Brain Tumor Detection Using Automatic Region Growing Segmentation

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Abstract: *Brain tumor detection and segmentation is very difficult task in MRI images. The MRI image generates a better contrast that indicates regular and irregular tissues. It's better for overlapping in margin of each limb. We use several automatic segmentation techniques. That may used to compensate with the problem if no growth of tumour and any small white part done. In this case when the tumor edge is not pointed then segmentation results are not accurate i.e. segmentation may be under or over. That procedure is done due to initial stage of the tumors. Segmentation of the Image is one of the ground laying techniques of digital image system.*

Keywords: Segmentation of image, Automatic Region Growing, Unseeded point selection

1. Introduction

The important fact for segmented image is independent with respect to domain. Segmentation of image is effective tool in many realms including industry, astronomy, care of health and different others fields. The concepts of segmentation base on a simple idea. Firstly we seeing at an image, then tell what regions are stored in the Images. Generally it is so casual to determine what the Region of interest (ROI) is and what is not. The partitioning of an image into different set of disjoint regions, homogeneous and meaningful with respect to few characteristics or computed property. E.g. grey level of image, texture of image or color to enable simple analysis of images. Two basic feature discontinuity and similarity are used with many Segmentation techniques for local neighbours. Segmentation methods which is based on property of discontinuity can be accepted as boundary.

1.1 Segmentation

In image processing the segmentation of image is most important. The whole image is converting into different parts that are **something's** more useful and easier for further analysis. The Segmentation is a process of enhancing pixel and enhancing tumour region. Segmentation of image may also depend on more than one feature **that's** contained in the image, e.g. color or texture. Before de noising an image, it is segmented to recover the original image. Mostly we use the segmentation to minimize the information for simple analysis. Segmentation is the technique that separates the image into non-overlapping regions, here every regions is standardized but the unification of any two neighbouring regions is inhomogeneous.

1.1.1 Region Growing
Due to simplicity and good performance the Region growing segmentation is one of the most popular techniques. This technique to **group's the** pixels or regions that have similar properties based on predefined criteria. Region-growing techniques exploit the crucial fact that pixels which are close together have similar gray scale values**.** The image is loaded and the homogeneity criterion is selected. The intensity difference and neighborhood type for the images are also

defined. In region growing segmentation the difference of intensity is selected experimentally and the user may tune the parameter values of the vector.

2. Related Works

The concept behind the present work base on these few points:
1) Symmetrical brain structure,
2) Intensity of pixel and histogram of the image and compare them
3) Automatic Segmentation.

Every one known that brain is symmetrical about its central axis and during this work we has been assumed that which part of brain has tumour, either right and left or top right/left and bottom right/left. Brain tumour is the collections of blood cells at some specific points. The brain image in MRI shows intensity of pixel. That intensity has a range between 0-255, where 0 show for black color and 255 show all white colors pixels. In gray matter the pixels intensity is always less than 255. In this paper firstly we detect the tumor position, either is left or right side of brain. This task is accomplished by the knowledge of maximum number of pixel having intensity near 255.

Now we implemented an algorithm using MATLAB.
1) The brain is divided into four parts around its central axis then intensity and histogram of each part drawn. This will helpful to detect tumour position.
2) Automatic Segmentation
3) Then detected image is cropped and we calculate the dimension of tumour.

3. Methodology

Using MRI technique the brain image is capture. Now we plotted the intensity of pixel and histogram corresponding to four parts of the brain. We know the most important fact of brain that is, brain have symmetrical structure along its central axis. So if any asymmetry is observed due to its symmetrical nature, show the presence of tumour. After the detection of tumour position, we use automatic thresholding

method that can be done for segmentation of the image. Using threshold point we can done segmentation technique. So threshold point can be achieved by:

Image=rgb2gray (image);
Imagestats = graycomatrix (image);
Th= (1+entropy (imagestats))/2.85;

Implementation of the whole work has been done by MATLAB 2013b. The flowchart fig2 shows the reported work.

