International Journal of Latest Research in Science and Technology **ISSN (Online):2278-5299**
Vol.1,Issue 4 :Page No.369-372 ,November-December 2012
https://www.mnkpublication.com/journal/ijlrst/index.php

PERFORMANCE COMPARISON OF DIFFERENT MEDICAL IMAGE SEGMENTATION ALGORITHMS FOR NORMAL AND ABNORMAL BRAIN MRI

Manoj kumarV[1]Sumithra M G[2]
PG Student[1], Professor of ECE Department[2]
Bannari Amman Institute of Technology, Sathyamangalam
manojpudunagaram@gmail.com[1],mgsumithra@rediffmail.com[2]

Abstract* : *Image segmentation plays an vital role in many medical-imaging applications, for the study of anatomical structures and to identify the region of interest. In this paper explaining the three existing segmentation approaches in medical image segmentation and performance evaluated for these methods for the brain MRI on the basis of pixel value, volume of ROI (region of interest), mean and variance. Then reviewed with an emphasis on the advantages and disadvantages of these methods and showing the implemented outcomes of the thresholding, clustering, region growing segmentation algorithm for the brain MRI.

Keywords *– Image segmentation, thresholding, clustering, region growing, pixel, mean, variance, region of interest.*

INTRODUCTION

Medical imaging is a valuable tool in medicine. Computed Tomography(CT), Magnetic Resonance Imaging (MRI), Ultra Sound imaging(US) and other imaging techniques provide more effective information about the anatomy of the human body. These technologies become more critical in diagnosis and treatment planning in medicine. Some computer algorithms are applying for the description of anatomical structures and other regions of interest. These algorithms become significant in assisting and automating specific radiological tasks. These algorithms, called as image segmentation algorithms, play a vital role in numerous biomedical-imaging applications.

More generally, segmentation can be defined as the process of partitioning a digital image intomultiple segments or into sets of pixels, also known as super pixels.The main goal of the image segmentation is to simplify and/or change the representation of an image into something that is more meaningful and easier to analyse [1].

Medical applications of the segmentation are study of anatomical structure, to identify the region of interest, to measure the tissue volume etc. segmentation methods attempt to partition or group regions according to common image properties. There are various problems in the segmentation of medical image like partial volume effect, intensity inhomogeneity, artifacts, Closeness in gray level of different tissue [1]. Medical images are very complex in nature and very noisy. So segmentation will face more difficulties in medical images.

This paper is organized as follows. Section II describes the four different segmentation techniques that used for the evaluation. Section III discuss the experimental results of various segmentation algorithms. In Section IVconclusion of paper is discussed.

IMAGE SEGMENTATION ALGORITHMS

Image segmentation may use statistical classification, thresholding, edge detection, region detection, or any combination of these techniques. The output of the segmentation step is usually a set of classified elements. Most segmentation techniques are either region-based or edge-based.

A. Thresholding

Thresholding is the simplest method of image segmentation. From a gray scale image, thresholding can be used to create binary images.In this method image is segmenting by comparing pixel values with the predefined threshold limit L [2]. The threshold segmentation can be mathematically represented as

Let I (i,j) be an image

$$I(i,j) = \begin{cases} 0, v(i,j) < L \\ 1, v(i,j) \geq L \end{cases} \qquad (1)$$

where v(i,j) is the pixel value at the position (i,j).

The procedure for the threshold segmentation is described as, comparing individual pixels in an image with threshold value and assign “0” or “1” depend upon the condition described in equation 1. Like that gray scale image convert to binary image.

Publication History
Manuscript Received : 8 December 2012
Manuscript Accepted : 11 December 2012
Revision Received : 23 December 2012
Manuscript Published : 31 December 2012

In the threshold segmentation, threshold is the key parameter. There are different methods to select the threshold. One is manual selection, which is like a trial and error method. Simple automatic threshold selection is based on mean or median and histogram. Unimodal threshold selection algorithm is much better to use in medical images, which is relatively simple, does not require much specific knowledge of the image [2].

B. Region Growing Method

Region growing is a classical segmentation method. This method tries to extracting an image region that is connected based on some predefined criteria. These criteria can be based on intensity information and/or edges in the image [3]. One example for the region growing method is seeded region growing method. The procedure for the same as follows [3].

