

# BRAIN REGION EXTRACTION AND VOLUME CALCULATION

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**Abstract:** Segmentation of anatomical regions of the brain is the fundamental problem in medical image analysis. In this paper brain tumor segmentation method has been developed and validated segmentation on 2D MRI Data. In this study, after a manual segmentation procedure the tumor identification, the investigations has been made for the potential use of MRI data for improving brain tumor shape approximation and 2D & 3D visualization for surgical planning and assessing tumor. Surgical planning now uses both 2D & 3D models that integrate data from multiple imaging modalities, each highlighting one or more aspects of morphology or functions. Finally, work was carried over to calculate the area of the tumor of single slice of MRI data set and then it was extended to calculate the volume of the tumor from multiple image MRI data sets. Experimental results show that method produces satisfactory output.

**Keywords:** Brain tumor segmentation, MRI, seeded region-growing segmentation and advanced gradient magnitude region growing technique.

## 1. INTRODUCTION

The body is made up of many types of cells. Each type of cell has special functions. Most cells in the body grow and then divide in an orderly way to form new cells as they are needed to keep the body healthy and working properly. When cells lose the ability to control their growth, they divide too often and without any order. The extra cells form a mass of tissue called a tumor. Tumors are benign or malignant. There are three methods of segmentation. These are Snakes (Gradient Vector Flow), Level Set Segmentation and Watershed Segmentation. The aim of this work is to design an automated tool for brain tumor quantification using MRI image data sets. This work is a small and modest part of a quite complex system. The whole system will when completed visualize the inside of the human body, and make surgeons able to perform operations inside a patient without open surgery.

More specifically the aim for this work is to segment a tumor in a brain. This will make the surgeon able to see the tumor and then ease the treatment. The instruments needed for this could be ultrasound, Computer Tomography (CT scan) and Magnetic Resonance Imaging (MRI). In this Paper, the technique used is Magnetic Resonance Imaging (MRI). Watershed segmentation uses the intensity as a parameter to segment the whole image data set. Moreover, the additional complexity of estimation imposed to such algorithms causes a tendency towards density dependent approaches. Three dimensional segmentations are a reliable approach to achieve a proper estimation of tumor volume. Among all possible methods for this purpose, watershed can be used as a powerful tool which implicitly extracts the tumor surface. Watershed segmentation based algorithm has been used for detection of tumor in 2D and in 3D. For detection of tumor in 2D the software used is MATLAB. Direct volume rendering is usually used to explore the internal structure. But it is often difficult to visualize MRI head data directly, due to fact that the classification methods adopted in direct volume rendering cannot discriminate anatomical organs of MR head image from each other. Although it is essential for radiologists to have a reliable MRI classification technique, there are too many different factors to consider, such as image contrast, image resolution, the ratio of signal to noise, and the capacity of data. The widely-used approaches in classifying anatomical objects from MR head images include: thresholding, statistical segmentation, and region growing. The hierarchical approaches have achieved great success in recent years. In this paper we propose a hierarchical brain segmentation method that combines thresholding, morphology operation, SNAKES operations and a direct volume rendering method for MRI head data.

## 2. Problem definition

Segmentation of anatomical regions of the brain is the fundamental problem in medical image analysis. While surveying the literature, it has been found out that no work has been done in segmentation of brain tumor by using watershed in MATLAB Environment. Here, a brain tumor segmentation method has been developed and validated segmentation on 2D MRI Data. In this study, after a manual segmentation procedure the tumor identification, the investigations has been made for the potential use of MRI data for improving brain tumor shape approximation and 2D & 3D visualization for surgical planning and assessing tumor. Surgical planning now uses both 2D & 3D models that integrate data from multiple imaging modalities, each highlighting one or more aspects of morphology or functions. Firstly, the work was carried over to calculate the area of the tumor of single slice of MRI data set and then it was extended to calculate the volume of the tumor from multiple image MRI data sets.

## 3. Solution Approaches

### 3.1 Solution Approaches (Theoretical)

A conceptually simple supervised block-based and image-based (shape, texture, and content) technique has been used to analyze MRI brain images with relatively lower computational requirements. The process flow of our proposed methodology may be the first section discusses how images are divided into regions using a block-based method. The second section shows how each classified block is studied individually by calculating its multiple parameter values. In this instance, the multi parameter features refer to the following three specific features: the edges (E), gray values (G), and local contrast (H) of the pixels in the block being analyzed.