1. Input Image

In Input image, the image of the brain is captured through MRI technique. MRI brain image is a RGB image. This image is first reformed into gray scale image.
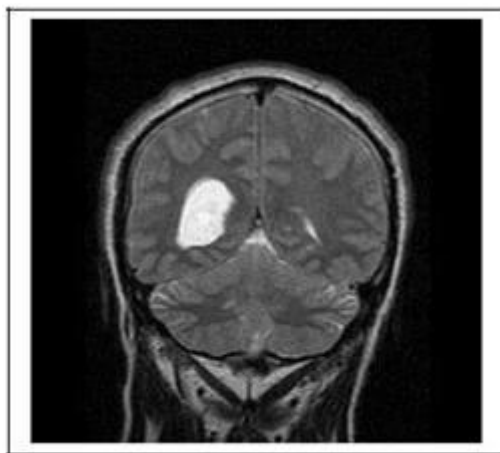
Figure 1: Input Image

Flow Chart
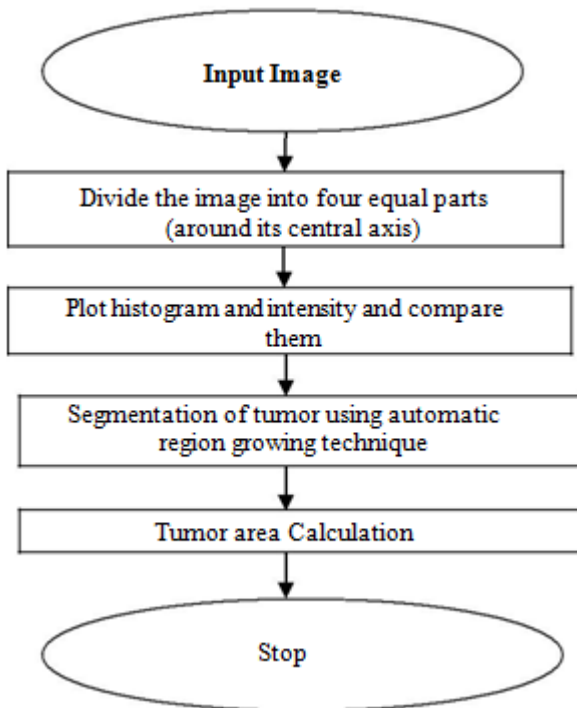
Figure 2: Flow Chart for Segmentation

2. Divide the Image

Now RGB image is transformed into gray col**or image, then it's** divided into four equal parts along its central axis. We use following algorithm to divide the image into four parts.

Step 1: All pixels of image are stored as variable says A, where A denotes the pixels value in row-column (2-D).

Step 2: Now number of rows and columns are stored in other variables (say B and C) Then rows values is divided by 2 and store them in another variables D. and also Column value is divided by 2 and store them in another variable name (say E).

Step 3: Form new matrix using *for loop* by
 I1=1: D, 1: E (Left top)
I2=D+1: B, 1: E (Right top)
I3=1: D, E+1: C (left bottom)
I4=D: B, E: 1+C (right bottom)

Using *'imshow'* command the new image is build up based on the new matrix. Now the original image will be converted into four parts.
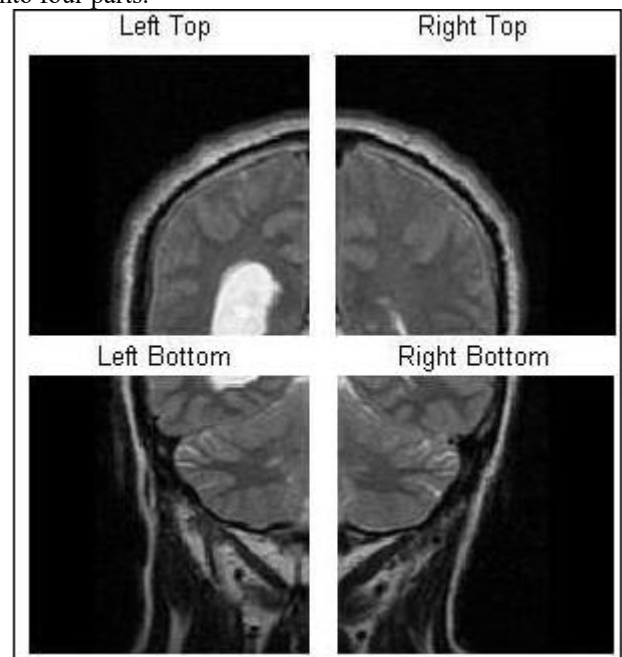

