International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 3 Issue 12, December-2014

Boundary Detection Algorithm Implementation for Medical Images

Prof. S. S. Kattire
Electronics & Telecommunication Engg.
DKTE's Textile & Engg. Institute
Ichalkaranji, India.

Prof. A. V. Shah
Electronic Dept.
DKTE's Textile & Engg. Institute
Ichalkaranji, India.

***Abstract*— we propose a new algorithm for boundary detection of various types of medical images. This algorithm is basically implemented in two steps. In first part vector information of image is calculated. In the second step texture information is calculated. In this method magnitude and directions, both are considered while calculating vector information. The vector details of image give idea about edge. Texture details are used to derive edge map. Not only magnitude of image but direction is also considered so this paper gives better result as compared to previous methods.**

Keywords— vector information, edge, boundary detection.

I. INTRODUCTION

In past years different types of algorithm are developed for detection of boundary of medical images. In field of image processing, segmentation is very important for various purposes. Segmentation also plays vital role in boundary detection. Two types of segmentation methods are available for boundary detection one which is based on edge data and another one which is based on regional data. Roberts, Sobel, Prewitt, Laplacian, and Canny[2], these are segmentation methods based on edge data and all of which are based on the difference of gray levels. Thresholding, clustering, region growing, and splitting and merging these are segmentation techniques based on regional data. This is based on similarity of regional data. But both of them have some limitations in boundary detection if that image contains noisy information. In image processing, there are many algorithms are available to overcome these limitations. Gradient is also an important for detection of boundary. But gradient based edge detection has several difficulties. In medical image, correct boundary is never detected because of noise content. Most of methods cannot give correct estimation of boundary. Normally medical images are very complex and too much noisy. To solve this problem this new algorithm is proposed.

II. BLOCK DIAGRAM OF PROPOSED SYSTEM

This algorithm is calculated in different steps. First step includes reading image. Then preprocessing and enhancement is carried out to remove noise and to improve image quality. Boundary detection algorithm helps to find correct boundary of noisy image [13].

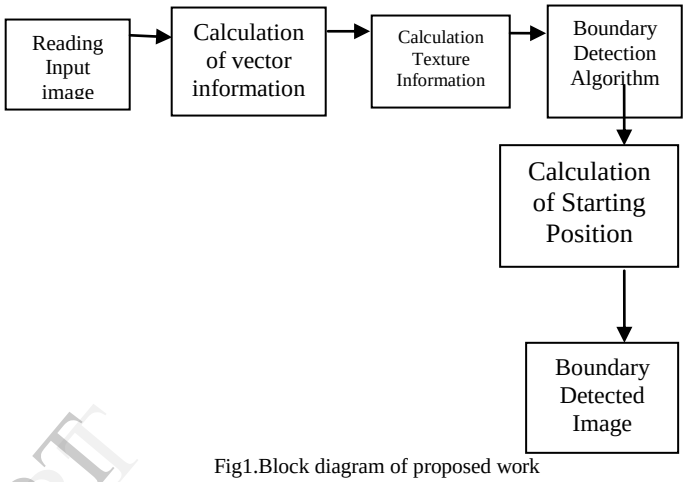


Fig1.Block diagram of proposed work

As shown in block diagram work is carried out in various stages. Reading of input image, pre-processing and image enhancement, calculation of vector information, calculation of texture information, boundary detection algorithm.For filtering purpose we are going to implement low pass or median filter. Median filter is used to reduce noise in preprocessing stage. Nonlinear digital filtering technique, often used to remove noise is referred as median filter. Image enhancement is also carried out to improve quality. Convolution between original image and corresponding mask gives idea about vector information. Texture information is obtained from Law's texture and canny edge detection. Finally boundary detection algorithm is applied to yield correct boundary of input image.

