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Efficient Analysis of Brain Tumor Detection and Identification Using Different Algorithms

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Abstract

Brain tumor is one of the major causes of death among people. It is evident that the chances of survival can be increased if the tumor is detected and classified correctly at its early stage. The segmentation of brain tumors in magnetic resonance images (MRI) is a challenging and difficult task because of the variety of their possible shapes, locations, image intensities. In this paper, it is intended to summarize and compare the methods of automatic detection of brain tumor through Magnetic Resonance Image using Histogram Thresholding with Region growing and K-mean segmentation. The proposed method can be successfully applied to detect the contour of the tumor and its geometrical dimension. MRI brain tumor images detection is a difficult task due to the variance and complexity of tumors. This paper presents three techniques for the detection purpose; first one is Histogram Thresholding, second is Region growing technique and third is K-mean. In this paper, the purposed method is more accurate and effective for the brain tumor detection and segmentation for MRI (DICOM) images. For the implementation of this proposed work we use the Image Processing Toolbox under Matlab Software.

Keywords: Histogram thresholding, brain tumor detection and identification, region growing and K-mean segmentation.

Introduction

Brain has a very complex structure and is considered as a kernel part from the body. Nature has tightly safeguarded the brain inside a skull that hinders the study of its function as well as makes the diagnosis of its diseases more intricate. But, brain is not prone to diseases and can be affected by the abnormal growth of the cells in that change its normal structure and behavior; a disease generally known as a brain tumor. Brain tumors either include tumors in the central spinal canal or inside the cranium. Automatic defects detection in MRI is quite useful in several diagnostic and therapeutic applications computed tomography and MRI are two imaging modalities that help researchers and medical practitioners to study the brain by looking at it non-invasively. Most of the time, the tumor segmentation and classification become harder due to quantity of MR images and blurred boundaries. Since brain is safeguarded by the skull, therefore, an early detection of brain tumor is only possible when diagnostic tools are directed at intracranial cavity. MRI is a medical imaging technique, and radiologists use it for visualization of the internal structure of the body. MRI can provide plentiful of information about human soft tissues anatomy as well as helps diagnosis of brain tumor. MR images are used to analyze and study behavior of the brain. A powerful magnetic field is used to align the nuclear magnetization of hydrogen atoms (or protons) of water in the body. In the presence of RF (radio frequency) electromagnetic fields, hydrogen nuclei produce a rotating magnetic field which is detectable by the scanner. Since protons can absorb energy at specific frequency and have the ability to reemit that energy; therefore, a transmitter coil is normally fitted around the human skull to measure the net magnetization. The transmitter coil functions in the following way: first, it produces electromagnetic waves and transmits these waves inside the brain, and then a receiver coil measures the intensity of the emitted electromagnetic waves. Moreover, an additional gradient coil is used for spatial localization of the signal. Lastly, the recorded signals (or electromagnetic waves) are reconstructed into an image by a specialized computer program. Early detection and classification of brain tumors is very important in clinical practice. Many researchers have proposed different techniques for the classification and detection of brain tumors based on different sources of information. In this paper we propose a

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process for brain tumor classification and detection, focusing on the analysis of Magnetic Resonance (MR) images. The performance of these approaches usually depends on the accuracy of the segmentation technique.

Brain Tumor Detection Using Neural Network [1] brain tumor segmentation in magnetic resonance imaging (MRI) has become an emergent research area in the field of medical imaging system. Brain tumor detection helps in finding the exact size and location of tumor. An efficient algorithm is proposed in this paper for tumor detection based on segmentation and morphological operators. Firstly quality of scanned image is enhanced and then morphological operators are applied to detect the tumor in the scanned image. Brain Tumor Detection and Segmentation Using Histogram Thresholding [2] in this study a technique to detect presence of brain based on thresholding technique have been developed. The segmentation of the brain is also being done while detecting the presence of the tumor. The physical dimension of the tumor which is of utmost importance to the physicians can also be calculated using the present technique. In [3] purposed an optimized fuzzy logic application for MRI brain images segmentation. In this research, we use optimized fuzzy logic technique based on FCM clustering that Incorporates the spatial information into the membership function to improve the segmentation Results. The membership functions of the neighbors centered on a pixel in the spatial domain are enumerated to obtain the cluster distribution statistics. These statistics are transformed into a Weighting function and incorporated into the membership function.

