Sheenam Bansal, Dr. Raman Maini / International Journal of Engineering Research and Applications (IJERA) ISSN: 2248-9622 www.ijera.com
Vol. 3, Issue 4, Jul-Aug 2013, pp.1640-1643

Performance Analysis of Color Based Region Split and Merge and Otsu's Thresholding Techniques for Brain Tumor Extraction

Sheenam Bansal[1], Dr. Raman Maini[2]
[1]Research Scholar, University College of Engineering, Punjabi University, Patiala
[2]Professor, University College of Engineering, Punjabi University, Patiala

ABSTRACT

A brain tumor is a solid mass of abnormal cells within the brain.It is a set of some tissues that occur due to the rise of uncontrolled cell division. The work forms an image processing pipeline, consisting of noise reduction, feature extraction by image segmentation morphological operations to extract the region of interest. The work is based on the simultaneous use of two segmentation techniques, CB region split and merge segmentation and Otsu's Thresholding to extract the area of brain containing tumor from the magnetic resonance imaging (MRI) of brain.It has been observed that the otsu's thresholding technique gives a better performance in terms of accuracy and diagnosing the complete tumor region from the MRI. The results of this study are quiet promising.

Keywords: Color Based Region Split and Merge, Otsu's thresholding method ,Segmentation,.

I. INTRODUCTION

A brain tumor is said to be an intracranial solid neoplasm that grows within the brain.It is a set of some abnormal tissues that have arisen due to uncontrolled cell division.[1]In normal cell growth the old cells or the damaged ones are replaced by new cells but in abnormal growth, for ceratin unknown reasons the tumor cells keep reproducing at a rapid speed. Brain tumors areclassified based on the cell type from which they grow. They may be primary (starting in the brain) or secondary (spreading to the brain from another area).Various treatment are available in today's time which vary depending on the tumor type, size and location, the age and medical health of the person[1,2].

Magnetic Resonance Imaging has been the major model to diagnose brain tumor from years. It is most commonly utilized for lesion detection, definition of extent, detection of spread and in evaluation of either residual or recurrent disease. Magnetic Resoance imaging has multiplanar imaging capability, high sensitivity to pathologic processes, and excellent anatomic detail which makes it virtually be the choice of imaging study in the evaluation of intracerebral tumors if cost and availability were not issues. Nowadays there are several methodology for classifying MR images, which are fuzzy methods, neural networks, atlas methods, knowledge based techniques, shape methods, variation segmentation[3,4].

The major process involved here is of segmentation. The first step is to preprocess the image to remove noise and enhance the edges. The preprocessed image is then segmented and the final output is obtained by post processing with the help of morphological operations. The two algorithms have been applied on several MRI scans .

II. METHODOLOGY

The two techniques applied here follows the same three stages [5]:

i. Preprocessing of the image
ii. Segmentation on the preprocessed image
iii. Post processing applied on segmented image.

2.1 Color Based Region Split And Merge

Split and merge is a region based segmentation that defines a predicate Q which is the basis of spitting and merging.The steps of execution are:

1. Split into different regions, R_i for which $Q(R_i)$=FALSE
2. When no further splitting is possible,merge adjacent regions R_i and R_j for which $Q(R_i \cup R_j)$=TRUE
3. Stop hn no merging is possible.

The work here is based on colored Region plit and merge. This method eliminates the need of user intervention and make this technique fully automatic without any need to give an initial seed point for the progress of algorithm[6].

The first step is to use median filter to remove salt and pepper noise and enhance the edges.In the segmentation,the initial step is to convert the original gray image to RGB model. This RGB image is then converted to L*a*b color space (,a Lab colorspace is color-opponent space with dimension L for lightness and ***a*** and ***b*** for the color-opponent dimensions, based on nonlinearly compressed CIE XYZ color space coordinates).The next step is to identify total number of different colors in image to split the source Lab space image depending upon the color value.Initially,we chose a small sample region for each color space and then

calculate each region's average color value.Calculate the mean values for areas extracted with roipoly command in MATLAB.Then classify each pixel by calculating the Euclidean distance between the pixel and each color marker and the image is segmented based on different colors After the image has been split using the color markers, it has to be merged to obtain the tumor image. For this, first the image is converted into gray image and then it is converted to binary image using a threshold calculated by graythresh function. To merge, all the connected components have to be removed with the pixels less than 30 (it has been observed that the brain contains five different type of classes : the foreground, background, boundaries, holes and blood vessels ,the brain tumor will not contain less than 30 pixels).Then all the holes and boudaries are removed to obtain the final segmented image.

To the segmented image, the postprocessing is done which involves application of dilation operation followed by erosion.

