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Segmentation of Healthy and Affected Tissues from Brain Magnetic Resonance Images

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Abstract: ***Medical imaging is the technique and process used to create images of the human body. Magnetic resonance imaging is the widely used brain imaging technique which is helpful in the identification and treatment planning of brain disorders. Segmentation of magnetic resonance image is a challenging and crucial task which facilitates the anatomical structure depiction and portrayal of the other desired regions. In this paper, the threshold, edge based and region based segmentation approaches are discussed. Experimental results indicated that the working of the proposed region based method is satisfactory.***

Keywords: Magnetic resonance imaging; segmentation; thresholding; edge based; region based.

I. INTRODUCTION

Image segmentation is the process of dividing a digital image into various parts based on the similarity of some attributes considered. The purpose of segmentation is to simplify the image for processing and analysis. Image segmentation generates a set of segments of images which covers the entire image[1].Computed tomography (CT),X-ray, magnetic resonance imaging (MRI) are some of the medical images on which image processing is performed for medical approaches. Magnetic resonance images show the brain structures, tumor's size and location. From the MRI images, information such as tumors location provides radiologists an easy way to diagnose the tumor and plan the surgical approach [2]. MRI's use radiofrequency and magnetic field to result image's human body without ionized radiations. MRI does not involve the use of ionization radiations and hence reduces health hazards. Hence, MRI is more preferable than any other images for medical processes [3].

II. SEGMENTATION

Segmentation is defined as the process of partitioning an image into multiple segments or sets of pixels. Segmentation is the most important, crucial and challenging task in image processing. Edge based, thresholding and region based are some of the commonly used segmentation techniques.

III. EXISTING SYSTEM

The edge based and thresholding are the types of segmentation techniques which are commonly and frequently used for segmentation of MRI images.

a) Edge based

Edge detection is the method of detecting the presence and location of edges identified by the changing intensity of the image. Image segmentation and object recognition uses edges which defines the boundary between regions [4]. The generalized algorithm for edge based detection technique has the following steps:

1. The derivative operator is applied to detect the edges.
2. The strength of the edge is measured by the amplitude of the gradient.
3. Retaining all the edges that have the magnitude greater than the threshold value.
4. Locate the position of cracked edges and retain or discard them based on the confidence it receives from its predecessor and successor edges.
5. Steps 3 through 4 are repeated for different threshold values to find the closed boundaries, we obtain the image segmentation.

In edge based method, boundaries are identified to segment the image. Edges are detected to identify the discontinuities in the image. Edges on the region are traced by identifying the pixel value and it is compared with the neighboring pixels. In this edge based segmentation, there is no need for the detected edges to be closed. Some of the edge detectors that are used to segment the images are [1] :

i) Sobel edge detection

The Sobel edge detection technique extracts all the edges of an image, regardless of direction. Sobel operation provides both differencing and smoothing effect. The implementation is done as the sum of two directional edge enhancement operations [4] [16].

ii) Laplacian edge detection

The Laplacian technique identifies the important regions where intensity rapidly changes and hence is often used for edge detection. The Laplacian technique is applied to an image that has first been regularized with a Gaussian Smoothing filter where the sensitivity to noise gets reduced. [4].

iii) Canny edge detection

Edges are defined in the discontinuity of their intensity, which provides a layout of the image. Calculating the intensities accurately we can trace all the objects in the image [1].

iv) Robert edge detection

Robert edge detection method measures a 2D spatial gradient of an image which is quick and simple to compute. The pixel values at a point estimates the absolute magnitude of the spatial gradient of the input image.[14].

b) Thresholding

Thresholding is usually identified as the simplest method of image segmentation. This method converts a gray scale image to a binary image using an assumed threshold value. Selecting the threshold value is identified as the key importance of this technique. It is done through that threshold values which are obtained from the histogram of those edges of the original image [10]. The threshold values are obtained from the edge detected image. So, if the edge detections are accurate then the threshold too is accurate. Segmentation through thresholding has fewer computations compared to other techniques [11].Segmentation is done through adaptive thresholding. The gray level points where the gradient is high, is then added to thresholding surface for segmentation [12].