1. This method takesa set of seeds as input along with the image. (The seeds spot each of the objects to be segmented).
2. The regions are iteratively grown by comparing all unallocated neighbouring pixels to the regions.
3. The difference between a pixel's intensity value and the region's mean, δ, is used as a measure of similarity.
4. The pixel with the smallest difference measured this way is allocated to the respective region.
5. This process continues until all pixels are allocated to a region.

C. Clustering Method

This is an iterative technique that is used to partition an image into clusters. In the clustering method number of clusters K is an input parameter. The main challenge is also the same, because quality of the segmented output depends on the K [1]. Procedure for the clustering is

1. Pick *K* cluster centers, either randomly or based on some heuristic
2. Assign each pixel in the image to the cluster that minimizes the distance between the pixel and the cluster center
3. Re-compute the cluster centers by averaging all of the pixels in the cluster
4. Repeat steps 2 and 3 until convergence is attained (e.g. no pixels change clusters)

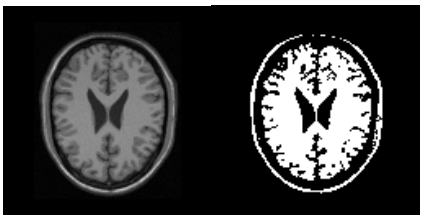
Clusters can be selected manually, randomly, or based on some conditions.Distance between the pixel and cluster center is calculated by the squared or absolute difference between a pixel and a cluster center.

EXPERIMENTAL RESULTS

In this section discusses the implementation of various segmentation algorithms for the MRI of brain. Evaluation for the various segmentation algorithms are considered in this section for the normal brain MRI, abnormal brain MRI.

A. Thresholding

Thresholding is the simplest method of image segmentation. This method is based on a threshold value to turn a gray-scale image into a binary image. Threshold segmentation for the normal brain MRI is shown in fig.1.



(a) **(b)**

Fig.1Threshold segmentation of normal brain MRI (a) original image(b) segmented image

This appropriate threshold segmentation is obtained for the threshold value 0.384. Threshold obtained based on trial and error method.Threshold segmentation of the abnormal brain MRI is shown in fig.2.

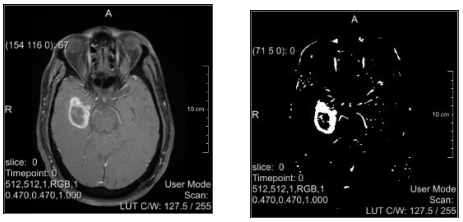
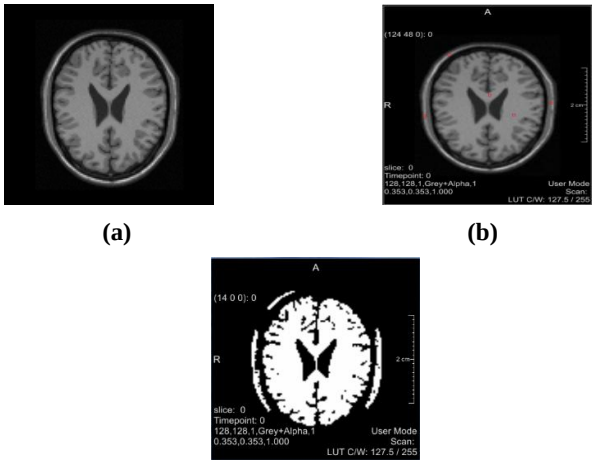


Fig.2 Threshold segmentation of the abnormal brain MRI (a) Original image(b) Segmented image

Appropriate threshold segmentation for the abnormal brain MRI is obtained for the threshold value 0.493. Gray level 0 to 255 is considered.

B. Region Growing

The region growing is a mostly used classical segmentation method. The seeds mark each of the objects to be segmented. There are 5 seed points used in this work for the appropriate segmentation of the normal brain MRI. Region growing segmentation of the normal brain MRI is shown in fig 3.

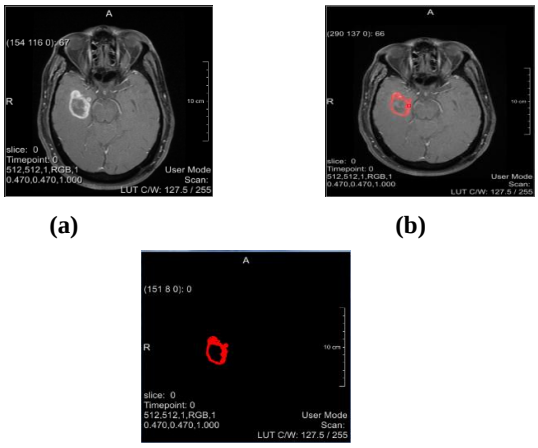


(a) **(b)**

(c)

Fig.3Region growing segmentation of normal brain MRI (a) Original image (b) image with seed point (c) segmented image

Region growing segmentation of the abnormal brain MRI is shown in fig.4.



