A COMBINED APPROACH FOR SEGMENTATION AND EXTRACTING OF THE TUMOR TISSUES FROM THE ENHANCED BRAIN MR IMAGES

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ABSTRACT

Image segmentation plays a vital role in the area of image processing. Especially while dealing with medical images required to initiate and sppedup the recovery process for surgery while taking pre surgery and post surgery decisions. Segmentation is needed in a very accurate manner in medical imaging in computer aided image processing of finding the unusual growth in tissues of the body. The modern high speed computer machines can't hold until we perform the manual segmentation of the abnormal tissues which allows us to observe the volume and position of the abnormal tissues. The problem mainly arises in cases of segmenting and labelling the voxels of the MRI images of brain tissues. The MRI images will contains the detailed information of voxels according to the Cerebrospinal Fluid (GSF), White Matter (WM)and Grey Matter (GM), and other tumors.The proposed paper described about segmentation of MR images for extracting the tumor tissues from MR images. The process involves combining of Malik anisotropic diffusion model and Perona model for enhancing an image and Kmeans clustering technique for grouping the specific type of tissues. The proposed method used PD, T1 and T2 weighted grey scale images.

***Keywords*: MRI images, White Matter (WM), Grey Matter (GM), Cerebrospinal Fluid (GSF), Segmentation.**

I INTRODUCTION

Due to rapid development in information technology, the usage of computer machines in medical applications is also increasing.The obvious reason of adopting the computer systems in medical operations is their accuracy, speed and easy accessibility. More over, the optimal solution giving and customizable features made the computer systems adopted in computer aided systems. The medical imaging process involves the capturing the image of a tissue, enhancing it, processing, digitization and extracting some important information from the image. The existed techniques for image processing involves manual segmentation of the images, but the manual segmentation is an inefficient and also time consuming technique.So, for the purpose of image segmentation, we need to introduce an accurate and efficient computer system in it. Along with the computer system, we need to automate the entire processing section to reduce the user interaction with the system. According to the traditional methods, the manual segmentation will consume atleast 3 hours to complete the segmentation of tissue images and to extract the volume information of the tumors.

The important factor detecting the difference between healthy tissues and abnormal tissues is in difference of intensity levels. Eventhough we can't rely on intensity levels to identify the difference between the tumor tissues. While detecting the tumor tissues, we should also consider the spatial information available in clusters of the pixels which forms the tumor.

II LITERATURE REVIEW

The literature involves of studying about various processes of segmentation and to introduce a maximum reliability in the image detail extraction.

2.1 Segmentation by Thresholding

A frequently used method of segmentation is Segmentation by thresholding.This method is very simply and reliable way to segmentation of the images with unlike intensities. This method will find out the threshold value of the pixels to categorize them. The main drawback with this method is it classifies the pixels in only two categories, so it is not possible for multiple channel image segmentation. This method also failed in retrieving the spatial characterstics of the image due to the image becomes sensitive to the noise and the MRI images are also sensitive to the noise. Therefore the image may causes to loss of it's histogram. To overcome the problem of the thresholding technique, various levels of thresholding methods are introduced by considering the locan connectivity and intensities of the image. Even though some there are some complexities, which make thresholding technique disadvantageous such as busyness in grey levels, inadequate contrast and intensity of surrounding light, etc.

2.2 Region Growing Method

The brain pathologies obtained from the MRI images will contains the information about the shape and dimensions of the tumor. This details are useful in region growing method previously.The region growing technique by using Bayes-based method will study the characterstics of the local regions and estimates the Bayes criteria for classifying. The technique semi manual method because it needs some user interaction for seed selection and it is also failed in producing the accurate results. This technique provides discontinuities and some holes in result images due to noise interference. The shape based segmentation is an alternative of region growing technique, though it requires pre executed plan for extracting the interested region. So, the both methods are semi automatic and produses falls results due to the un reliable plan and wrong selection of seed image.

2.3 Supervised and Un supervised Segmentation methods

The supervised and un supervised methods are attempted to do segmentation by using KNN and both fuzzy c-means clustering. The supervised segmentation method enables us to classify the pixels for enough no. of class of interests. In the unsupervised method, no need of pre hand level knowledge for classes. It employees a clustering method for classification. The supervised classification includes the MNN, HL and Parzen classifiers and un supervised classification includes hierarchical clustering techniques, K-means and minimum distance etc.

