Detection Of Clot In Brain MRI Images By Using Segmentation Techniques

Heena Dafade, Akash Dutta
Department Of Electronics Engineering
Shri Ramdeobaba College Of Engineering And Management, Nagpur

Abstract

Magnetic Resonance Imaging [MRI] provides good contrast between the different soft tissues of the body compared with other medical imaging techniques. Hence Brain MRI Images is quite useful in the detection of brain abnormalities such as clot. Clot is a condition in which there is insufficient flow of blood to the brain to meet the metabolic demand. In this paper, we are detecting the clot by implementing two proposed techniques of segmentation. Such as Edge Based and Region Based Segmentation. In the first category, the assumption is made that the boundaries of the region are sufficiently different from each other and background. So, boundary detection is based on discontinuity in intensity. Whereas, region based segmentation approaches on partitioning an image into regions according to a set of predefined criteria.

***Keywords* — MRImage, Discrete Wavelet Transform,Gabor Wavelet, Threshold Segmentation, Morphological** Operation

1. INTRODUCTION

Advances in Image Processing have enabled in analysis of vast amount of multidimensional biomedical data. Automatic segmentation of medical images is a difficult task as medical images are complex in nature and rarely have any simple linear feature. Further, the output of segmentation algorithm is affected due to:

- Partial volume effect.
- Intensity inhomogeneity
- Presence of artifacts
- Closeness in gray level of different soft tissue

Firstly, we are applying the edge based detection method to the Brain MRI images. Further, the same clot is also detected by using region segmentation method. The last challenge is the analysis on comparison between two used techniques.

Causes of clots in brain:

a. *Athrosclerosis:*
During the aging process, fat and plaque can begin to build up in the arteries. This build up leads to narrowing can result in a stroke.

b. *Brain injury*
Injury to brain can cause bleeding and a clot. The bleeding from traumatic brain injury can lead to compression of brain.

c. *Heart conditions:*
The clot that causes heart attack or problems with valves in the heart can dislodge and move into and occlude arteries that supply the brain.

1.1 Segmentation Techniques

Segmentation is the process dividing an image into regions with similar properties such as gray level, color, texture, brightness, and contrast. The role of segmentation is to subdivide the objects in an image; That is, segmentation should stop when the object or region of interest have been detected.In case of medical image segmentation the aim is to:

- Study anatomical structure
- Identify Region of Interest i.e. locate tumor, lesion and other abnormalities
- Measure tissue volume to measure growth of tumor (also decrease in size of tumor with treatment)
- Help in treatment planning prior to radiation therapy; in radiation dose calculation

Following are the types Segmentation Techniques

1 Edge based
2 Region based
3 Threshold based
4 Deformable models based
5 Fuzzy based

In this paper, we are detecting the clot in Brain MRI Images by comparing two Segmentation Techniques.

1.2 Edge Based Segmentation

Edge based segmentation is the most common method based on detection of edges i.e. boundaries which separate distinct regions. Edge detection method is based on marking of discontinuities in gray level, color etc. and often these edges represent boundaries between objects. This method divides an image on the basis of boundaries. In this paper, we have used Canny Edge Detector.

The generalized algorithm for edge based segmentation has the following steps.

1. Apply the derivative operator to detect edges of the image.
2. Measure the strength of edges by measuring amplitude of the gradient.
3. Retain all edge having magnitude greater than threshold T (removal of weak edge).
4. Find the position of crack edges; the crack edge is either retained or rejected based on the confidence it receives from it predecessor and successor edges.
5. Step 3 and 4 are repeated with different values of threshold so as to find out the closed boundaries; segmentation of an image is achieve.

1.3 Region Based Segmentation

Region based methods are based on the principle of homogeneity - pixels with similar properties are clustered together to form a homogenous region. The criteria for homogeneity is most of the time gray level of pixels.

Region growing, region splitting and merging; these are the alternative procedures involved in region based segmentation.

Region growing is a procedure that group pixels or sub-regions into larger regions based on predefined criteria for growth.

An alternative is to subdivide an image initially into a set of arbitrary, disjoint regions and then merge and/or split the regions in an attempt to satisfy the conditions of segmentation.

The generalized algorithm for region based segmentation has following steps.