Jianping Fan,Yau Elmagarmid & Aref's [13] paper presents an automatic image segmentation method using thresholding technique. This is based on the assumption that adjacent pixels whose value (gray level, color value, texture, etc) lies within a certain range belong to the same class and thus, good segmentation of images that include only two opposite components can be obtained. Dzung L. Pham, Chenyang Xu, Jerry L. Prince proposed the basics that segments of images are created by binary partitioning of the intensity values of the image. It attempts to determine an intensity value, called the threshold, which separates the desired classes of the images based on the intensities. Segmentation is achieved by grouping all pixels with intensity greater than the threshold into one class, & all other pixels into different class. Determination of more than one threshold value is a process called multi thresholding [3].

One of the thresholding algorithm techniques is p- tile. P-tile method is one of the earliest thresholding technique used which is based on the grey level histogram. In this technique, the object of image is assumed to be brighter than the background which occupies a fixed picture area [15]. This method is simple and suitable for all sizes of objects. It yields good anti-noise capabilities. Thresholding is very simple and fast (especially if repeating on similar images) to implement. This is very good for some kind of images such as documents and controlled lighting. But thresholding gives no guarantees of object coherency, may have holes and extraneous pixels.

IV. PROPOSED SYSTEM

In region growing method, the regions are separated exactly on the properties required [8]. A good segmentation result which has clear edges of the original image is provided. Simple concept where small numbers of seed points are required to emphasize the property required. Criteria on determining the seed point is made simple. Multiple criteria can be chosen at the same time. This method performs well with respect to noise. Region growing based segmentation models shares the following assumption about the image pixels properties. The intensity values within each region /object conforms to Gaussian distribution, the mean intensity value for each region/object is different [8].

The proposed system is the region growth method in which the image along with a seed point is provided as the input. The working of the proposed method is shown in fig. 1.

