Detection of Brain Tumor from MRI Images Using MATLAB

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Abstract— Medical image processing is the most emergent field these days and processing of images scanned through MRI are the part of it. For image processing, Segmentation is widely used. In that way MRI-Magnetic Resonance Imaging has become practical means for the analysis of brain tumor images. In the paper we have presented some noise removal functions, three types of segmentation and morphological operations. Using MATLAB software, we have detected and extracted the tumor from MRI scan images.

Keywords- MRI, histogram, segmentation, brain tumor.

I.   INTRODUCTION

Brain cancer is the virus of the brain. Cancer arises basically when the body cells start to divide without any control and they spread around the nearby parts. Some of the cancers form solid tumors. Tumors also named as neoplasm are the masses of the tissue. Many medical imaging modalities are available today to capture the abnormality such as tumor in human body. Magnetic Resonance Imaging (MRI), Computed Tomography (CT) scan, X-ray, Ultrasound and   Electrocardiogram (ECG) are some of the modalities which are used to capture the images. MRI is best appropriate and believed to be powerful technology among all others to collect ideal internal data of the human body for clinical diagnosing. In MRI images, the quantity of data is in large amount, that why the manual interpretation and its analysis becomes difficult and time consuming. From the past few years, brain tumor segmentation in MRI has turn into a growing study area. For the identification of abnormal tissue (tumor), location and size of brain tumor plays an important role.

We propose an algorithmic approach for tumor (abnormal tissue) recognition based on segmentation and morphological operators. First of all, the image is enhanced and then various segmentation techniques are applied on it to detect the tumor part. In future the work will be extended to categorize the particular tissue as either Normal or Abnormal Tissue using a classification technique called as Support Vector Machine. Then volume of the extracted tumor region will be calculated to analyze its size.

II. RESEARCH METHODOLOGY

Using various image processing modalities, we have developed an algorithm for the detection of abnormal mass of tissue in the brain scanned through MRI. In this, we are presenting a methodology that detects the tumor region present in the brain.

According to this algorithm we have two stages, namely Preprocessing and Post processing.
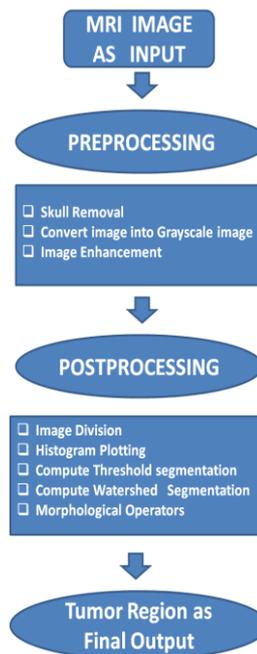
The architecture of Methodology is as follows:

Figure 1.   Flow Chart of Methodology

A.   Image Acquisition

MRI images are acquired when a patient is scanned by MRI Machine on the computer. MRI images can be taken of any part of the body which is desired or to be tested. Images are taken on a 1.5T using T1, T2- weighted axial contrast images. Thickness of the image is slice 0.5 cm, and image format is PNG and JPEG.

B.   Preprocessing

Using MATLAB, brain image scanned through MRI is imported using the command "imread()"and displayed using "imshow()". Then this image is converted into gray scale image .After this, skull stripping is performed, that is removal of non-brain regions. This is an important step in preprocessing which is performed using the morphological operator " imopen()".Then we have applied contrast stretching techniques known as Histogram equalization that stretch out the intensity values. In this step, we are basically concerned with the location of abnormal tissue present which is found in the bottom region of the scanned image.
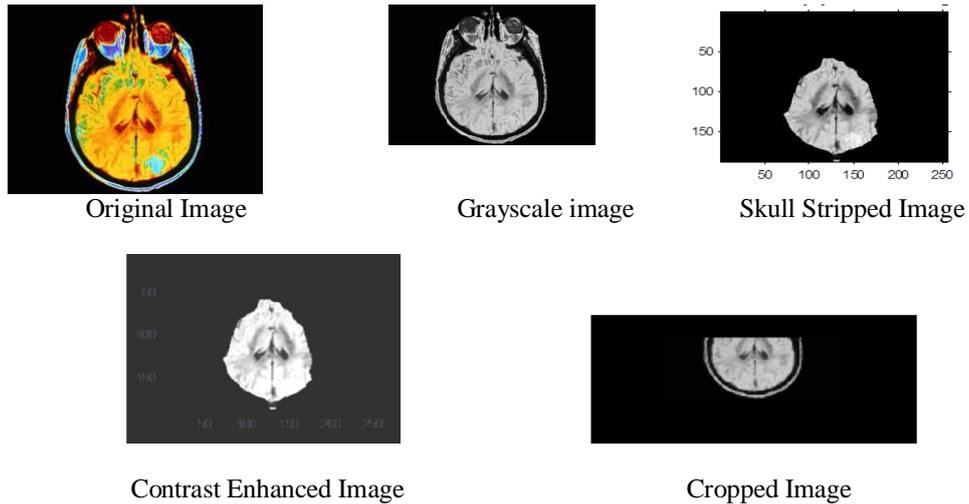
Original Image   Grayscale image   Skull Stripped Image

Contrast Enhanced Image   Cropped Image

Figure 2.   Preprocessing steps

C. *Postprocessing*

1. **Image division**

In this module, the image is divided into two halves as top and bottom to extract features from each half.
The following algorithm is used to accomplish this procedure:

  i)Take two variables as A and B for storing the number of rows and columns.
  ii) Take some other variable C that contains the number of columns divided by 2.
  iii) Using the command "imcrop()",image will be the half of the input image.