Figure 3: Divide Image into Four Equal Halves

3. To Plot Histogram and Intensity and then Compare :

The histogram is a plotted between number of pixel and pixel intensity of the image. And intensity is plotted between frequency of signal and time. The code of histogram firstly reading the grayscale value and then coming up with pixel intensity that range is lie between 0-255. When histogram code is operates the values increments total number of pixels and then it will turn on to the next row or column until it done reading all the raster data.

From figure 4 (a) and 4 (b), we see the histogram and intensity of four sides of brain are not **symmetrical. That's indicates** the presence of tumour in original input image. In fig. 4(b) horizontal axis shows intensity of pixels and vertical axis show number of pixels.
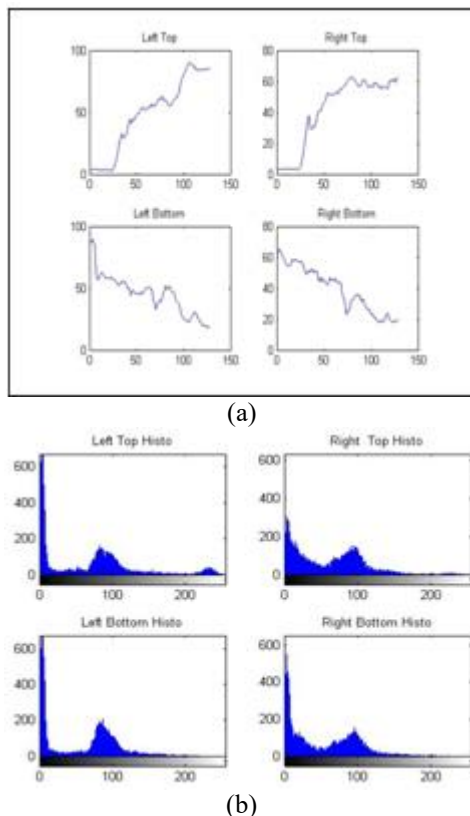
(a)

(b)

Figure 4: (a) Intensity (b) Histogram plot

To plot the intensity and histogram, we see it is clear that the histogram and intensity plotted for four sides are not symmetrical. Thus we clearly see which part of the brain have a tumor.

4. Segmentation of Tumor using Automatic Region Growing Technique

The segmentation of automatic region growing is one of the most important techniques for medical image. It very simple and have a good performance. We know in region growing segmentation, the segmentation process is start in the middle of the image **and then "growing" outward** until it meets the object boundaries. In theory, finding an object by locating its boundary and finding it by establishing the region it covers will give you exactly the same object. In this paper we implemented unseeded region growing method. W**e don't** need a seed point.

4.1 Unseeded Region Growing Method

Unseeded region growing method is so adjustable and automatic segmentation approach. This method is based on postulate of pixel similarities within regions. It does not rely on tuning parameters and is also independent of physical inputs. Segmentation process is initialized with containing a single starting point, which is evaluated by the mean of the images rows and columns**. That's gives a** starting point.