III. CALCULATION VECTOR INFORMATION

Suppose input image is represented by I(x, y).By using following equations vector information is calculated.

$$\vec{v}(i,j) = \frac{1}{k}(Mx(i,j)\vec{\imath} + My(i,j)\vec{\jmath}) \quad (1)$$

$$\vec{v}(i,j) = \frac{1}{k}\left(\frac{\partial I(x,y)}{\partial x}\vec{\imath} + \frac{\partial I(x,y)}{\partial y}\vec{\jmath}\right) \quad (2)$$

$$k = \max_{i,j}\left(\sqrt{Mx(i,j)^2 + My(i,j)^2}\right) \quad (3)$$

Each element is the convolution between the image and the corresponding difference mask which are calculated

using the Gaussian vector operator. These operators are represented in the x and y directions, respectively. Magnitudes of edges and directions of edges of an object give vector information. But in noisy images the vectors may distribute randomly in magnitude and direction. To overcome this limitation average is calculated. Because of which average of all the values in the local neighborhood is calculated and it is placed at position of each vector. In this algorithm 3 × 3 window is considered.

IV. CALCULATION OF TEXTURE INFORMATION

Important information about boundary is obtained at this stage. Law's texture and Canny edge detection yields edges of objects in an image[13]. Here texture details of image are obtained by performing convolution of input I(x.y) with the mask. Mask is calculated by the multiplication of column vector L and its transpose. Where L=(1, 4, 6, 4, 1).Then input image is convolved with texture mask to derive output image. After this edge detection is carried out using canny operator. Basic purpose of using canny edge detector is to reduce noise and locate object boundary. In canny edge detector previous output image is convolved with Gaussian filter. After that magnitude and direction of gradient is obtained. Finally thresholding is done to detect edges. At this step texture details are obtained from input medical image.

V. BOUNDARY DETECTION ALGORITHM

At this stage boundary of object is detected. In most of the algorithm only magnitude of information is used to derive boundary. But in many applications this method cannot detect correct boundary. So in this method along with magnitude, direction of input image is calculated and which is used as basic information for searching correct boundary. This algorithm uses information obtained at previous stage i.e vector information and texture information .In this way here more information is available that will be useful for correct boundary detection. And probability of error will also be very less as compared to previous methods.

VI. STARTING POSITION

This stage is performed to determine a starting position of edge which can be used for the boundary detection. This starting position estimation is very important. If this is taken incorrectly then incorrect boundary will be detected at final output. Determination of starting position of image is very difficult and it takes too much time in computation. In this algorithm the starting position of edge is determined by the different steps. Average magnitude of the image I(x,y) is determined at first stage. Average magnitude is indicated by M (i, j).The position that represents high magnitude should be a good element of strong edges on the image. Then for each and every pixel density of edge is calculated from vector information and texture information. To determine edge length, density of image is calculated by considering every pixel. Following equation is used to obtain the density of edge length in each pixel. Density is indicated by d (i, j).

$$d(i, j) = N(i, j)/\max N(i, j) \quad (4)$$

Here N (i, j) represents the number of connected pixels at each position of pixel. At last stage summation of average magnitude and density of edge length determined which represents starting position of image. Starting position is indicated by S(i ,j).

$$S(i, j) = 1/2(M(i, j) + d(i, j)). \quad (5)$$

Finally thresholding may be carried out so that it will represent correct starting position. If Tmax < S(i, j) then S(i, j) is the correct starting position of edge. Here threshold is equal to 95 % of its ,maximum value.

VII. PERFORMANCE PARAMETERS

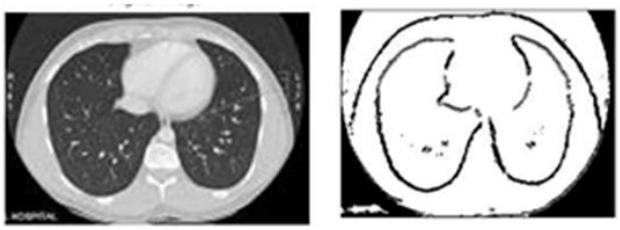
Different types of medical images such as lung cancer CT image, Heart images, Lung nodule MRI image are tested by this algorithm. And various parameters are calculated such as probability of error, Hausdorff distance, Mean square error and peak signal to noise ratio. Following table shows calculation for different medical images.

