

Extraction and Calculation Area of Human Brain Tumor from MR Images

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Abstract: The human brain tumor is great threat in the world. Now-a-days it is detected in the early age people. So brain tumor treatment has been a challenge to medical science. . If it is detected at an early stage than the chances of saving a life are increased. In this work the proposed strategy to detect and extraction of human brain tumor from patient's Magnetic Resonance Imaging (MRI) scan images of the brain. The essential steps of this paper are image preprocessing, segmentation and feature extraction. First of all, consider MR images of brain tumor as input and convert to gray scale images. The images were filtered by low pass filter for noise removal. Then images were applied median filter to enhance the quality of image. Using threshold segmentation, the edges of brain tumor are detected. Then remove unnecessary portion of brain tumor using morphological operation. Applying watershed segmentation for extraction of watershed ridges of brain tumor. Then in the feature extraction step, calculate the values of area and perimeter of extracted brain tumor. This paper provides a significant contribution of technologies which can be used to predict brain tumor.

Keywords: brain tumor, segmentation, magnetic resonance imaging (MRI).

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I. Introduction

A brain tumor is a collection of abnormal cells that grows in or around the brain. It poses a risk to the healthy brain by either invading or destroying normal brain tissue or by compressing and displacing the brain. Since the brain is enclosed inside the skull which has a fixed amount of space, a growing brain tumor can cause significant damage to the brain. Brain tumors can be malignant (also called brain cancer) or benign (do not contain cancer cells) [1]. Brain cancer is one of the most common causes of cancer death in all population. If it's suspected that a patient have a brain tumor, a number of tests and procedures are advised among them Computed Tomography (CT) and Magnetic Resonance Imaging (MRI) are two of them [2]. Where Computed Tomography (CT) is the scan combines with high-speed X-ray technology with a computer. The CT scanner circles the head, taking X-rays from every angle. The computer then combines these thousands of X-ray images into a cross-sectional image of the brain. Where the MRI scanner uses magnetic fields and radio waves, not x-rays, to generate detailed images of the brain tissue. MRIs can create two-dimensional or three-dimensional pictures of the brain [3]. In some cases a dye called a contrast medium may be injected through a vein in arm before the scan to create a clearer picture. So tumor is defined as the abnormal growth of the tissues. Brain tumor is an abnormal mass of tissue in which cells grow and multiply uncontrollably, seemingly unchecked by the mechanisms that control normal cells [4].

. The Magnetic Resonance Imaging (MRI) is a medical imaging technique used in radiology to form pictures of the anatomy and the physiological processes of the body in both health and disease [5]. MRI scanners use strong magnetic fields, radio waves, and field gradients to generate images of the inside of the body. The brain images obtained by using MRI include not only image of tumor but also grey matter, white matter, cerebrospinal fluid and skull tissues and also noise [6]. In medical image segmentation of images plays a vital role in stages which occur before implementing object recognition [7]. Image segmentation helps in automated diagnosis of brain diseases and helps in qualitative and quantitative analysis of images such as measuring accurate size and volume of detected portion. Accurate measurements in brain diagnosis are quite difficult because of diverse shapes, sizes and appearances of tumors

In this paper we describe the strategy to extract and detect brain tumor from the patient's MR scan image. It includes pre-processing, image segmentation, morphological operation, watershed segmentation and calculate area and perimeter of tumor region and tumor region detection. The entire paper is organized as material and methods in section II, result and discussions in section III and conclusion is in section IV. In this paper, we will develop a unique technique of extraction of a human brain tumor by using segmentation with different MATLAB techniques.

II. Material And Methods

In this research work, the main objectives are to extract and detect brain tumor region in the MRI images using different methods and we calculate various parameters like

- Area
- Perimeter of tumor region

The algorithm has different stages, first is pre-processing of given MRI image and after that segmentation and then perform morphological operations and calculate area, perimeter of detected tumor region. The steps of algorithm are given below,

1. Take MRI image of human brain as input.
2. Convert it to gray scale image.
3. Apply low pass filter for noise removal.
4. Apply median filter to enhance the quality of image.
5. Compute threshold segmentation.
6. Compute morphological operation
7. Compute watershed segmentation
8. Finally output will be a tumor region
9. Calculate area and perimeter of tumor region

Figure 1 shows the block diagram of working model.