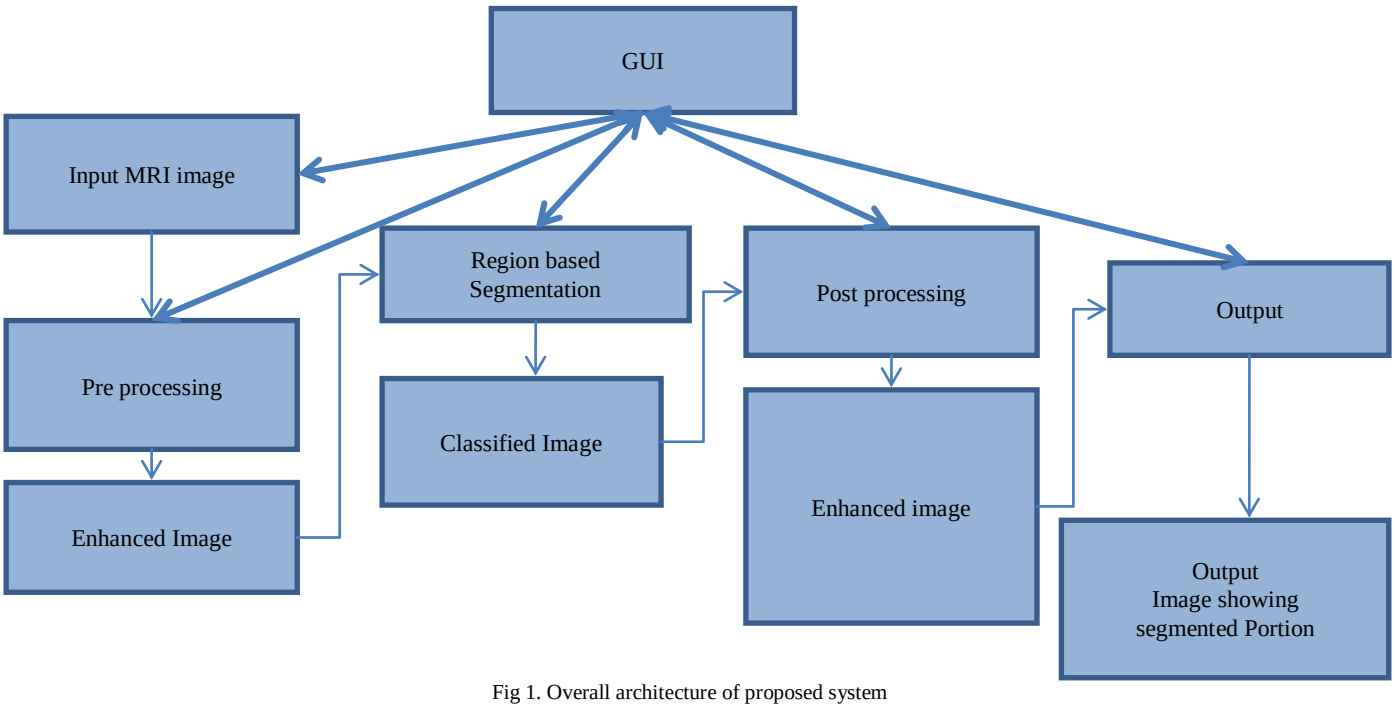

Fig 1. Overall architecture of proposed system

A. *Graphical user interface*

Graphical User Interface (GUI) is implemented because user interface allows users to interact with the proposed system through graphical icons and visual indicators. Complex, multi-step and dependent tasks are grouped together using GUI.

B. Pre processing

This step is used to enhance the quality of input image by using median filter to remove noise and convert to grayscale image to reduce the complexity of further processing.

C. Region based segmentation

The object to be segmented in the image is chosen by the seed point selected. The neighbouring pixels are compared with seed point and selected if the intensity of the neighbouring pixel is closer to seed point value [9]. The measure of similarity of the intensity values of the pixel is given by the difference of the pixel's intensity value and the region mean intensity. This process is repeated until all the pixels of the image are compared to the seed point and allocated to a region if intensity value matches with the seed point. The result of the segmented image depends on the choice of the seed point taken. Because of noise present in the image, sometimes the seeds are poorly placed [8]. In this technique related pixels of an object are grouped together for segmentation [5]. The boundaries are identified for segmentation. In each and every step at least one pixel is related to the region and is taken into consideration [6]. Based on the identified pixels, the image is reconstructed to represent the extracted portion. [7].

D. Post processing

Segmented region may have holes if the seed point selection is not proper. Dilation process, a morphological operation, is used as post processing operation to fill the holes. Experimental results of the proposed method are shown in figure 2 and figure 3.

