

Tumor Detection through Image Processing Using MRI

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Abstract— Automated brain tumor segmentation and detection are immensely important in medical diagnostics because it provides information associated to anatomical structures as well as potential abnormal tissue necessary to delineate appropriate surgical planning. Therefore, the primary purpose of this research is to elaborate upon and find ways to take a step ahead; the research will be conducted on Automated Tumor Detection (ATD) in Magnetic Resonance Imaging (MRI) images through algorithms in order to improve the current scenario. A comparison between Region Growing Technique (RGT) and Morphological Tools (MT) for the segmentation of brain tumor from the Hemangiopericytoma tumor has been observed. Segmentation of anatomical regions of the brain is the fundamental problem in medical image analysis. Applying conventional techniques of tumor extraction manually is time-consuming and often unreliable and insufficiently accurate. The study of brain has been of great interest to the researchers. While studies show that it is one the most difficult task to accurately segment the tumor from the case of Hemangiopericytoma. After analytical and numerical evaluation the results achieved depicts that RGT is more effective while MT is more timely efficient technique for tumor detection.

Index Terms— Tumor, hemangiopericytoma, anatomical structure, edema, Magnetic Resonance Imaging, Regionprops, Coronal Plane.

1 INTRODUCTION

A brain tumor is an abnormal mass of tissue in which some cells grow and multiply uncontrollably, apparently unregulated by the mechanisms that control normal cells. The growth of a tumor takes up space within the skull and interferes with normal brain activity. A tumor can cause damage by increasing pressure in the brain, by shifting the brain or pushing against the skull, and by invading and damaging nerves and healthy brain tissue. The location of a brain tumor influences the type of symptoms that occur [2].

The research and analysis has been conducted in the area of brain tumor detection using different segmentation techniques. These techniques are applied on different cases of brain tumor and results are obtained according to their accuracies and comparison bases. But these techniques of segmentations have limitations in the domain of automation and accuracy.

In complex medical images the segmentation of suspicious region in brain is found out to be the most crucial task. Automatic detection of brain tumor through MRI can provide the valuable outlook and accuracy of earlier brain tumor detection [1]. Active contours are often implemented with level set methods because of their power and versatility. The primary drawback of level set methods is that, they are slow to compute. [2]. Using machine learning algorithms i.e. SVM has been proposed earlier for the tumor extraction e.g. in [3] but these algorithms required training to distinguish the results.

A comparative study and statistical analysis on Modified Region Growing Method (MRGM) show that it gives more accurate and better performance for automatic calculation of 3D volumetric size of brain tumor and also gives more accurate boundary detection [4]. A semi-automatic brain tumor segmentation method using watershed segmentation has been developed, without any requirement of initialization inside the tumor while the other methods need initialization. Provide 2D and 3D visualization for surgical planning and assessing tumor [5] but the reproducibility is one the main problem in this case. So, further work can be carried out to make method automatic and more accurate so that brain tumor can detect the dimensions of the segmented tumor automatically with higher degree of accuracy.

In the selected case of MRI image, the edema also present with tumor and it is difficult to distinguish between tumor and edema. Therefore tumor identification requires a lot of experience. The primary objective is to segment tumor automatically without presence of edema and this can be recognized by any person and this method of segmentation of tumor neither require too much time nor require personnel with medical background.

2 BACKGROUND

The theoretical background of the methodology that follows throughout the research is.

2.1 Removal of Patient Details and Text from Image

Firstly maximum and minimum intensity values of image are found out and then maximum values of intensity are converted into minimum i.e. white text is converted into black. The median filter command `medfilt2` used in our code performs median filtering in two dimensions. Each output pixel contains the median value in the 3-by-3 neighborhood around the

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corresponding pixel in the input image.

2.2 Edge Detection

Sobel Edge detecting technique is used in order to significantly reduce the amount of data and filters out useless information, while preserving the important structural properties in an image. It performs a 2-D spatial gradient measurement on an image and returns edges at those points where the gradient of image is maximum. The Sobel edge detector uses a pair of 3x3 convolution masks, one estimating the gradient in the x-direction (columns) and the other estimating the gradient in the y-direction (rows). A convolution mask is usually much smaller than the actual image. As a result, the mask is slid over the image, manipulating a square of pixels at a time.