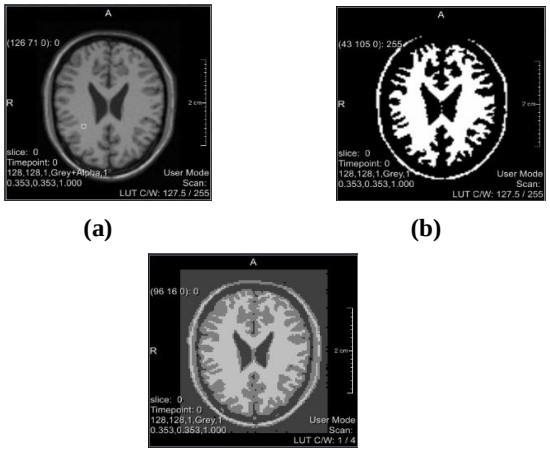
(a) **(b)**

(c)

Fig.4Region growing segmentation of abnormal brain MRI (a) Original abnormal brain MRI, (b) image with seed point (c) segmented image

Region growing method gives better output, when compared to the thresholding method in identifying the abnormality. Region growing clearly extracts the abnormal tissue volume. But it require manual interaction to select the seed point. One seed point used to extract the region of interest. Because abnormal part has unique property when compared to the back ground.

C. Clustering Method



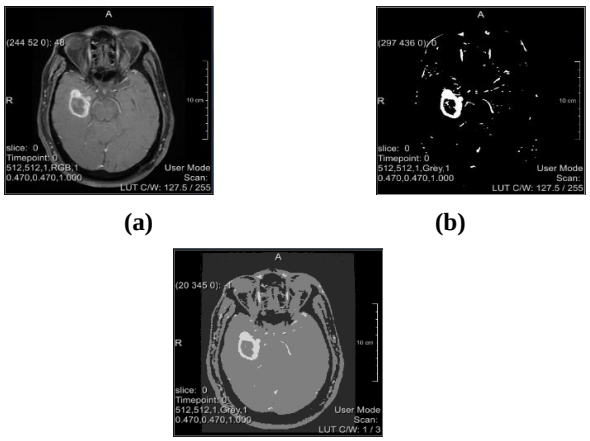
(a) **(b)**

(c)

Fig.5 Cluster segmentation of normal brain MRI (a) Original image (b) segmented image and (c) merged image of (a) and (b)

Clustering segmentation of normal brain MRI is shown in fig.5. In which figure (c) is the merged output of (a) and (b) for the clarity of the image. Here fuzzy c-means algorithm is implemented.Value of cluster center used here for the normal brain MRI is 12.5937, performed iterations is 7.There are missing of more number of pixels in the clustering, when compared to the threshold method and the region growing method.Missing of pixels is due to the noise interference and this lead to the holes in the segmented image. Clustering segmentation for the abnormal brain MRI is shown in fig.6.

It clearly indicates the tumour or abnormal part in the brain MRI and it satisfying the clinical validations like Utility, improved diagnosis and patient management.Value of cluster center used for the clustering is 11.0981 and the iterations performed 3.



(a) **(b)**

(c)

Fig.6Clustering segmentation of abnormal brain MRI (a) original image (b) segmented output.

Table 1 parameters for the segmented normal brain MRI.

Parameters	Threshold	Region Growing	Clustering
Pixel value	16800	14940	8217
Volume(mm^3)	2090.27	1858.85	1022.37
Mean	186.62	67.97	91.18
Standard Deviation	112.97	112.75	122.22

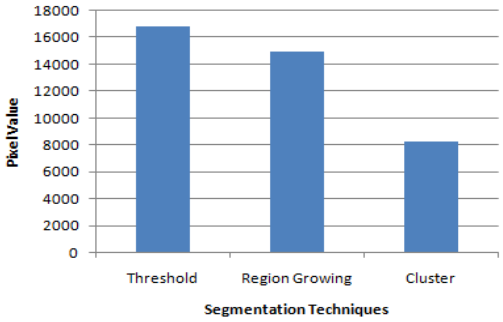
Table 2 parameters for the segmented abnormal brain MRI (ROI).