III METHODOLOGY

The image captured on a brain will contains four regions. i.e., White Matter (WM), Gray Matter (GM), Cerebrospinal Fluid(CSF) and background. The input image to processed is divided into this four regions by considering this four regions as four classes. After classification, the outer most elliptical shaped object in the image to avoid non brain tissue information from the image and soft tissues only will left with image information. T1, T2 and MD type of brain MRIs were used in this experirent. These images will have same size and same intensity values. The considered pixels should be always in an aforementioned class. The required tumorous pixels can be extracted by applying some post processing operations. The process uses K-means clustering technique to solve this problem. This algorithm mainly aimed in reducing the clustering issues especially squared error function. This function canbe mathematically represented as

$$J = \sum_{j=1}^{k}\sum_{i=1}^{x} Px_i\, 1^{(j)} - C_j P^2$$

In the above euqtion, the $Px_i\, 1^{(j)} - C_j P^2$ is the diatance measure chosen between the data point and a cluster centre. Here $x_i\, 1^{(j)}$ is the data point and C_j is the cluster centre, which indicates the distance between the n data points and to their respective cluster centre. The image containing skull tissues which is not comes under non brain elements will be removed in pre processing steps And it may cause misclassification.

Among the below given figures, the figure 1 shows the methodology of this work. Figure 2 shows the brain image including with skull as an outer elliptical ring. In the figure 3, we have removed the skull tissues by a morphological process called dilation and erosin. Mathematically this function can be represented as follows.

$$A \ominus B = \{w : B_w \subseteq A\}$$

$$A \oplus B = \bigcup_{x \in B} A_x$$

The following figure shows the methodology of the entire system .

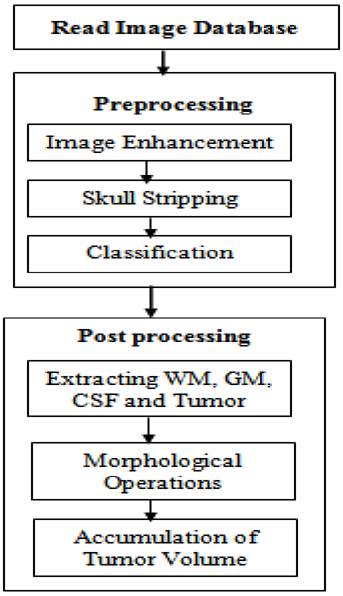


Figure 1: Methodology

The following inage shows the brain MRI image with skull as outter ring as shown in Fig:2. The following figure shows the image after removing the skull outer ring by using a morphological process as shown in Fig:3

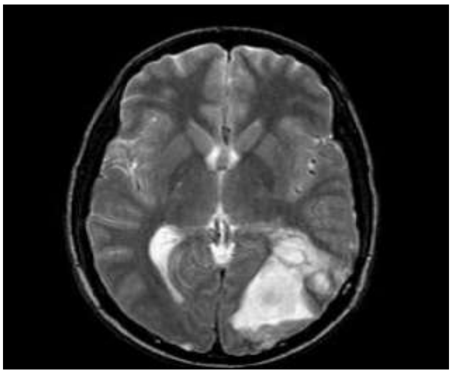


Figure 2: Image with skull as outer ring

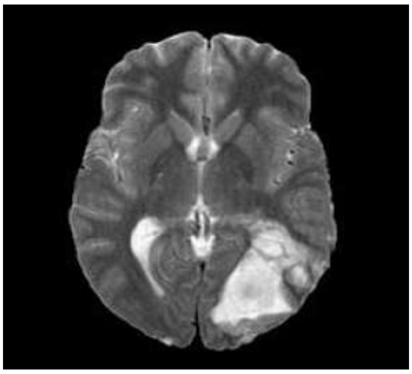


Figure 3: After removing skull

A white guassian noise is added to the image to test the algorithm. And then the image is then enhanvced with Perona and Malik model. With the use of following mathematical expression, the model enhances smoothens the image without loss of any important data.

$$It = \nabla.[f(x,y,t)\nabla I] = div(f(x,y,y)\nabla I)$$

Here I(x,y,t) is the intensity of the image at position of sampling (x,y) and at a scale t and f(x,y,t) id the diffusitivity on the system. The diffusitivity is described as follows

$$f(x,y,t) = f(P\nabla P^2) = \frac{1}{1 + P\nabla P^2/k}$$

The following figures shows the image with added noise to test the methodology and the image after enhamcing with these methodology respectively.