Proposed Technique

This section illustrates the overall technique of our proposed detection and identification of brain tumor through Magnetic Resonance (DICOM) Image using Histogram Thresholding, Region growing and K-mean segmentation. There purposed techniques are given below:

A. Histogram Thresholding

In image processing, the Histogram Thresholding method (HT) is a very simple method used for automatic image Thresholding. Like 'Otsu's Method' and the 'Iterative Selection Thresholding Method', this is a histogram based Thresholding method. This approach assumes that the image is divided in two main classes: The background and the foreground. The HT method tries to find the optimum threshold level that divides the histogram in two classes. Histogram thresholding is used by the Object Extraction, Background and Image Factory (segmentation) tools to select a range of pixel values that should match to what you want to select in the image.

Thresholding is a technique for converting a grayscale or color image to a binary image based upon two threshold values. The histogram presents the frequency of intensity values of a channel in an image. The threshold values (min and max) can be applied by moving the arrows above the histogram or by using an automatic threshold method.

B. Region growing

Region growing is a region-based image segmentation method. It is also classified as a pixel-based image segmentation method. This approach to segmentation examines neighboring pixels of initial seed points and determines whether the pixel neighbors should be added to the region. Region growing methods can correctly separate the regions that have the same properties we define. It provides the original images which have clear edges with good segmentation results. The concept is simple. We only need a small number of seed points to represent the property we want, and then grow the region. We can determine the seed points and the criteria we want to make.

C. K-mean

K-means is a method of vector quantization, originally from signal processing, that is popular for analysis in segmentation. K-means aims to partition n observations into k clusters in which each observation belongs to the cluster with the nearest mean, serving as a prototype of the cluster. This results in a partitioning of the data space into Voronoi cells. The problem is computationally difficult; however, there are efficient heuristic algorithms that are commonly employed and converge quickly to a local optimum. These are usually similar to the expectation-maximization algorithm for mixtures of Gaussian distributions via an iterative refinement approach employed by both algorithms. Additionally, they both use cluster centers to model the data; however, k-means clustering tends to find clusters of comparable spatial extent, while the expectation-maximization mechanism allows clusters to have different shapes.

The main improvements in our work are Histogram Thresholding. This approach assumes that the image is divided in two main classes: The background and the foreground. With the help of this we can easily detect and segment the MR images.

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The improvement is based on automatic utilization of specified regions of interest within the tumor area in the MRI images using HT, region growing and K-mean segmentation.

Evaluation and Results

To verify the effectiveness (qualities and robustness) of the proposed brain tumor detection technique, we conduct several experiments with this procedure on several MRI images.

There are some steps of our proposed technique are given below:

1. Firstly we develop a particular GUI for this implementation. After that we develop a code for the loading the MRI image in the Matlab database.
2. Develop a code for the Histogram thresholding and apply on the loaded image.
3. Develop a code for the region growing segmentation. Image segmentation is the process of partitioning a digital image into multiple segments (sets of pixels, also known as super pixels). The goal of segmentation is to simplify and/or change the representation of an image into something that is more meaningful and easier to analyze. So we apply the segmentation on the MRI image.
4. After that we develop code for the K-mean and apply on the MRI image. After that develop the code for the detection of the tumor present in MRI image.

In our proposed method we implement detection and identification of brain tumor through Magnetic Resonance (DICOM) Image using Histogram Thresholding, Region growing and K-mean segmentation.