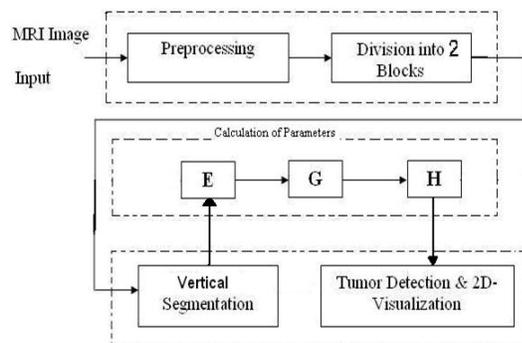
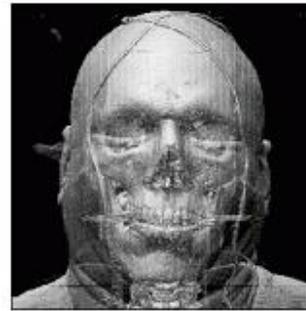


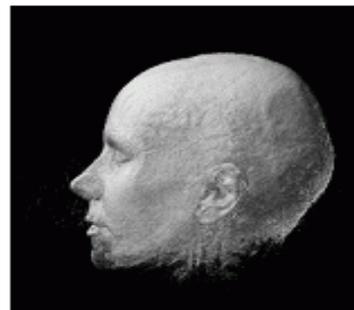
Figure 1: Methodology

## Overview of the Previous Method

Fig. 2 shows the distinctive outcomes for the data acquired from different image modalities. The image from CT head data can display skin and skull as shown in Fig. 2(a), whereas the image from MRI cannot display skin and brain as shown in Fig. 2(b). Drevin classify the anatomical parts of CT data assuming that air, fat, soft tissue, and bone all have different voxel values. But the MRI head data has voxels with the same intensity that belong to different anatomical organ of the head. To resolve this problem, we have developed a three stage pipeline for direct volume rendering MR head image data as illustrated in Fig. 3. In the first stage, the head region of MR head image slices is divided into the brain region and the remaining region. In the second stage, the values of voxels of the brain region are increased and the voxels of the brain region are recombined with the remaining region, i.e. skin, skull, and scarp, using the window-level transfer function. In the third stage, all slices of the recombined MR head image data is drawn using direct volume rendering.

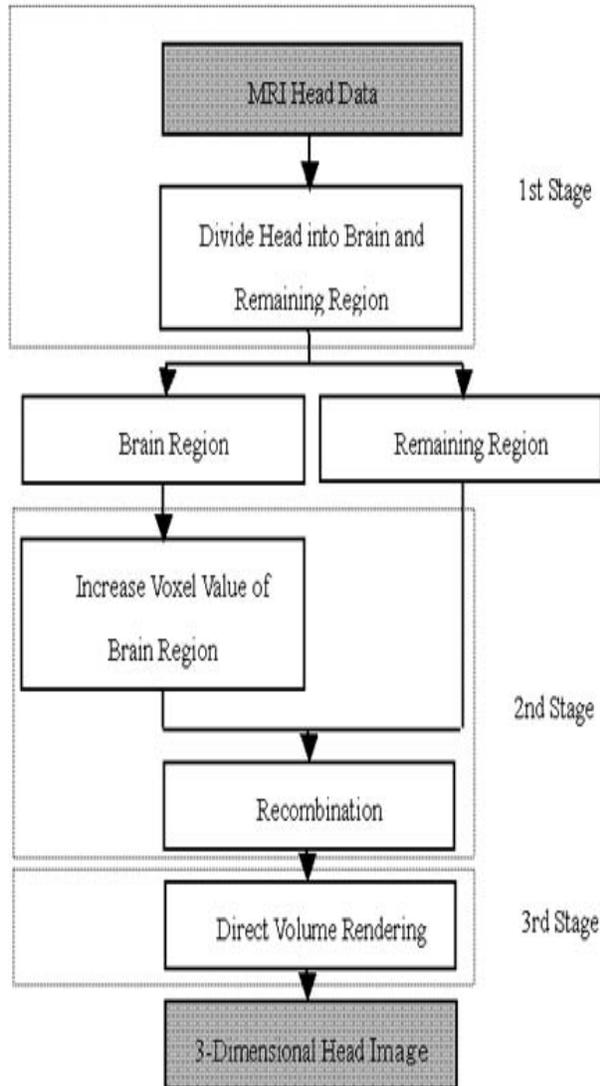


(a) CT Head Data



(b) MRI Head Data

Figure 2. Direct volume rendering of 3D tomography



**Figure 3:** Direct volume rendering pipeline for MRI head data

### 3. Overview of the Current Method:

#### 3.1.1 Preprocessing

The Preprocessing is used for loading the Input MRI images to the MATLAB Environment and also it removes any kind of noise present in the input images. In preprocessing the first step is to load the MRI image data set on to the MATLAB workspace.

