are available that can extract the edges from

noisy image [6] [7]. But it will not give the accurate result for detecting the edge. In this paper, we used the fuzzy based edge detection.

THRESHOLDING

Thresholding is the fundamental tool for image segmentation. Thresholding convert the gray image to the binary image. There are various thresholding method are available in image processing, this paper, we applied the Minimum Cross-Entropy thresholding used for binaries the original image. Then the resulting threshold image applied the fuzzy interface system and calculates the boundary of the object.

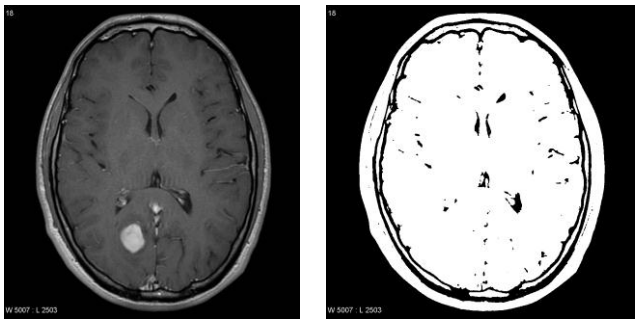


Figure 2: Threshold Image

III METHODOLOGY

MINIMUM CROSS ENTROPY THRESHOLDING

The cross entropy was proposed by kullback [10]. Let X=$\{x_1, x_2, \ldots, x_N\}$ and $Y = \{y_1, y_2, \ldots, y_N\}$ be the same set of two probability distribution. The cross entropy between the X and Y is an information theoretic and the two probability distribution distance is defined by

$$D(X,Y) = \sum_{i=1}^{N} f_i \log \frac{X_i}{Y_i} \quad (1)$$

The minimum cross entropy thresholding (MCET) algorithm [13]. It chooses the threshold by minimizing the cross entropy. The cross entropy between the threshold image and the original image

Let I be the original image, then the histogram h (I) with the gray level L, I=1,2,…, L. I_t denoted the threshold image the threshold fromnstructed by

$$I_t(a,b) = \begin{cases} \mu(1,t), & I(a,b) < t \\ \mu(t,L+1), & I(a,b) \leq t \end{cases} \quad (2)$$

Where

$$\mu(m,n) = \sum_{i=m}^{n-1} ih(i) / \sum_{i=m}^{n-1} h(i) \quad (3)$$

The cross entropy is calculated by

$$D(t) = \sum_{i=1}^{t-1} ih(i) \log\left(\frac{i}{\mu(1,t)}\right) + \sum_{i=1}^{L} ih(i) \log\left(\frac{i}{\mu(t,L+1)}\right) \quad (4)$$

The Minimum cross entropy threshold t^* by minimizing the cross entropy,viz

$$t^* = \arg\ min_t \{D(t)\} \quad (5)$$

FUZZY INTERFACE SYSTEM

The fuzzy interface system we applied 3*3 masks slid the whole image. Here we apply two inputs 0 and 1, 0 denote black and 1 denotes white, then the signed membership function used for input and the triangular membership function is used for output. The three outputs are black, white and edge

Table 1:3*3 mask

P1	P2	P3
P4	P5	P6
P7	P8	P9

The eight input pixels are P1, P2, P3, P4, P6, P7, P8, P9 then P5 is the output pixel.

There are 28 rules are inserted in Rule Editor. We have to define the rules for the fuzzy interface system. In this paper, 3*3 masks are used and 28 rules are followed [8] [9].

P1	P2	P3	P4	P6	P7	P8	P9	P5
1	1	1	1	1	0	0	0	E
0	0	0	1	1	1	1	1	E
0	1	1	0	1	0	1	1	E
1	1	0	1	0	1	1	0	E
0	0	1	0	1	0	1	1	E
1	1	0	1	0	1	0	0	E
0	1	1	0	1	0	0	1	E
1	0	0	1	0	1	1	0	E
0	0	0	0	1	1	1	1	E
1	1	1	0	1	0	0	0	E
0	0	0	1	0	1	1	1	E
1	1	1	1	0	0	0	0	E
0	0	0	0	0	1	1	1	E
0	0	1	0	1	0	0	1	E
1	1	1	0	0	0	0	0	E
1	0	0	1	0	1	0	0	E
0	1	1	0	1	1	1	1	E
1	1	1	0	1	0	1	1	E
1	1	1	1	1	0	0	1	E
0	0	1	1	1	1	1	1	E
1	1	1	1	1	1	0	0	E
1	1	1	1	0	1	1	0	E
1	1	0	1	0	1	1	1	E

1	0	0	1	1	1	1	1	E
1	0	0	1	0	1	1	1	E
1	1	1	1	0	1	0	1	E
0	0	1	0	1	1	1	1	E
1	1	1	0	1	0	0	1	E

Table 2: Fuzzy Rules

IV Flow chart

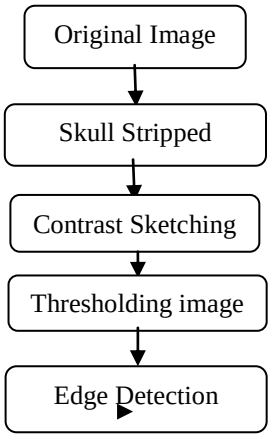


Figure 3: Flow chat for entire operation

V RESULT

The edge detection is successfully taken by using the minimum cross entropy thresholding and FIS. At first we have the original image, then add some pre-processing operation like contrast sketching and filtering for image appearing clear. The images are thresholding by using the Minimum Cross-Entropy. This method is based on the gray level histogram. The result image applied the fuzzy interface system and it has rules. The masks slid the whole image and find the edge.