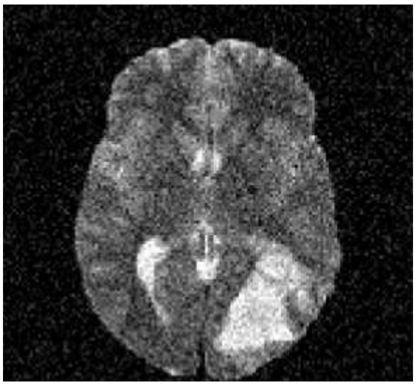


Figure 4: Image with Noise

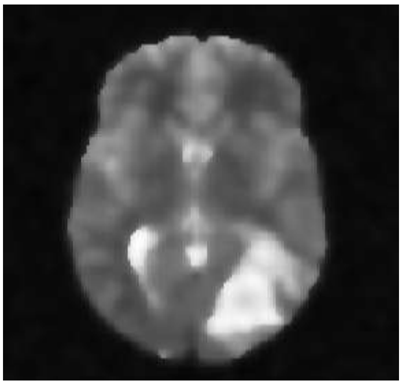


Figure 5: Image after Enhancement

IV RESULTS & CONCLUSION

After getting the experimental results of this methodology, we can observe that by combining the Perona and Malik method with K-means clustering method, we can get the reliable results. The technique uses a un supervised approach, so it produces noise free results.

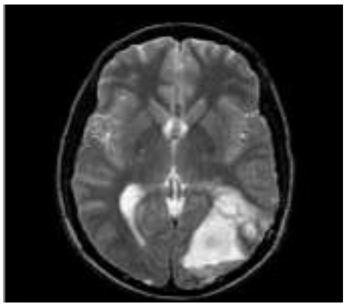


Figure 6a: Original Image (L)

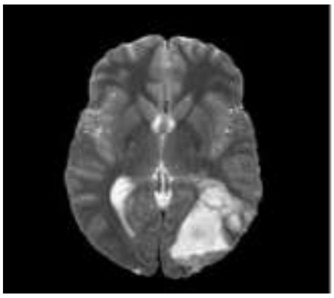


Figure 6b: Skull removed (R)

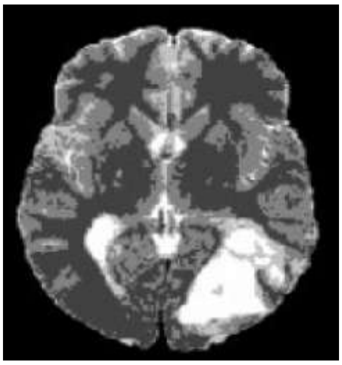


Figure 6c: Segmented Image (L)

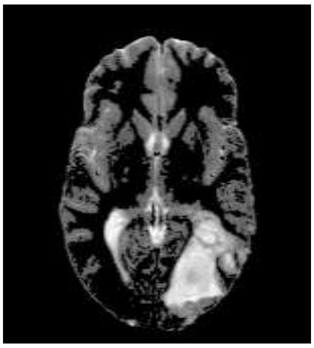


Figure 6d: Extracting WM (R)

Figure 6e: Intensity corrected in WM (L)

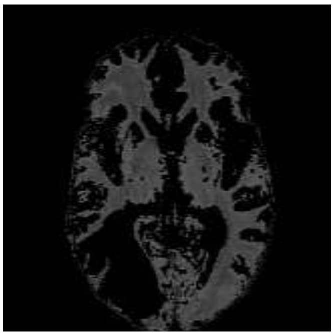


Figure 6f: Extracting GM (R)

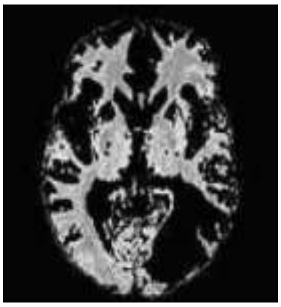


Figure 6g: GM after intensity correction (L)

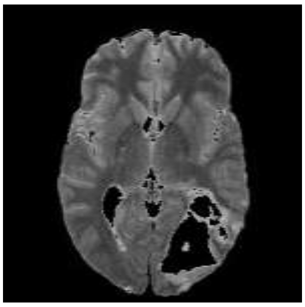


Figure 6h: Removing Tumor (R)

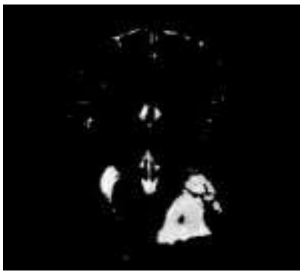
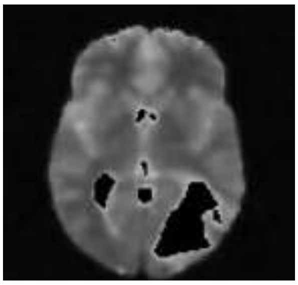


Figure 6i: Tumor Volume (L) **Figure 6j: Erosion (R)**

After observing the result images, we can deduce that the un supervised method is better than supervised method. Because of the supervised segmentation is having lot of pre processing steps to complete. However the fuzzy clustering methids are a bit complicated compared with K-means clustering method. The following figures shows the checking of accuracy of the clean image by comparing with a noisy image with white guassian noise.