2. **Histogram Plotting and comparison between them**

In digital imaging world, Histogram Plotting is a graphical depiction between scale of pixels and the intensity of pixels of the image. In the figure, the horizontal axis shows the scale of pixel intensity and vertical axis shows the intensity of pixel present in the image. Figure 3 (a), (b), (c) shows the histogram graph of the original image and the plot of both halves. It is clearly visible that the bottom half has more deviation around 200.Figure 4 indicates that abnormal tissue is present in the bottom part of the image.
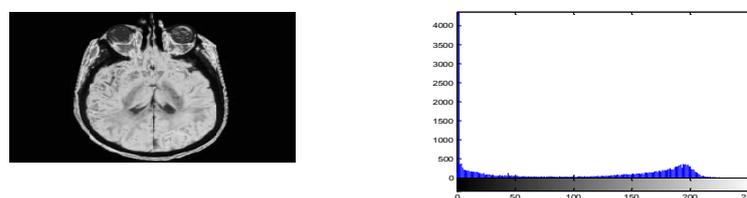
Original Image and its histogram
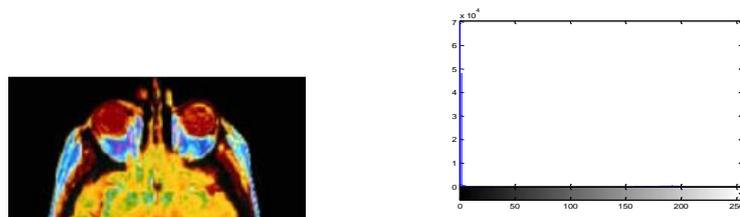
Top half and its histogram

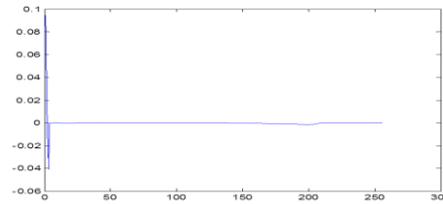

Bottom half and its histogram

Figure 3.   Difference of two histograms
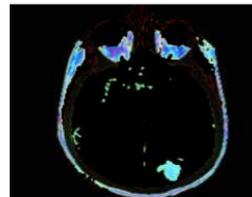
3. **Compute Threshold Segmentation**

Threshold segmentation is the easiest segmentation which is widely used. This method is based on getting binary image out of gray scale image. To segment abnormal tissue we are using thresholding as segmentation algorithm. In this first of all, select a threshold value for initial segmentation. Various methods are present for this task such as K-means clustering, Otsu's method. Using K-means clustering, representation of an image can be made which is somewhat easier to analyse the results. This is basically used to locate boundaries and objects.
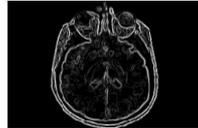

Figure 4.   (a)   Object in cluster index   (b)objects in cluster

(c)Gradient magnitude   (d) After Thresholding Technique

4. **Compute Watershed Segmentation**

In this transformation, image is considered as a topographic surface and the gray level of the image represents the altitudes. Regions with a constant gray level constitute the flat area of an image and region edges depict high watersheds and low rise region depicts catchment basis. Every part has their own minima, and even if single drop of water falls on one plane of the watershed, minima of that region will be reached. Watershed lines represent the boundaries of the object.
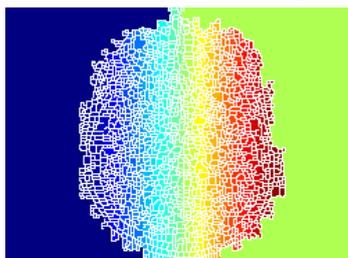
Watershed transform of gradient magnitude (Lrgb)

Figure 5.Watershed tarsnform of gradient magnitude

5. **Morphological Operators**

After applying threshold and watershed segmentation, chain of morphological operations are applied. In this, first we have applied erosion operator to shrink the objects in the image. Size and shape of the structuring element is been controlled by this operation. Then we have applied Dilation operator which will grow or thickens the object. Structuring element plays an important role in both of the operations. Then we apply the operations such as opening and closing formed from combining these two (dilation and erosion) operations. After applying all these operations, we can clearly figure out the tumor (abnormal) region present in the brain.
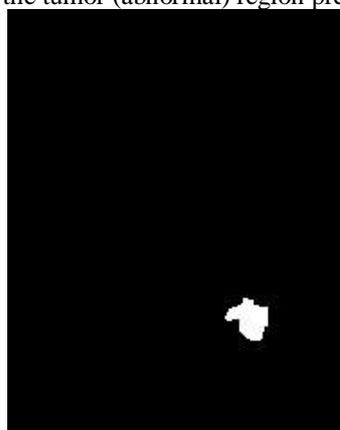

Figure 5.   Tumor Region as final output

III.   APPLICATIONS

The Magnetic Resonance Imaging (MRI) technique is the finest due to its superior resolution than the other methods. For the early detection of brain tumor images, MRI is widely used. To make complete images of the body parts and cells within the body, Magnetic Resonance Imaging (MRI) Scan utilizes strong radio waves and magnetic field. Manual segmentation of the abnormal tissue from the scanned images using MRI is generally tricky and takes lot of time. That's why we are using Automated segmentation technique that give suitable results with less work for the manual operator. The goal of this work is to offer an automated tool which locates the tumor on MRI scanned image.

IV.   CONCLUSION

The research was done for detection and extraction of tumor from the MRI image. Various noise removal techniques were used. Mainly segmentation was used to extract the tumor region based on the methods as Watershed, Texture and Threshold Segmentation. In this study, various samples were collected, scanned using MRI, preprocessed and further evaluated using morphological operators, thus locating the tumor and getting efficient end results. In future the work will be extended to generate a new algorithm for volume calculation of the tumor region to analyze its size.

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