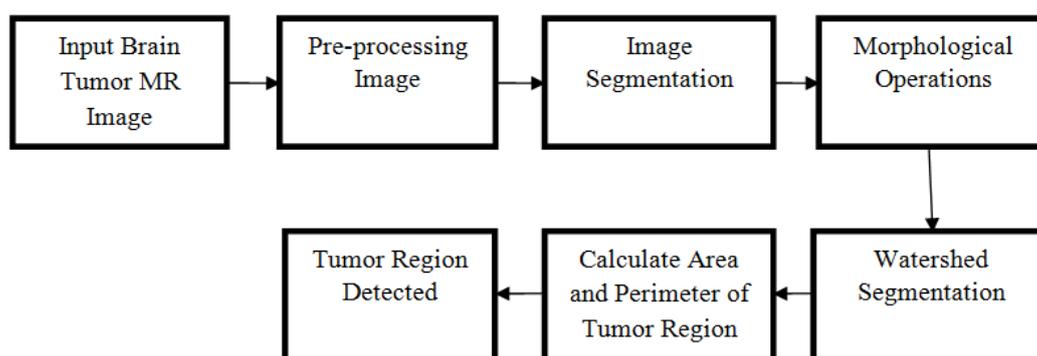


Figure 1: Block diagram of working model

Grayscale Conversion

Generally the brain tumor MR images are generated with combination of red, green and blue (RGB) colors. It makes computational complexities and still does not make better results. Therefore in image pre-processing, grayscale images are considered. The function `rgb2gray (image)` is used for conversion a RGB to grayscale image.

Preprocessing of Grayscale Image

Pre-processing of MR images is the basic step in image analysis. It performs for image enhancement and noise reduction techniques. It uses to enhance the image quality. In this work, the pre-processing techniques are developed to remove the skull portion surrounding the human brain tissues. The experimental results are analysed of distance measure for feature extraction techniques. Following two filters are considered for the pre-processing image.

Low Pass Filter

The gray scale image is taken as an input to low pass filter for performing smoothing image. It called a "blurring" or "smoothing" filter. It calculates the average of a pixel and all of its eight immediate neighbours. The process is looped for every pixel in the image.

Median Filter

Now the image is given to median filter for noise reduction. The median filter is a standard nonlinear digital filtering technique. It preserves edges while removing noise. It arranges the pixel values in an order around the neighborhood and takes the median value as the result.

Image Segmentation

Image segmentations typically used to detect objects and boundaries (lines, curves, etc.) in images. It generally based on one of two basic properties of intensity values: discontinuity and similarity. In the first property, the approach is to partition an image based on abrupt changes in intensity, such as isolated points, lines and edges in an image. The principal approaches in second property are based on partitioning an image into regions that are similar according to a set of predefined criteria.

Threshold Segmentation

The thresholding technique is simplest method of image segmentation. It is based on a clip-level (or a threshold value) to turn a gray-scale image into a binary image.

Morphological Operation

Morphological technique simplified segmented images by smoothing out object outlines using filling small holes, eliminating small projections. Dilation and erosion are primary operations. These operations use a structuring element which determines exactly how object will be dilated or eroded. The structuring element is positioned at all possible locations in the image and it is compared with the corresponding neighbourhood of pixels. These operations test whether the element "fits" within the neighbourhood, while others test whether it "hits" or intersects the neighbourhood.

Watershed Segmentation

Watershed segmentation is a gradient-based segmentation technique. This method used after morphological operations. It method is carried out as input images to detect the anatomical connectivity of human brain tumor region. After all the operations the extracted tumor region would be detected in output result. In output image tumor will be shown in terms of watershed ridges.

Feature extraction

Feature extraction is most important elemental tasks for recognizing images. There are different types of features to be used of image recognition such as visual features and statistical features of pixel. In this work, two features such as area and perimeter of pixel are calculated. They are very useful for the recognition of brain tumor images. Then, the experimental result shows that area and perimeter are calculated of detected brain tumor region from input images.

Area

Area is the summation of detected areas of pixels. Detected areas are calculated using regionprops function in Matlab which is measured a set of properties of image regions for each connected object in the binary image. This image have only two values either black or white (0 or 1). In this work, 512_512 dimension is a maximum size of the image. The binary image can be represented as a summation of total number of white and black pixels. So, area of the image is the total number of the pixels present in this area.