2.3 Image Segmentation

Segmentation plays a crucial role in medical image processing. It involves partitioning an image into groups of pixels which are homogeneous with respect to some criterion. In this research tumor is segmented from other parts of the brain by using region growing technique and morphological tools.

2.3.1 First Technique

The technique used here takes a seed as input along with the image and grows a region iteratively by comparing all unallocated neighboring pixels to the region. The difference between a pixel's intensity value and the region's mean, is used as a measure of similarity. The pixel with the smallest difference measured this way allocates to the region. This process stops when the intensity difference between region mean and new pixel becomes larger than a certain threshold. `regiongrowing(l,x,y,t)` uses segmentation algorithm described in [1].

2.3.2 Second Technique

Morphology is a broad set of image processing operations that process images based on shapes. Morphological operations create an output image of the same size by applying structuring element to an input image. In a morphological operation, the value of each pixel in the output image is based on a comparison of the corresponding pixel in the input image with its neighbors.

The most basic morphological operations are dilation and erosion. Dilation adds pixels to the boundaries of objects in an image, while erosion removes pixels on object boundaries. The number of pixels added or removed from the objects in an image depends on the size and shape of the structuring element used to process the image.

2.3.3 Complement and Logical AND

The binary image have been complemented i.e. zeros become ones and ones become zeros; black and white are reversed. `IM2 = imcomplement (IM)` computes the complement of the image IM. IM can be a binary, grayscale, or RGB image. IM2 has the same class and size as IM. `C=A&B` performs element wise logical AND operation between two binary images A and

B of same size to obtain resultant image C.

2.4 Regionprops

Regionprops function is used to compute properties for image regions. By using this area and the volume of the tumor was calculated.

3 METHODOLOGY

In order to apply the segmentation techniques, the required data is arranged from the radiology department of DOW University of Health Sciences (Ojha Campus). Specifically brain MR images with different techniques are collected along their radiology reports.

In the selected case of brain tumor, the edema is present along with Hemangiopericytoma tumor. The intensity of tumor and edema are same due to which it is difficult to distinguish between edema and tumor.

3.1 Region Growing

The T1 slice from the selected case of axial plane (slice # 5) is converted into .jpg format first then this .jpg image is loaded into MATLAB (Fig.1). After this patient details and other information has been removed by using median filter. For clarify the tumor boundaries from image sobel edge detector is used (Fig.2). The region growing technique is carried out for the segmentation of T1 image (Fig.3). Complement of region grown T1 image has been taken out. T2 image has been called on the directory and repeat the whole process again for this image too. And logic operation has been performed on processed image of T1 and T2 (Fig. 5). Binary image is then converted into RGB format to highlight the tumor, superimpose the extracted image on original T2 image and RGB image is converted to transparency. Tumor area of all planes is calculated.

3.2 Morphological Tools

A slice is picked out from the T2 and the corresponding slice is chosen from the T1 (slice # 5). Load the slice from T1. Remove the patient details and other text. Apply Median filter for noise reduction. Apply Median filter for noise reduction. Morphological reconstruction (Opening & Closing) is carried out on the image. Load the slice from T2 and repeat the whole process again for image T2. The output of both images are added using Logical AND operator and converted into RGB image. Tumor area of all planes are calculated.

4 RESULTS

Apply region growing technique on the plane of axial T1 and T2 slices from the selected case of tumor. The resulted images are obtained after performing algorithm. Below are the images of techniques applied on the axial images from the case under study after the executions of the codes are:

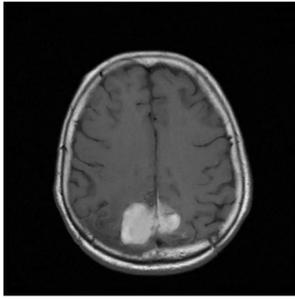


Fig. 1 Axial T1 Image

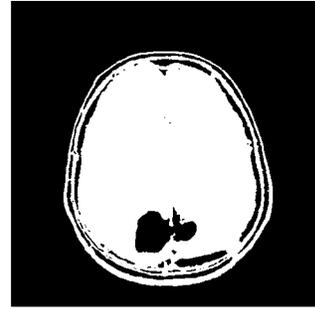


Fig. 5 Region Growing Technique Applied on Axial Image T1

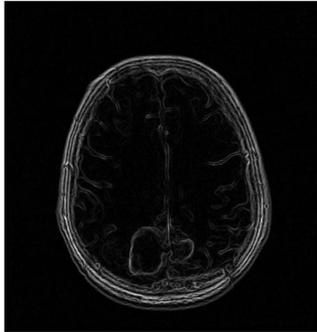


Fig. 2 Sobel Edge Detection of T1

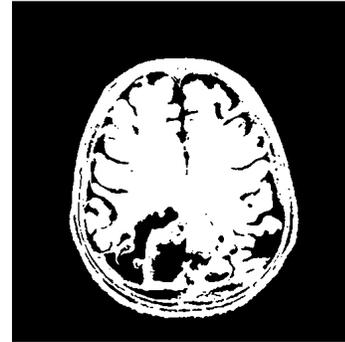


Fig. 6 Region Growing Technique Applied on Axial Image T2

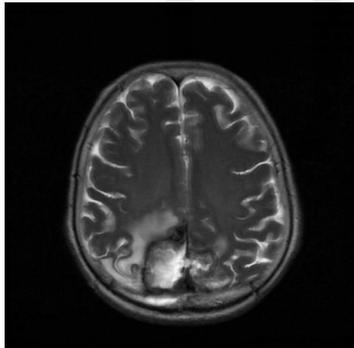


Fig. 3 Axial T2 Image



Fig. 7 and of Complimented Axial T1 and T2 Image

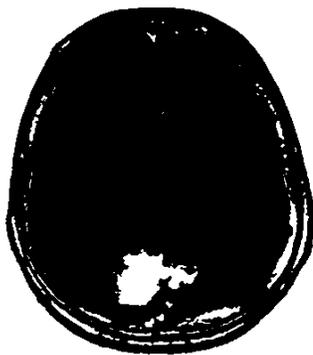


Fig. 4 and of Complimented Axial T1 and T2

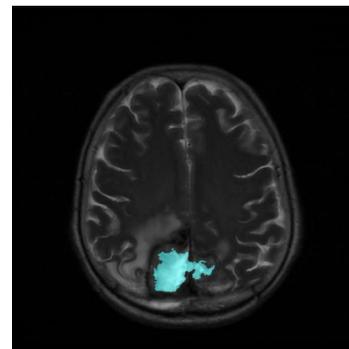


Fig. 8 Final Result: Tumor in Blue

5 ANALYTICAL ANALYSIS

By performing analytical analysis of the two applied techniques the results obtained are that morphological operation took lesser time as compared to region growing segmentation but the result of segmented tumor by applying region growing algorithm is more accurate as compared to the other technique.

Plane	Region Growing Segmentation	Morphological Operation
Time Estimated		
Axial	19.01 sec	5.38sec
Coronal	9.12 sec	1.54sec
Sagittal	8.45 sec	1.54 sec
Area Calculated		
Axial	2945	2912
Coronal	6944	5837
Sagittal	5997	5626
Centroid		
Axial	(245.6927,391.4764)	(245.9536,391.6762)
Coronal	(252.3975,161.9817)	(249.4209, 162.2904)
Sagittal	(410.1729,217.5810)	(409.5094, 219.2206)

6 CONCLUSIONS

The proposed method of brain tumor segmentation helps surgeon in detecting tumor automatically in lesser time as compare to manually calculation and it also provide accuracy.

For segmentation of tumor without edema different segmentation techniques are tested but all techniques come across with failure except morphological and region growing segmentation. The primary problem is that the intensities of tumor and other parts of brain are same, therefore, segmentation becomes a difficult task to perform and tumor shape gets destroyed.

The primary objective is to segment out tumor excluding any other parts of brain and edema. Both tested techniques, morphological operation and region growing segmentation, show desired results.

Morphological operation takes lesser time as compare to region growing but region growing has more accurate result. The final tumor region is highlighted in color and then this image is overlap on original image for showing accuracy of the applied.

7 FUTURE WORK

The proposed algorithm apply on particular case of tumor i.e. Hemangiopericytoma. For the future work this algorithm can be applied on other slices of the selected case and other cases of

tumor as well. The future scope of this project is to segment all types of tumor automatically and a general system can be proposed with higher accuracy and lesser time. Volume of the tumor can be calculated for neurosurgeries. The research can be extended to detect cancer in MRI slabs of other body parts.

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