Table1 .Observation Table

Image	Probability of error	Hausdorff distance	MSE	PSNR
Lung cancer CT image	4.9208	3.7417	0.03	63.86
Heart CT image	4.1725	3	0.00	76.01
Lung image	3.7891	3.3166	0.03	63.92
Lung nodule MRI image	4.0393	3.8730	0.01	68.66
Lung cancer MRI image	6.4276	4.1231	0	78.52

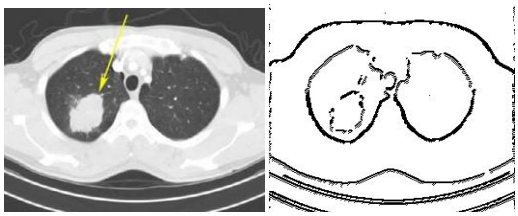
VIII. RESULT

RESULTS FOR ABOVE IMAGES ARE SHOWN BELOW



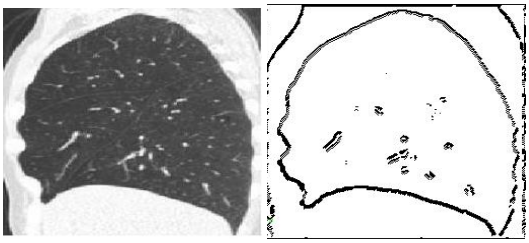
(A) ORIGINAL IMAGE OF HEART (B) FINAL OUTPUT

Fig.2 Original and final output of heart image



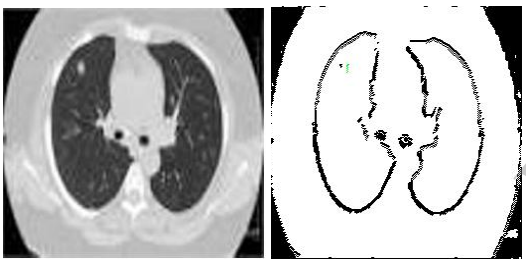
(A)LUNG CANCER ORIGINAL IMAGE (B) FINAL OUTPUT

Fig.3 Original and final output of lung cancer image.



A)LUNG ORIGINAL IMAGE (B) FINAL OUTPUT

Fig4.Original and final output of lung image



A)LUNG (MRI) ORIGINAL IMAGE (B) FINAL OUTPUT

Fig4.Original and final output of lung MRI image

CONCLUSION

We introduced boundary detection algorithm for noisy medical images. It can also be applied to any image processing problems in which ill-defined edge is encountered. This is another advantage of our proposed method over the classical contour models to detect the correct object boundary. It gives better results as compared to previous models. Also computation cost for this method is very less as compared to previous methods.

REFERENCES

[1] M.Kass, Andrew Witkin, Demetri Terzopoulos "Snakes: Active contour models "*The Eighth International Journal of Computer Vision*, pp.321-331, 1988.

[2] J. Canny "A computational approach to edge detection," *IEEE Transaction on Pattern Analysis and Machine Intelligence*, vol. PAMI-8, no. 6, pp. 679-698, 1986.

[3]Tony F Chan "Active contours without edges" *IEEE Transaction on Image processing*, vol. 10, no. 2, pp.266-277, 2001.

[4] Pankaj Agrawal, Dr. S. K. Shriwastava *"MATLAB implementation of image segmentation algorithms," IEEE*, pp. 427-431,

[5]Saurabh Chaudhury "A new approach for image segmentation with MATLAB," *International Conference on Computer Communication Technology*, pp.194-197, 2010.

[6] Richard J. Qian and Thomas S. Huang "Optimal edge detection in two-dimensional Images" *IEEE Transaction on Image processing*, vol. 5, no. 7, pp.1215-1220, 1996.

[7] Raman Maini & Dr. Himanshu Aggarwal "Study and Comparison of Various Image Edge Detection Techniques" *International Journal of Image Processing*, Volume 3: Issue 1, pp.1-

[8] J. R. Parker, "*Algorithms for Image Processing and Computer Vision*" New York Wiley,1997.