Perimeter

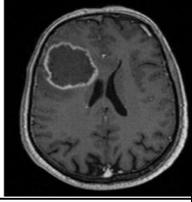
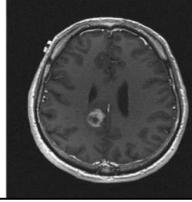
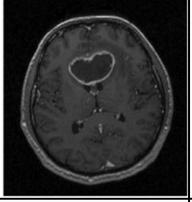
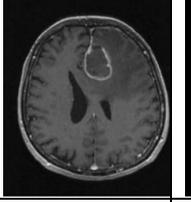
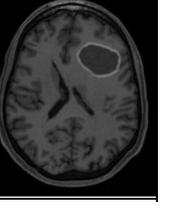
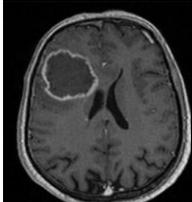
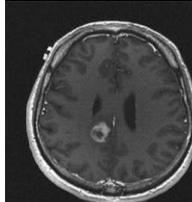
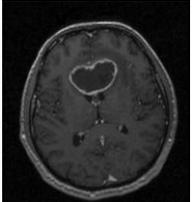
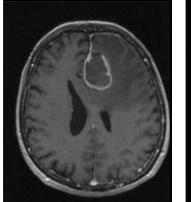
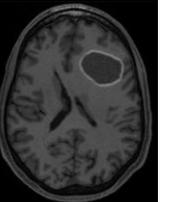
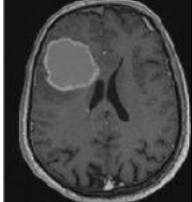
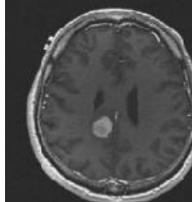
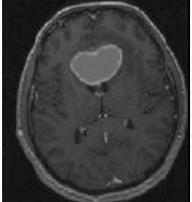
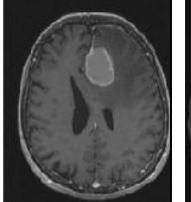
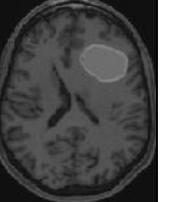
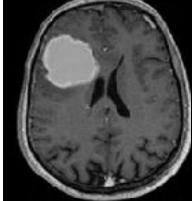
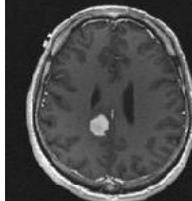
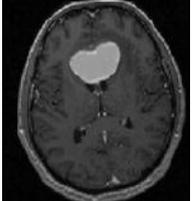
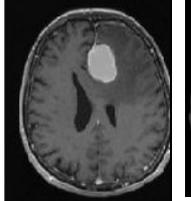
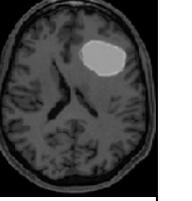
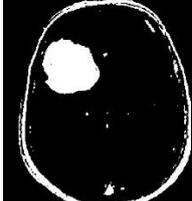
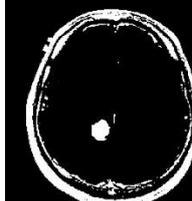
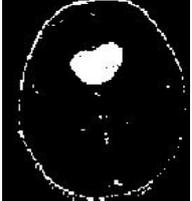
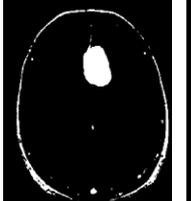
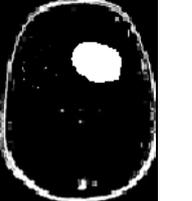
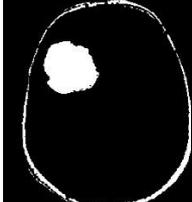
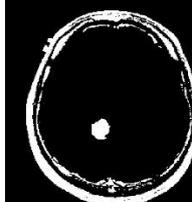
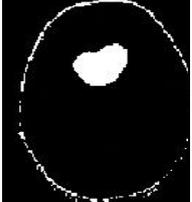
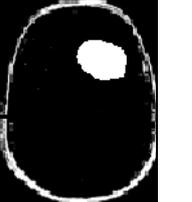
Perimeter is the number of pixels in the boundary of the detected object. It is measured as the sum of distances between every consecutive boundary points. Detected perimeters are also calculated using regionprops function in Matlab.