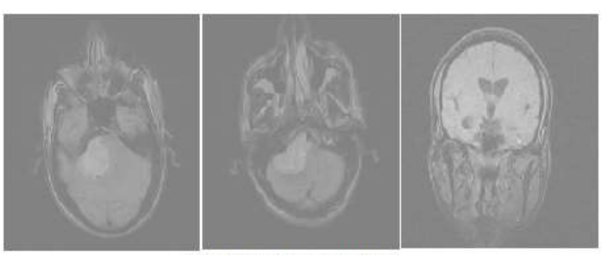

fig 1. Three Abnormal Images

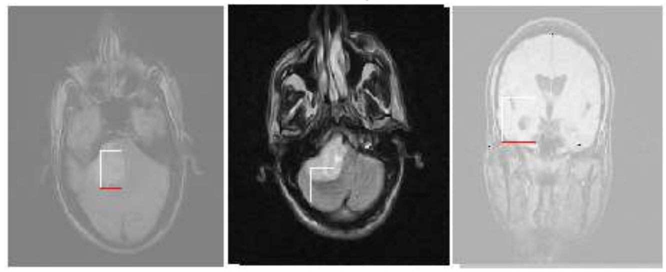

fig 2. Detection of tumor in images with differrent algorithm

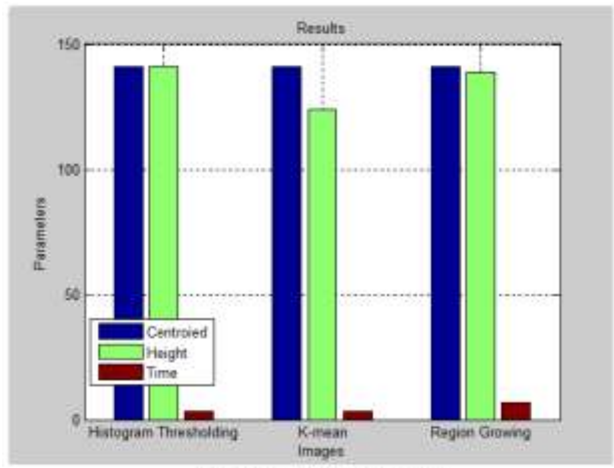

fig 3. Three parameter for 1st case image

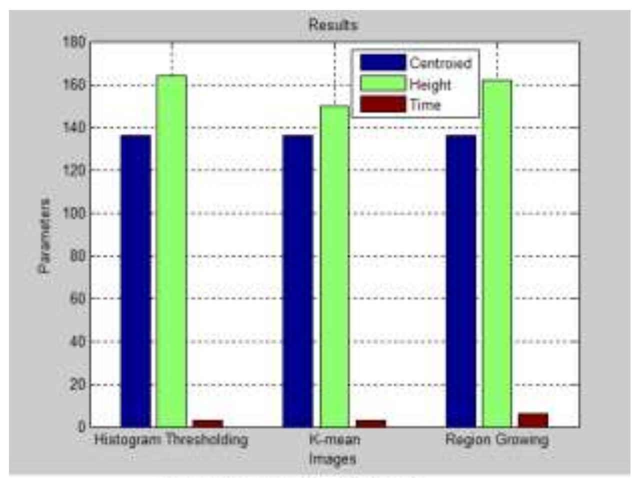

fig 4. Three parameter for 2nd case image

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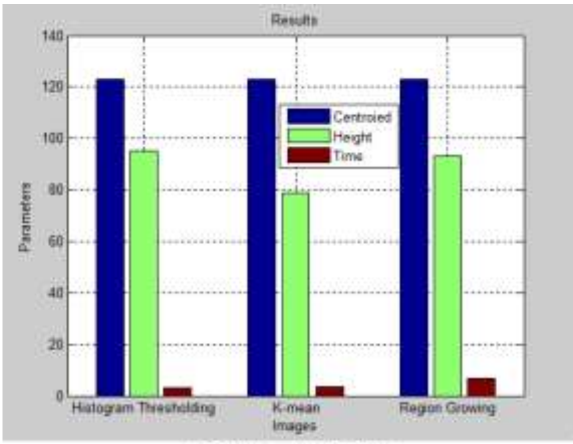

fig 5. Three parameter for 3rd case

Parameter	Hist_Thr	K-mean	Region growing
	1st case		
Centroid	136	136	141
Height	164	150	139
Time	3.2418	3.8509	7.2654
	2nd case		
Centroid	136	136	136
Height	164	150	162
Time	4.2761	4.0684	6.9303
	3rd case		
Centroid	123	123	123
Height	95	79	93
Time	3.2056	3.3917	6.7443

Table 1: Result of all cases

Conclusion & Future Scope

In this paper, we proposed three approaches for Brain tumor detection, identification and classification. We proposed detection and identification of brain tumor through Magnetic Resonance (DICOM) Image using Histogram Thresholding, Region growing and K-mean segmentation. The proposed image processing algorithm is based on a modified Histogram Thresholding algorithm and implemented using MATLAB Software. However, simulation results using this algorithm showed its ability to accurately detect and identify the contour of the tumor, its computational time and accuracy were much less than its corresponding algorithms. For future we enhance our result using C-mean and Watershed segmentation and calculate more parameters also.

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