[9] R. C. Gonzalez and R. E. Woods, *Digital Image Processing. Reading*, MA: Addison-Wesley,1992.

[10] J. M. S. Prewitt, "Object enhancement and extraction," in *Picture Processing and Psychopictorics.* B. S. Lipkin and A. Rosenfeld, Eds., New York: Academic Press, pp. 75– 149, 1970.

[11] V. Caselles, F. Catte, T. Coll, and F. Dibos, "A geometric model for active contours,"*Numer.Math.*, vol. 66, pp. 1–31, 1993.

[12] F. Leymarie and M. D. Levine, "Tracking deformable objects in the plane using an active contour model," *IEEE Trans. Pattern Anal. Mach. intell.*, vol. 15, no. 6, pp. 617–634, Jun.1993.

[13]K.Somkantha,N.Theera-Umpon,S.Auephanwiriyakul "Boundary Detection in Medical Images Using Edge Following Algorithm Based on Intensity Gradient and Texture Gradient Features" *IEEE Tran on biomedical engineering*, vol. 58, no. 3, March 2011.

[14] J. Guerrero, S. E. Salcudean, J. A. McEwen, B. A. Masri, and S. Nicolaou, "Real-time vessel segmentation and tracking for ultrasound imaging applications," IEEE Trans. Med. Image., vol. 26, no. 8, pp. 1079– 1090, Aug. 2007.

[15] F. Destrempes, J. Meunier, M.-F. Giroux, G. Soulez, and G. Cloutier, "Segmentation in ultrasonic B-mode images of healthy carotid arteries using mixtures of Nakagami distributions and stochastic optimization," IEEE Trans. Med. Image., vol. 28, no. 2, pp. 215–229, Feb. 2009.

[16] N. Theera-Umpon and P. D. Gader, "System level training of neural networks for counting white blood cells," IEEE Trans. Syst., Man, Cybern. *C, App. Rev.*, vol. 32, no. 1, pp. 48–53, Feb. 2002.

[17] N. Theera-Umpon and S. Dhompongsa, "Morphological granulometric features of nucleus in automatic bone marrow white blood cell classification," IEEE Trans. Inf. Technol. Biomed., vol. 11, no. 3, pp. 353–359, May 2007.

[18] J. Carballido-Gamio, S. J. Belongie, and S. Majumdar, "Normalized cuts in 3-D for spinal MRI segmentation," IEEE Trans. Med. Image., vol. 23, no. 1, pp. 36–44, Jan. 2004.

[19] J.-D. Lee, H.-R. Su, P. E. Cheng, M. Liou, J. Aston, A. C. Tsai, and C.-Y. Chen, "MR image segmentation using a power transformation approach," IEEE Trans. Med. Image., vol. 28, no. 6, pp. 894–905, Jun. 2009.

[20] H. Greenspan, A. Ruf, and J. Goldberger, "Constrained Gaussian mixture model framework for automatic segmentation of MR brain images," IEEE Trans. Med. Image., vol. 25, no. 9, pp. 1233–1245, Sep. 2006.

[21] N. Eua-Anant and L. Udpa, "A novel boundary extraction algorithm based on a vector image model," in Proc. IEEE Sym. Circ. and Syst., 1996, pp. 597–600.

[22] P. Jiantao, J. K. Leader, B. Zheng, F. Knollmann, C. Fuhrman, F. C. Sciurba, and D. Gur, "A computational geometry approach to automated pulmonary fissure segmentation in CT examinations," IEEE Trans. Med Image., vol. 28, no. 5, pp. 710–719, May 2009.

[23] I. Isgum, M. Staring, A. Rutten, M. Prokop, M. A. Viergever, and B. van Ginneken, "Multi-Atlas-based segmentation with local decision fusion—Application to cardiac and aortic segmentation in CT scans," IEEE Trans. Med. Image., vol. 28, no. 7, pp. 1000–1010, Jul. 2009.

[24] E. Argyle, "Techniques for edge detection," Proc. IEEE, vol. 59, no. 2, pp. 285–287, Feb. 1971.