E.g. region mean = P(r, c); the mean of the images rows and columns to give starting point, e.g. region mean = P(r, c); the starting points are then compared to their neighbours based on maximum relative distance to its neighbors. Then **neighbors'** of a pixel are calculated by 4-connectivity. In 4-

connectivity, the neighbours of the pixels that are connected horizontally and vertically. A starting point must have the maximum relative distance to its neighbors and less than a threshold value. If the difference values is minimum a specified threshold, then the pixel belongs to that region and is subsequently labeled. Otherwise the pixel is not labeled and skipped. The algorithm for implementing the unseeded region growing algorithm is as follows:

Step 1: The starting points are computed on the basis of the mean of the images rows and columns, e.g. mean= P(r, c); the starting points are then compared to their neighbours based on the maximum relative distance.
reg_maxdist= (1+entropy(imagestats))/2.85; And reg_size =1; Number of pixel in region (obviously one as starting is one point)

Step 2: Free memory to store neighbours of the (segmented) region.
neighbour_free = 10000;
neighbour_position=0;
 neighbour_list=zeros (neg_free);
Pixeldist=0; a distance of the region newest pixel to the region mean

Step 3: Neighbour location (footprint) neighb=[-1 0; 1 0; 0 -1; 0 1];
Start region growing until distance between region and possible new pixel become higher than a certain threshold.

Step 4: Compute the neighbours of the pixel and store them in the neighbour matrix if not labeled.
While(pixeldist<reg_maxdist&&reg_size<n ume1(I))
Add new neighbors pixel for j=1:4 Otherwise,
- Skip the pixel and choose the next neighbour pixel.
████████████, until all the pixels in the neighbour list are not checked.

Step 5: Then update the mean of new region, and add 4 neighbors. Repeat the process until all pixels of the image are labeled into their corresponding regions.

If the pixel distance is less then region max **distance then it's** decides the pixel to be allocated or unallocated to that region. If the difference is less than a specified threshold then pixel is allocated to that specific region.
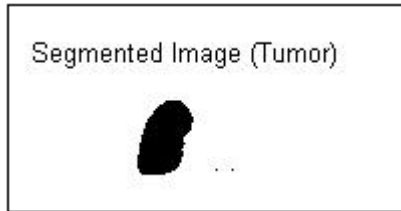

Figure 5 (a): Original image

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Figure 5 (b): Segmented image

Tumor Area Calculation

After segmentation, we crop the segmented part of the input image. The desired region is selected by the process of cropping. Then the cropped image shows the desired portion of tumor. Now cropped image is used to calculate the tumor area.

Segmented Area (no. of pixel) = no. of rows * no. of Colum

Tumorsize = nnz(segmented area)

nnz returns the number of nonzero elements in matrix segmented area.

5. Results

Table 1: Values of Segmented Image.

| Images	S.P	T.S	Energy	Homogn	Contrast	Co-reln
Ba.jpg	961	76	0.969675	0.999341	0.001317	0.954586
Pa.jpg	1243	710	0.976002	0.999372	0.001256	0.944771
Ba1.jpg	899	75	0.971612	0.999387	0.001225	0.954885
Pa1.jpg	1288	736	0.975042	0.999326	0.001348	0.942908
Bb.jpg	637	20	0.979328	0.999326	0.001348	0.930246
Pb.jpg	3829	2188	0.905492	0.992218	0.015564	0.803456
Bb1.jpg	738	10	0.979328	0.999326	0.001348	0.930246
Pb1.jpg	779	445	0.983663	0.9993	0.001409	0.905604
Bc.jpg	6728	29	0.809269	0.997059	0.005882	0.968183
Pc.jpg	5432	3104	0.905113	0.998866	0.002267	0.975523
Bc1.jpg	4183	28	0.876667	0.9983	0.003401	0.971647
Pc1.jpg	5283	319	0.90735	0.998836	0.002328	0.974222
Bd.jpg	1020	28	0.967587	0.998836	0.001654	0.946218
Pd.jpg	770	440	0.984421	0.999449	0.001103	0.923814
Bd1.jpg	9380	107	0.667101	0.98666	0.02668	0.913076
Pd1.jpg	10300	1945	0.903281	0.99441	0.01118	0.869485
Be.jpg	501	300	0.658011	0.94562	0.002556	0.835642
Pe.jpg	899	651	0.686101	0.99264	0.002989	0.952842
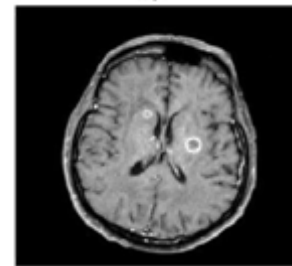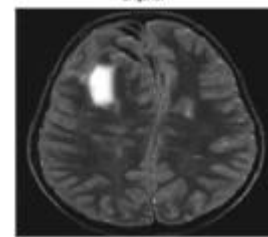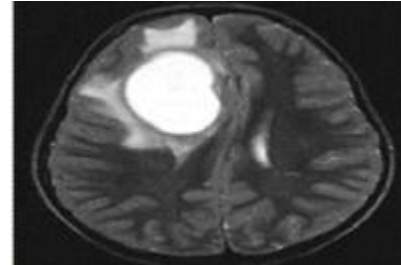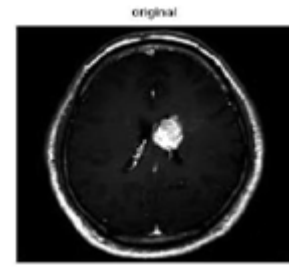
Figure 6: (a) Original Images