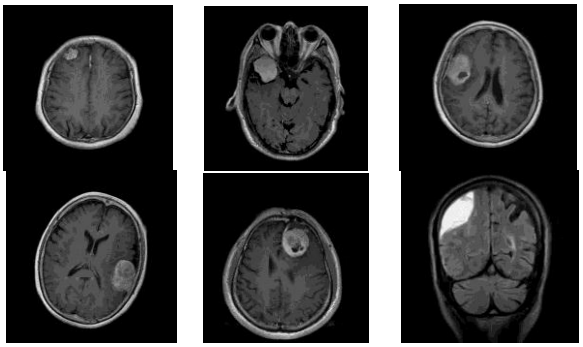


Figure 4: Original image

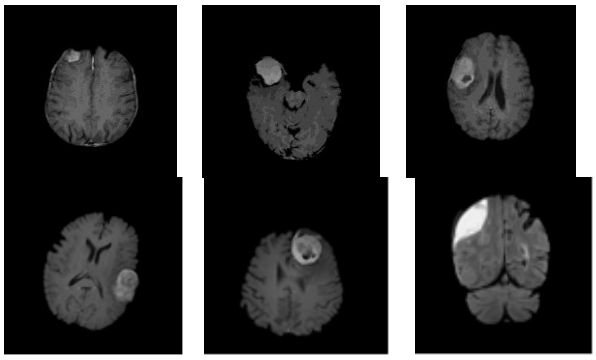


FIGURE 5: SKULL STRIPPED IMAGE

FIGURE 6: THRESHOLDING IMAGE

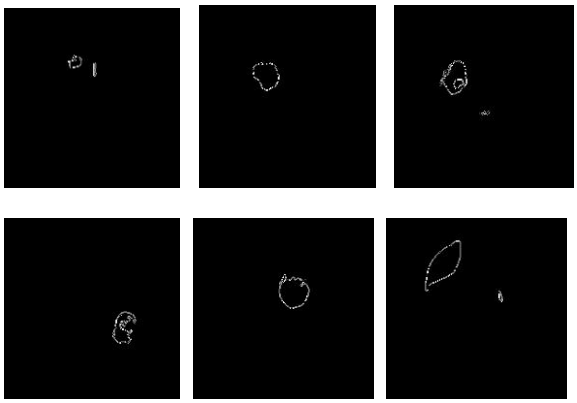
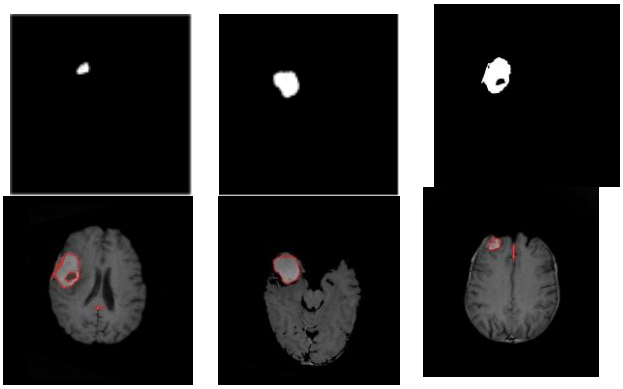


FIGURE 7: EDGE DETECTION



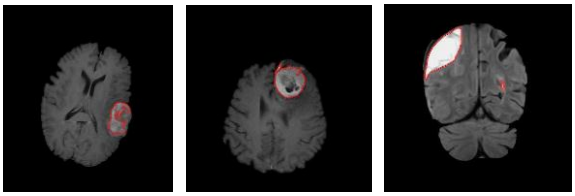


FIGURE 8: RESULT

VI CONCLUSION

Minimum Cross Entropy is the thresholding technique. The Minimum Cross Entropy method finds the tumor in the given brain image. We want to identify the edge of a particular brain tumor. The fuzzy logic method is used to find the more accurate result of edge detection. The size of the mask is 3*3 give more rules give the accurate result.

REFERENCES

[1]Rafael C.Gonzalez Richard E. Woods, "*Digital Image Processing*".2nd ed., Beijing:Publishing House Of Electronics Industry, 2007.

[2] C. Li, and C.Lee , "*Minimum Cross Entropy Thresholding*" . Pattern Recognition-Elsevier , vol 26,1993,pp.617-625.

[3]A.sengur, I.Turkoglu and M. Ince, "*A Comparative Study On Entropic Thresholding Methods* " Journal of Electrical & Electronicics Engineering , vol.6,no.2,2006,pp.183-188.

[4]K.M.Passion , S.Yurkovich," *Fuzzy control*" , Addison Wesley,1998.

[5]H.Voorhees and T.Poggio,"*Detection textons and texture boundaries in natural images*" ICCV 87:250-25,198

[6]S.Selvarajan and W.C.Tat,"*Extraction Of man-made features from remote sensing imageries by data fusion technique*" 22nd Asian Conference on Remote Sensing ,5-9 Nov.2001 ,Singapore

[7]E.Argyle,"*Technique for edge detection* " proc. IEEE ,vol 59,pp.285-286,1971.

[8] Yau-Hwang Kuo, Chang-Shing Lee and Chao-Chin Liu, ―*A New Fuzzy Edge Detection Method for Image Enhancement*‖, IEEE,p 1069-1074 97.

[9] N. Senthilkumaran, R. Rajesh, "*Edge Detection Techniques for Image Segmentation and A Survey of Soft Computing Approaches*", International Journal of Recent Trends in Engineering, Vol. 1, No. 2, PP.250-254, May 2009.

[10] S.Kullback ,"*Information Theory and statistics*" ,Dover,New York,1968.

Authors Profile

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