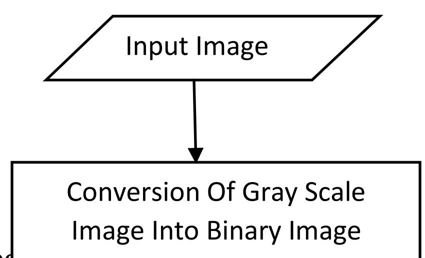
1. Find all connected components in S(x,y) and erode each connected component to one pixel; label all such pixels found as 1. All other pixels in S are labeled 0,
2. Form an image fQ such that, ar a pair of coordinates (x,y), let fQ(x,y)=1 if the input image satisfies the given predicate, Q, at those coordinates; otherwise, let fQ(x,y)=0.
3. Let g be an image formed by appending to each seed point in S all the 1-valued points in fQ that are 8-connected to that seed point.
4. Label each connected component in g with a different region label (eg.,1,2,3,…)

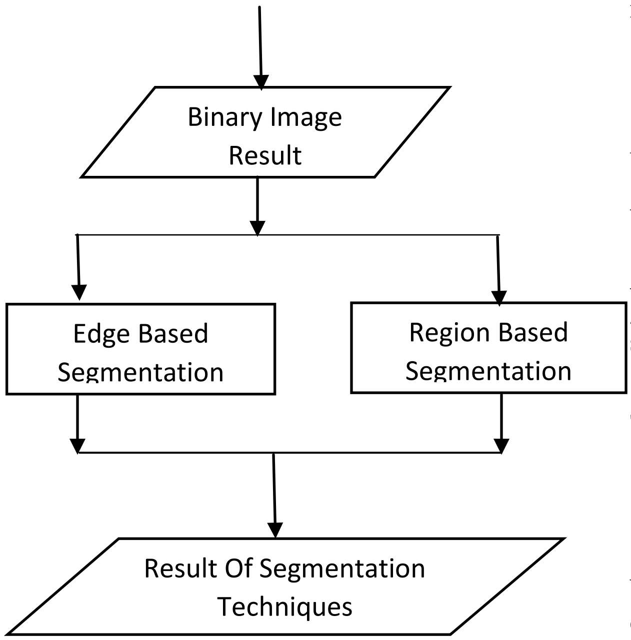
1.4 Threshold Based Segmetation

It creates binary images from grey-level ones by turning all pixels below of the threshold value to zero and all pixels above threshold to one. We are using Otsu's Method for Threshold Based Segmentation.

The method is optimum in the sense that it maximizes the between-class variance, a well-know measure used in statistical discriminant analysis. The basic analysis is that well-threshold classes should be distinct with respect to the intensity value of their pixels &, conversely, that a threshold giving the best separation between classes in terms of their intensity values would be the best (optimum) threshold. In addition to its optimality, Otsu's method has the important property that it is based entirely on computation perform on the histogram of an image, an easily obtainable 1-D array.

2. Flowchart





3.Methodology

The goal of our proposed algorithm is to remove the non-brain tissues of the 2D MRI axial brain images using segmentation operations. As morphology operations require binarization of the image.

3.1 Edge Base Algorithm

An edge in an image may point in a variety of directions, so the Canny algorithm uses four filters to detect horizontal, vertical and diagonal edges in the blurred image. The edge detection operator (Roberts, Prewitt, Sobel for example) returns a value for the first derivative in the horizontal direction (G_x) and the vertical direction (G_y).

From this the edge gradient and direction can be determined:

Let f(x,y) denote the input image and G(x.y) denote the Guassian function:

$$G(x,y)=e-((x^2+y^2)/2a^2)$$

We form a smoothed image, fs(x,y), by convolving G and f:

$$f_s(x,y)= G(x,y)*f(x,y)$$

This operation is followed by computing the gradient magnitude and direction (angle).

$$M(x,y)=\sqrt{}(gx2+gy2)$$

And$\alpha(x,y)=\tan^{-1}(gy/gx)$

withgx=δf/δx and gy=δfs/δy

Any of the filter mask pairs be used to obtain gx and gy. Here, M(x,y) and α(x,y) are arrays of the same size as the image from which they are computed.

3.2 Region base algorithm

$$H(\mathbf{x}) = \begin{bmatrix} L_{xx}(\mathbf{x}) & L_{xy}(\mathbf{x}) \\ L_{xy}(\mathbf{x}) & L_{yy}(\mathbf{x}) \end{bmatrix}$$

where $L_{aa}(\mathbf{x})$is second partial derivative in the a direction and $L_{ab}(\mathbf{x})$is the mixed partial second derivative in the $a$and $b$directions. It's important to note that the derivatives are computed in the current iteration scale and thus are derivatives of an image smoothed by a Gaussian kernel:

$$L(\mathbf{x}) = g(\sigma_I) \otimes I(\mathbf{x}).$$

As discussed in the Harris affine region detectorarticle, the derivatives must be scaled appropriately by a factor related to the Gaussian kernel σ_I^2.