2.2 Otsu's Thresholding Technique

Otsu's method selects the threshold by minimizing the within-class variance of the two groups of pixels separated by the thresholding operator which in turn maximizes the between-class variance. The separability of two classes is given by:

$$n(k) = \frac{\sigma_B^2(k)}{\sigma_G^2} \quad (1)$$

And

$$\sigma_B^2(k) = \frac{m_G P_1(k) - m(k)^2}{P_1(k)[1 - P_1(k)]} \quad (2)$$

Then the optimum threshold is that value of k that maximizes $\sigma_B^2(k)$. [7]

The method has been implemented in MATLAB 7.0.Firstly the image is preprocessed by applying a high pass filter of matrix of form:

-1	2	-1
0	0	0
1	-2	1

Fig 1: Filter to enhance the image

After this the median filter is applied to the image.Then segmentation is done.In the methodlogy implemented,using the graythresh function of MATALB,a threshold value is obtained and since the tumor region is a highly illuminated region,a value of 0.3 is added to the threshold value computed so that it can correctly diagonise the tumor area.The final threshold thus obtained is applied on the preprocessed image to convert it to a binary image with this threshold value.The image is thus segmented and this image is further ready for post processing to obtain the final tumor image which involves repeated use of dilation and erosion operation,for this a structuring element of shape 'disk' with radius 1 has been used.

III. RESULTS AND DISCUSSIONS

3.1 Qualitative Results

The two techniques have been implemented in MATLAB 7.0 .Using the GUI ,the image is browsed for which the brain tumor has to be extracted. The results for the two techniques that have been implemeneted follows in this section.It has been found that the otsu's thresholding technique has found to work better in terms of accuracy for extracting brain tumor than color based region split and merge.The color based region split and merge fails to identify the difference between boundaries and tumor area while the otsu's technique clearly extracts the tumor area,giving a better result.The images are as follows:

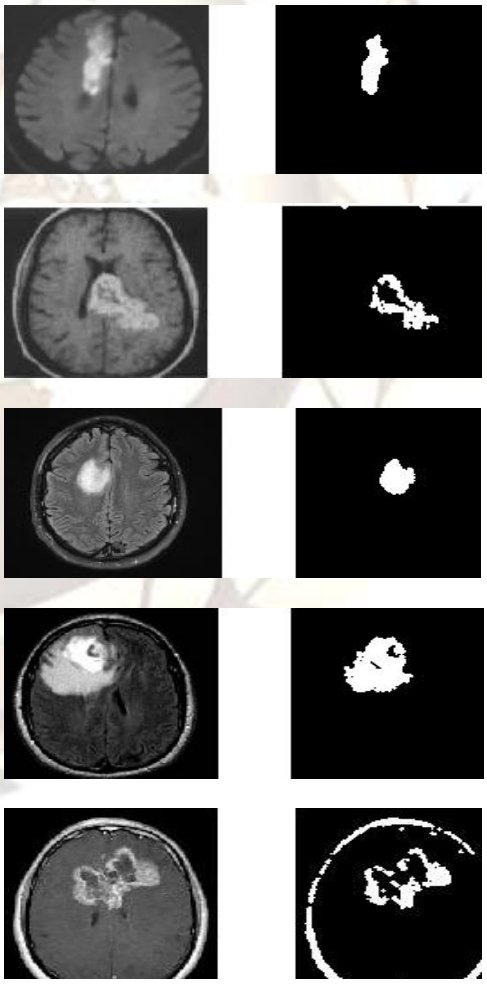

Fig 2(a,b,c,d,e): Result of applying Otsu's Thresholding technique for segmentation,the first column has the original image,the second is the segmented image.

The following images show the result of application of color based region split and merge :