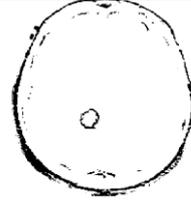
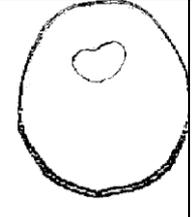
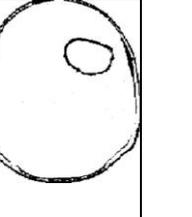
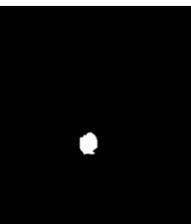
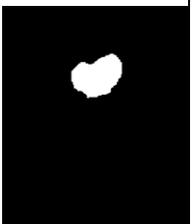
III. Result

Table no 1 shows there are five input MR images of brain tumor are considered. They are converted to grayscale images to reduce computational complexities. The following conversion is used the function `rgb2gray` (image) and the simulation result is given table no 1. Second step of simulation is to pass through low pass filtered of the grayscale output image in previous step. It is observed in table no 1 that images are smoothed and these low-pass filtered images look a little bit blurrier. For the next step the low-pass filtered images are passed through median filter further enhancing the quality of the MR images. It can be observed in table no 1 that edges are detected clearly. Then the next step involves the application of threshold segmentation on median filtered output images. It is clearly observed from table no 1 that threshold segmentation which gives the accurate edge detected images from processed images. In the next step morphological image processing is used for erosion and dilation operations. In this work erosion is applied to detect the tumor. Table no 1 shows also the segmented images which are segmented using watershed segmentation. It is a most significant segmentation system for separating an image to partition a tumor from the images. Finally the extracted brain tumor images are shown in table no 1. The area and perimeter are calculated and the values are

given in table no 1. It is clearly observed that values of area and perimeter are indicated the size of brain tumors. If the values are indicated large than the tumors size big or the values are small than the tumors size also small.

Table no 1: Shows metabolic parameters of patients of the three groups before treatment.

Input Image					
Grayscale Image					
Low Pass Filter					
Median Filter					
Threshold Segmentation					
Morphological Operation					
Watershed Segmentation					

					
Detected Tumor					
Area of Tumor	13725	1566	3088	2063	2947
Perimeter of Tumor	493.0970	165.0130	281.9600	187.8550	200.6340

IV. Conclusion

In this paper, a brain tumor MR images is applied to pre-processing and after that tumor are extracted by watershed segmentation processes. It is very clearly visualized that there are some significant differences in calculation values of extracted area and perimeter of brain tumor. The values are indicated that some tumors small and some are large. It can be helpful for improved diagnosis and treatment. The brain tumor detection is a great help for the physicians and a boon for the medical imaging and industries working on the production of MR imaging. The future works involve the segmentation and detection of more images with more features.

References

- [1]. W. Gonzalez, "Digital Image Processing", 2nd ed. Prentice Hall, Year of Publication 2008, Page no 378
- [2]. S. Murugavalli, V. Rajamani, "A high speed parallel fuzzy c-mean algorithm for brain tumour segmentation", "BIME Journal", Vol. no: 06, Issue (1), Dec., 2006
- [3]. Hardik Modi, Neha Baraiya, Himanshu Patel. An Efficacious Graphical User Interface Implementation for Automatic Classification of Brain Tumor from Magnetic Resonance Imaging Images Using Image Processing
- [4]. Rajesh C. Patil, Dr. A. S. Bhalchandra. Brain Tumour Extraction from MRI Images Using MATLAB
- [5]. Yogita Sharma, Parminder Kaur. Detection and Extraction of Brain Tumor from MRI Images Using K-Means Clustering and Watershed Algorithms
- [6]. SivaSankari S., Sindhu M., Sangeetha R. and ShenbagaRajan. "Feature Extraction of Brain Tumor Using MRI." In International Journal of Innovative A Research in Science, Engineering and Technology, 2014, 3(3): pp. 10281-6
- [7]. Baraiya, N. and Modi, H. "Comparative Study of Different Methods for Brain Tumor Extraction from MRI Images using Image Processing." Indian Journal of Science and Technology, 2016 9(4): 1-5

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