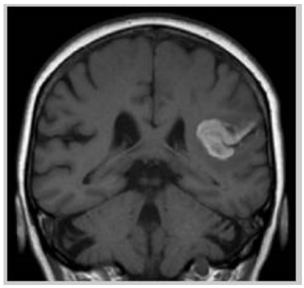
At each scale, interest points are those points that simultaneously are local extreme of both the determinant and trace of the Hessian matrix. The trace of Hessian matrix is identical to the Laplacian of Gaussians (LoG)

$$DET = \sigma_I^2(L_{xx}L_{yy}(\mathbf{x}) - L_{xy}^2(\mathbf{x}))$$
$$TR = \sigma_I(L_{xx} + L_{yy})$$

3. Results

Two segmentation methods are experimented in this paper that is edge based and region based segmentation.

a. Input Image

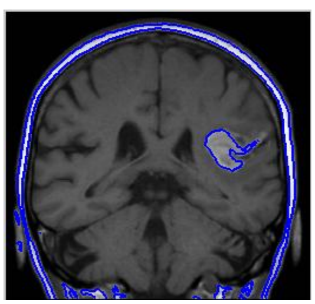


Fig(a) We have taken MRI image of brain as an input.

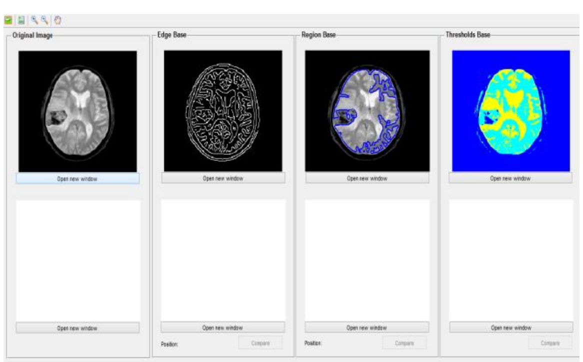
b. Edge Based Segmentation

Fig(b) In edge based segmentation, boundary of clot is detected.

c. Region Based Segmentation



Fig(c) In region based segmentation, area under clot is detected.



Fig(d) In region based segmentation, area under clot is detected

4. CONCLUSION

The proposed algorithm of segmentation techniques of Brain MRI images has been utilized.For future development, further research may focus on overcoming problem of segmenting similar intensity.Our proposed Algorithm is found to be reliable. The experimented results are robust and least dependent on operator. Thus we have achieved accuracy in detection of clotting.

REFERENCES

[1] A Hybrid Method for Automatic Skull Stripping ofMagnetic Resonance Images (MRI) of Human HeadScansK.Somasundaram1 and P.Kalavathi2 2010

[2] A Modified Fuzzy C-Means Algorithm for Bias FieldEstimation and Segmentation of MRI Data Mohamed N. Ahmed, *Member, IEEE*, Sameh M. Yamany, *Member*, *IEEE*, Nevin Mohamed Aly A. Farag*, *Senior Member*, *IEEE*, and Thomas*IEEE* Transaction on Medical Imaging Vol. 21, No. 3, MARCH 2002

[3] BSS and ICA in Neuroinformatics: From Current Practices to Open Challenges Ricardo Vigário and ErkkiOja, *Fellow*, *IEEE* Reviews in Biomedical Engineering VOL. 1, 2008

[4] Brain Functional Localization: A Survey of Image Registration TechniquesAli Gholipour*, Nasser Kehtarnavaz, *Senior Member*, *IEEE*, Richard Briggs, Michael Devous, and Kaundinya Gopinath., Vol. 26, NO. 4, APRIL 2007

[5] A Stochastic Model for Studying the Laminar Structure of Cortex From MRIPatrick Barta*, Michael I. Miller, *Senior Member*, *IEEE*, and Anqi Qiu,*IEEE*Transaction onMedical Imaging IEEE, Vol.24, NO. 6, JUNE 2005

[6] International Journal of Emerging Technology and Advanced EngineeringWebsite: www.ijetae.com