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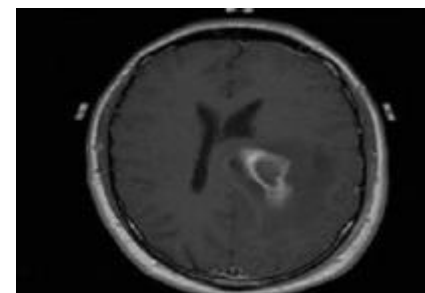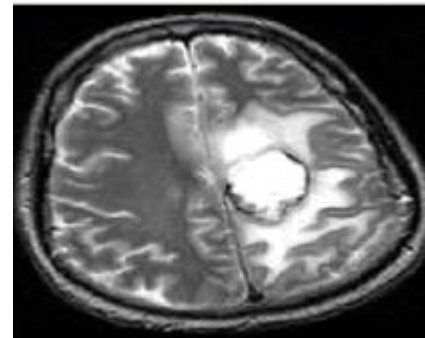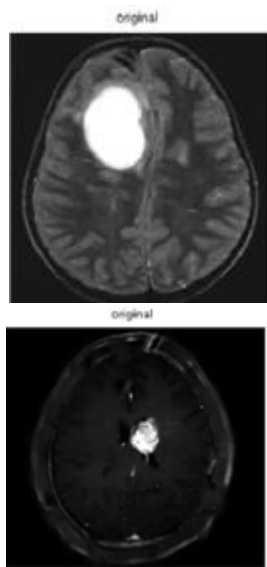
Figure 6: (b) Original Input Images