#### 3.1.2 Multi-parameter Calculations

Recent advances in medical image analysis often include processes for an image to be segmented in

terms of a few parameters and into smaller sizes or regions, to address the different aspects of analyzing images into anatomically and pathologically meaningful regions. Classifying regions using their multi parameter values makes the study of the regions of physiological and pathological interest easier and more definable. Here, multi parameter features refer to the following three specific values for the edges (E), gray values (G), and local contrast (H) of the pixels.

#### 3.1.2.1 Edge (E) Parameter

Edge information is often used to determine the boundaries of an object. This is mainly used for analysis to derive similarity criterion for a predetermined object. The incidences of cerebral compression reduce the edge.

Edge detection is the process of finding sharp contrasts in intensities in an image. This process significantly reduces the amount of data in the image, while preserving the most important structural features of that image. Canny Edge Detection is considered to be the ideal edge detection algorithm for images that are corrupted with white

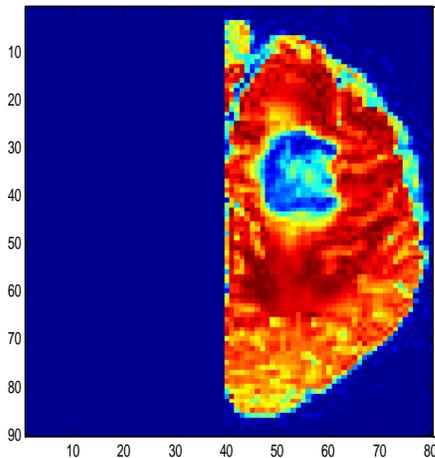
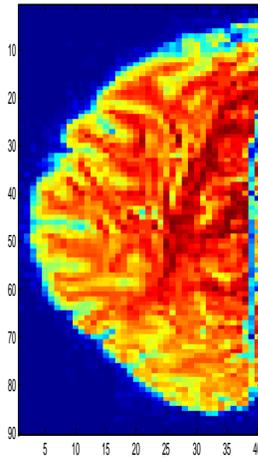


noise.



### 3.1.2.2 Gray (G) Parameter

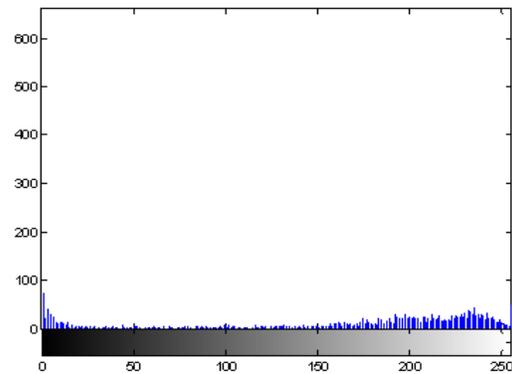
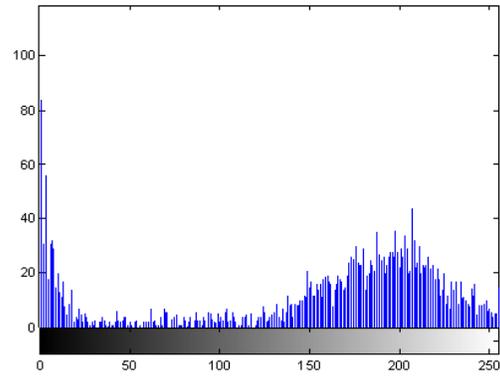
Gray parameter avoids the need to scale the data-to-color mapping, which would be required if we used a color map of a different size. The gray parameter (G) for each block of the brain is accumulated.



### 3.1.2.3 Contrast (H) Parameter

An intensity image is a data matrix,  $I$ , whose values represent intensities within some range. MATLAB stores an intensity image as a single matrix, with each element of the matrix corresponding to one image pixel. The matrix can be of class double, uint8, or uint16. While intensity images are rarely saved with a color map, MATLAB uses a color map to display

them. In essence, MATLAB handles intensity images as indexed images. Contrast (H) is often used to characterize the extent of variation in pixel intensity. In the present technique, the computational program analyses the differences, especially in instances of strong dissimilarity, between entities or objects in an image.



## 5. Discussion

Here, we proposed a new method for segmenting of MRI head data without segmenting all the anatomical organs in a head. The proposed method segmenting human brain into two parts vertically. After the segmentation is processed, the first stage extracts the approximated brain boundary by Canny edge detection algorithm and find the gray matter in human brain.

In the next part we have to find the volume of each part of the human brain. We are able to direct volume render the MRI head data by finding the radius of the human brain.

The total process is as follows:

1. Input a normal human brain.
2. Segment the normal human brain into two halves (vertically). We will get two half hemispheres.
3. Find the edge detection of each half of hemisphere.
4. Find the volume of each hemisphere.
5. Get a human brain with a tumor in a half of hemisphere.
6. Proceed step 2 to 5 & compare between two.
7. Stop

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