Parameters	Threshold	Region Growing	Clustering
Pixel value	16470	15372	4617
Volume(mm^3)	3643.96	3401.03	1021.5
Mean	126.52	31.02	112.39
Standard Deviation	127.50	83.36	126.62

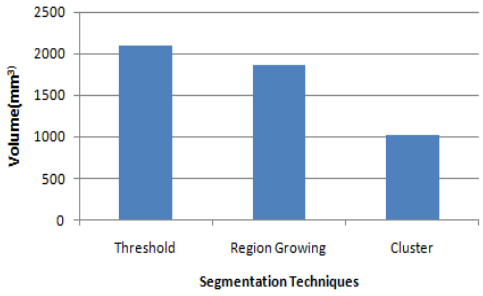
Parameters obtained for the various segmentation methods for normal image and ROI is shown in table 1, 2. Performance comparison for different segmentation methods are shown in following plots.

CONCLUSION

Image segmentation plays a crucial role in many medical-imaging applications, by automating or facilitating the delineation of anatomical structures and other regions of interest. Many methods are existing and still developing the new methods for the segmentation to overcome the shortcomings of the existing methods. Here various segmentation methods have implemented on brain MRI. Outcomes are depend on some input parameter like, threshold for the thresholding, number of cluster centres, and seed point for the region growing method. Region growing needs manual interaction. Running time for the clustering method depends on the number of iteration used. Even though still existing some drawbacks in segmented output. Clustering method gives worst performance, it need pre-processing and region filling process. And if the threshold value is accurate thresholding gives best performance and region growing gives intermediate performance in between the thresholding and clustering. If the existing techniques combined with the pre-processing procedures and volume estimation, output will be better.

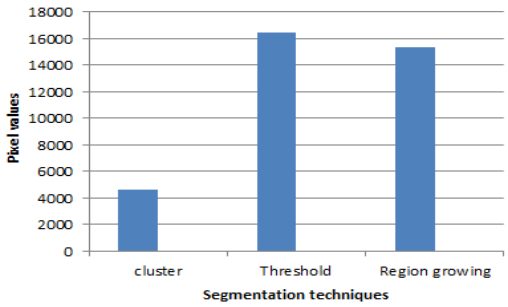


(a)

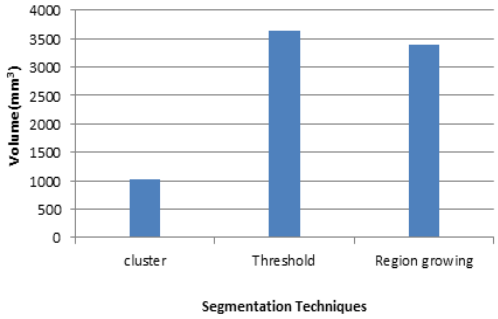


(b)

Fig.7 (a) and (b) performance evaluation for normal brain MRI



(a)



(b)

Fig.8 (a) and (b) performance evaluation for the ROI in abnormal brain MRI

REFERENCE

[1] Dzung L. Pham, ChenyangXu, and Jerry L. Princ,"Current Methods In Medical Image Segmentation," Department of Electrical and Computer Engineering, The Johns Hopkins University,Annu. Rev. Biomed. Eng. 2000. 02:315–37.

[2] Shapiro, Linda G and stockman, George C. Computer Vision. prentice hall. ISBN 0-13-030796-3, 2002.

[3] TranosZuva, Oludayo O, Olugbara, Sunday O. Ojo and Seleman M Ngwira,"Image Segmentation, Available Techniques, Developments and Open Issues,"Canadian Journal on Image Processing and Computer Vision Vol. 2, No. 3, MARCH 2011.

[4] KritSomkantha, NiponTheera- Umpon,,and Sansanee Auephanwiriyakul,"Boundary Detection in Medical Images Using Edge Following Algorithm Based on Intensity Gradient and Texture Gradient Features"ieee transactions on biomedical engineering, vol. 58, no. 3, march 2011.

[5] NahlaIbraheemJabbar, and Monica Mehrotra, "Application of Fuzzy Neural Network for Image Tumor Description", World Academy of Science, Engineering and Technology 44 2008.