Figure 6: (b1) Segmented Images
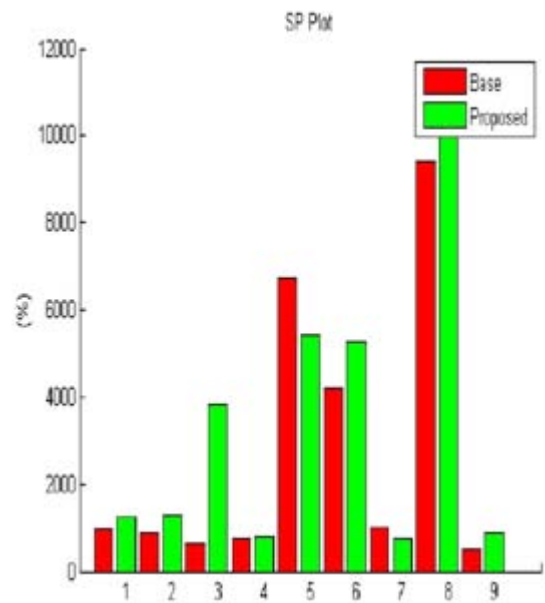

Figure 7: (a) Segmented pixel plot
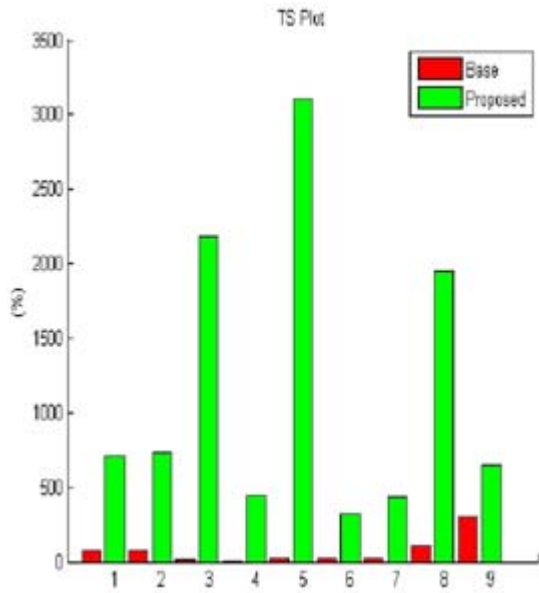

Figure 6: (a1) Segmented Images

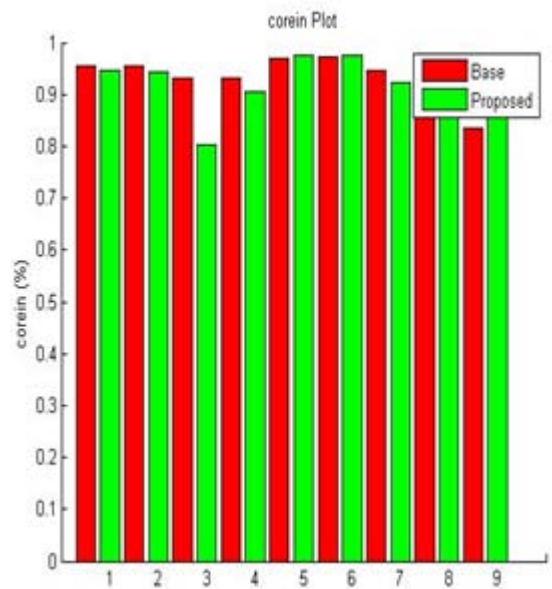**Figure 7:** (b) Tumor size in pixel plot