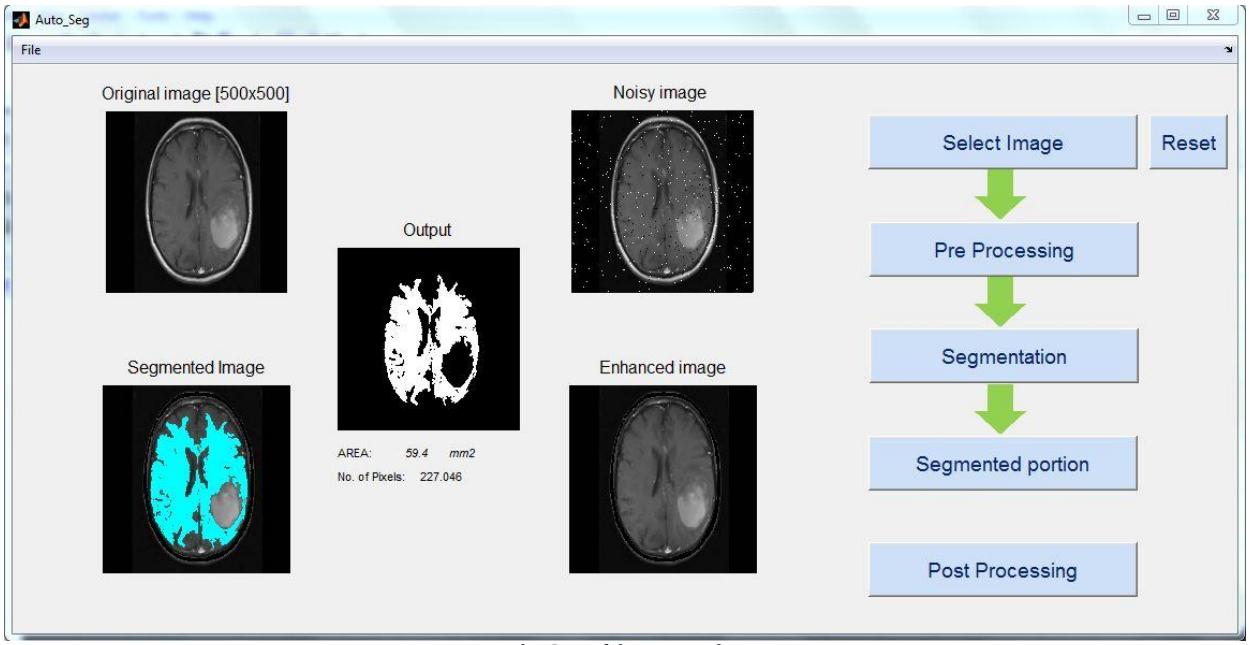

Fig2. The GUI of the proposed system

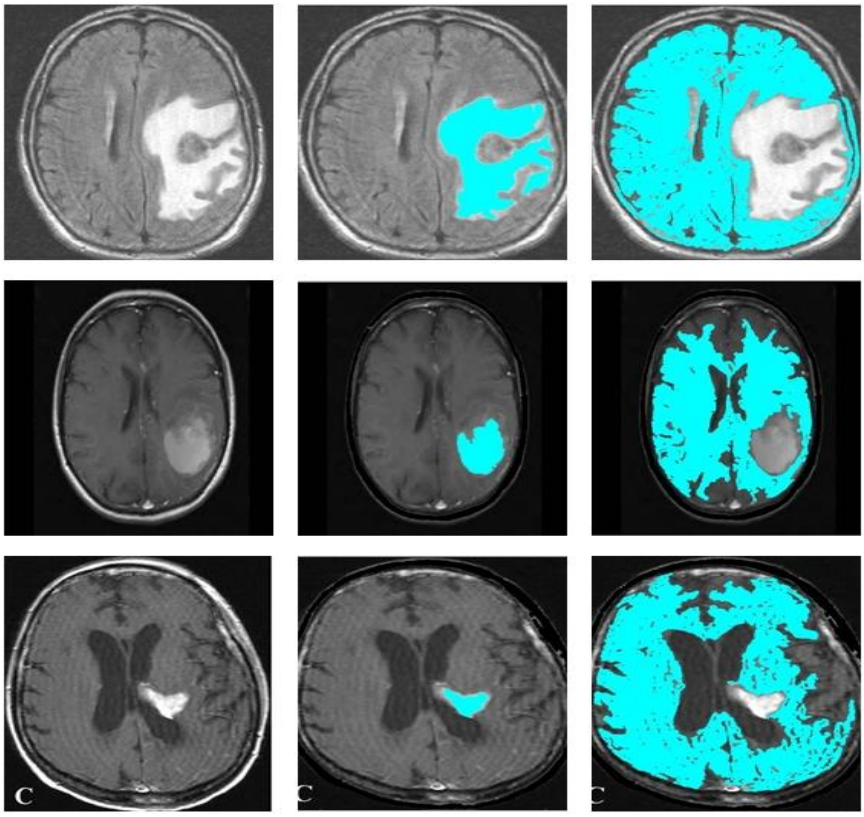

Fig. 3 First column shows the original MR images, and second column shows abnormality identification and third column shows healthy tissue identification

V. CONCLUSION

Segmentation is a very crucial task in medical image processing. This paper summarizes some of the segmentation techniques like edge based thresholding and region growth. The study and experimental results indicated that the identification of healthy and abnormal tissues from brain MR images by region based segmentation method was satisfactory.

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