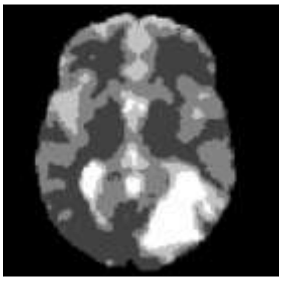
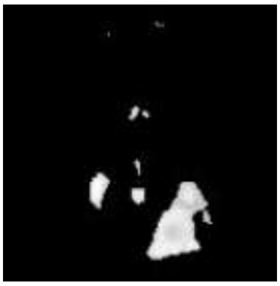


Fig 7a: Deleting normal tissues from enhanced MRI slice (L) **Fig 7b: Segmenting the enhanced MRI slice (R)**



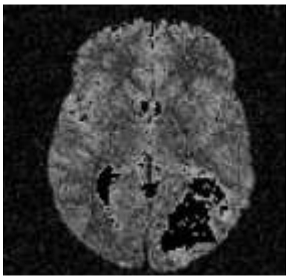


Fig 7c: Extraction of Tumor (L) **Fig 7d: Noise image with only normal tissues (R)**

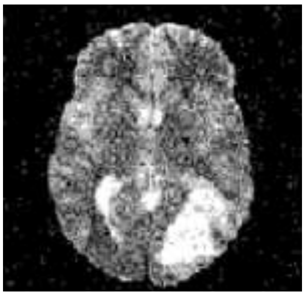


Fig 7e: Segmentation of Noisy Image (L) **Fig 7f: Deleting normal tissues and retaining tumor cells (R)**

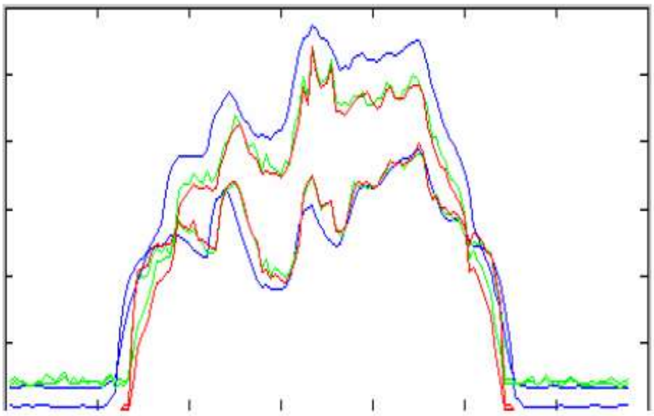


Fig 8: Mean and Standard deviation of noisy image and enhanced image

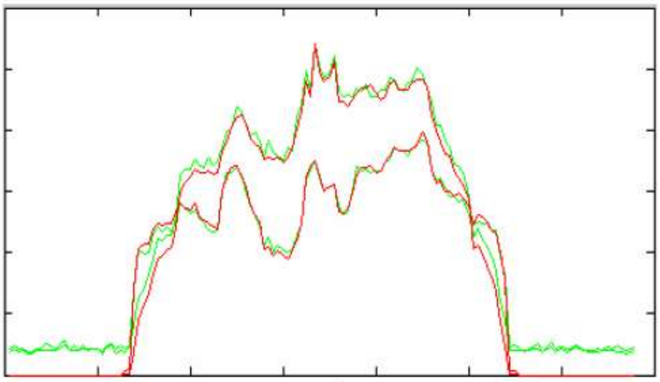


Fig 9: Mean and Standard deviation of Clean and Enhanced image.

The above figure 7 shows the results obtained from enhancing an image by usingPerona-Malik anisotropic diffusion model. The image corruted by guassian noise is enhanced in this technique, we can observe the difference between the both results that this Perona-Malik approach extracted the tumor tissues from the image and marked various points regarding the normal tissues. The results are very similar to the clean image and accurate. The above figure 8 & 9 shows the mean and deviation of the different images after enhancing graphically.

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