Figure 7: (e) Co-relation plot
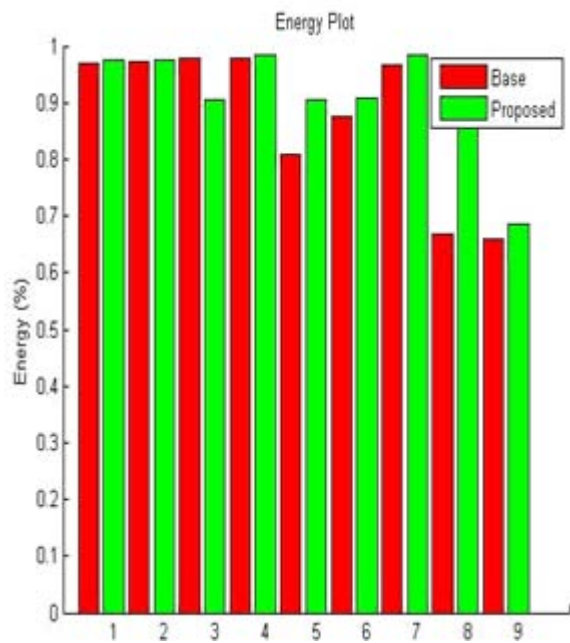
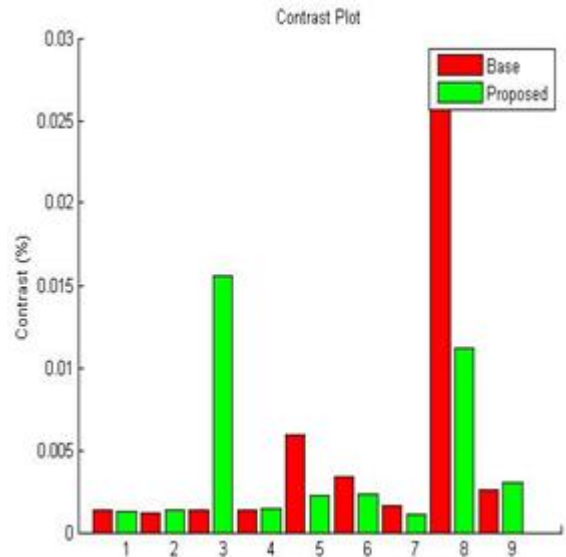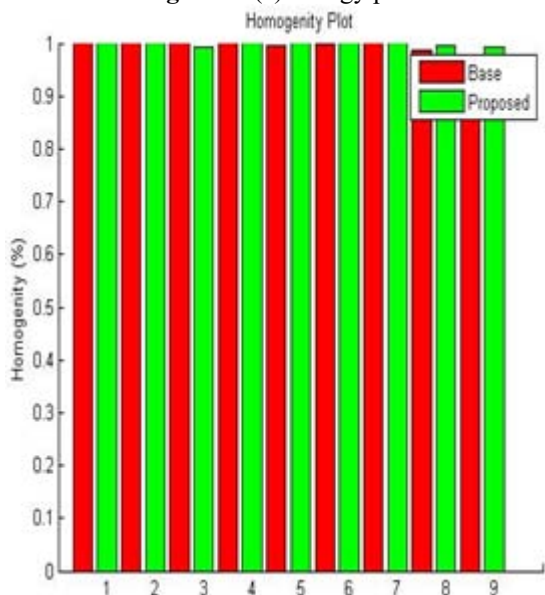**Figure 7:** (c) Energy plot

Figure 7: (f) Contrast plot

Note: The above plots are describe the compression between automatic thresholding and automatic region growing segmentation technique.

 Feature extraction from GLCM:
Contrast

$$\sum_{i,j} |i - j|^2\, p(i, j)$$

Correlation

$$\sum_{i,j} \frac{(i - \mu i)(j - \mu j)p(i, j)}{\sigma_i \sigma_j}$$

Energy

$$\sum_{i,j} p(i, j)^2$$

Figure 7: (d) Homogeneity plot

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Homogenity

$$\sum_{i,j} \frac{p(i,j)}{1+|i-j|}$$

6. Conclusion

The region growing segmentation technique correctly Separate the pixel of image that have similar properties to form large regions. As this approach depends on the spatial correlation of pixels in an image, the segmented output is expected to be better as compared to the histogram thresholding based scheme.

In the future, the work of this research can be extended to increase the detection and segmentation accuracy. So another segmentation technique need to be applied which work on every type of axial brain images.

References

[1] **Jun Zhang and Jinglu Hu "Image** Segmentation Based on 2D Otsu Method **with Histogram Analysis"International** Conference on Computer Science and Software Engineering, IEEE 2008

[2] Zheng Lin, Jesse Jin and Hugues Talbot, **"Unseeded region growing for 3D image segmentation"**.

[3] Yu-**Hsiang Wang, "Tutorial: Image** Segmentat**o", National Taiwan University,** Taipei, Taiwan, ROC.

[4] Robert M Haralick; K Shanmugam; Its'hakDinstein (1973). "Textural Features for Image Classification" (PDF). *IEEE Transactions on Systems, Man, and Cybernetic.* SMC-3(6): 610 621

[5] C. jiang, X. Zang, W. Huang and C. **Meinel "Segmentation and quantification of brain tumor", IEEE International** Conference on Virtual Environments, Human-Computer Interfaces, and Measurement System Boston, 2004.

[6] Gambotto JP (1993) A new approach to combining region growing and edge detection. Pattern Recog. Letters. 14, 869-875