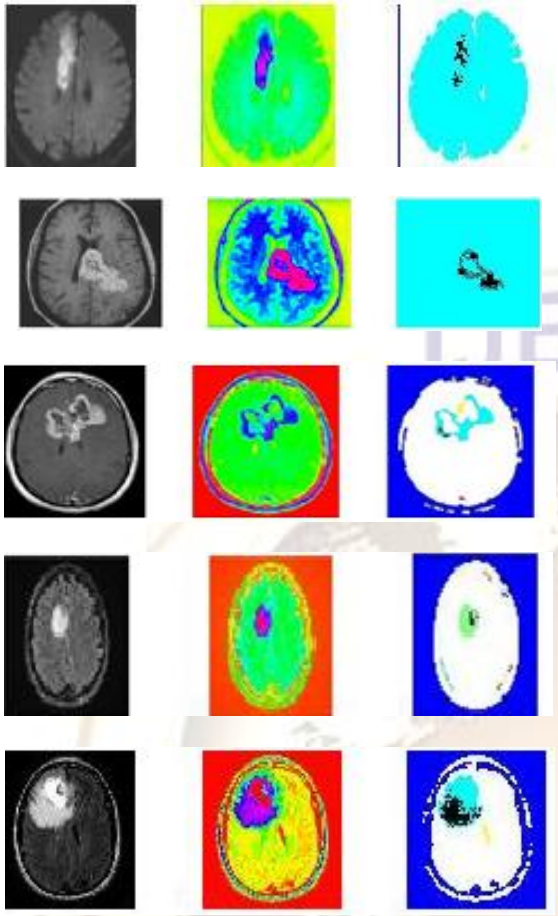

Fig 3(a,b,c,d,e):Result of applying CB Region Split and Merge technique for segmentation,the first column has the original image,the second is the colored image of original and third column has the segmented image

3.2 Quantitative Results

3.2.1 Specificity

Specificity measures the performance by giving a propotion of negatives which are correctly identified as such(eg: the percentage of healthy people identified to not have the condition to be sick). It relates to the test's ability to identify negative results.

Numerically,it can be stated as,

$$specificity = \frac{TN}{TN+FP} \quad (3)$$

Highly specific tests rarely misses negative outcomes so they can be considered reliable when their result is positive[8,9].

3.2.2 Sensitiviy

Sensitivity is the measure of proportion of actual positives which are correctly identified as such.It relates to the test's ability to identify positive results[8,9].

Numerically,it can be stated as,

$$sensitivity = \frac{TP}{TP+FN} \quad (4)$$

3.2.3 Accuracy

Accuracy is the proportion of correctly diagnosed cases from the total number of cases.Numerically it is calculated as,

$$Accuracy = \frac{TP+TN}{TP+TN+FP+FN} \quad (5)$$

The following table gives the values of various parameters for otsu's threshold and color based region split and merge

	CB Split and Merge	Otsu's Method
No of test images	16	16
True positives(TP)	9	14
True negativs(TN)	7	11
False positives(FP)	2	3
False ngatives(FN)	7	2
Sensitivity	56.25%	87.5 %
Specificity	77.77%	78.57 %
Accuracy	64 %	83.33 %

Table 1: Values of parameters for two tests

A higher value of sensitivity and specificity in case of otsu's thresholding method indicates it gives a higher performance as it has greater ability to predict positive and negative outcomes as compared to the Color Based Split and Merge and the results of Otsu's method are highly accurate.

IV. CONCLUSIONS

After the above investigation the main point of winding up of the performance analysis of CB Region Split and Merge Image Segmentation technique and Otsu's thresholding using brain tumor extraction is that otsu's method gives a better performance for extracting the brain tumor. Our motive was to detect if there is tumor present in the MRI image (i.e. YES or NO), but the research ended up successfully with the extraction of brain tumor from the MRI using both techniques and comparing the results of two to indicate which gives a better performance.

After conduction of this experimentation it was very comprehensible from the obtained results that using Otsu's thresholding segmentation was more productive as compared to CB region split and merge in terms of accuracy. And also it has been observed that both the methods are more efficient as compared to other algorithms followed under Region Growing but the only shortcoming that both encounter is of time, means both the techniques are a little time consumimg.

REFERENCES

[1] Maintz, J. and Viergever, M. (1998). An overview of medical image registration methods. Medical Image Analysis,Vol 2,1–36

[2] Brown, M. and Semeka, R. (2003). MRI: Basic Principles and Applications.John Wiley and Sons, Inc., Vol. 3

[3] Schad, L., Bluml, S., and Zuna, I. (1993). MR tissue characterization of intracranial tumors by means of texture analysis. Magnetic Resonance Imaging,Vol. 11,Issue 6,889

[4] Wang Zhengjia, Brain tumor detection from 3d magnetic resonance images,full thesis

[5] Capelle, A., Alata, O., Fernandez, C., Lefevre, S., and Ferrie, J. (2000). Unsupervised Segmentation for automatic detection of brain tumors in mri. In IEEE International Conference on Image Processing, pages 613–616

[6] Schad, L., Bluml, S., and Zuna, I. (1993). MR tissue characterization of intracranial tumors by means of texture analysis. Magnetic Resonance Imaging,Vol. 11,Issue 6,889

[7] Dr.N. Nandha Gopal, Automatic Detection Of Brain Tumor Through Magnetic Resonance Image, International Journal of Advanced Research in Computer and Communication Engineering Vol. 2, Issue 4

[8] Otsu, N. (1979). A threshold selection method from gray-level historgrams. IEEE Trans. Systems, Man adn Cybernetics, vol 9,Issue 1

[9] www.wikipedia.org/wiki/Sensitivityand_ specificit