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Comparative Study of Brain Tumor Detection in MRI Images

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Abstract: ***The method of brain tumor segmentation is nothing but the differentiation of different tumor area from Magnetic Resonance (MR) images. There are number of methods already presented for segmentation of brain tumor efficiently. However, it's still critical to identify the brain tumor from MR images. The segmentation process is extraction of different tumor tissues such as active, tumor, necrosis, and edema from the normal brain tissues such as white matter (WM), grey matter (GM), as well cerebrospinal fluid (CSF). As per the survey study, the brain tumors most of time detected easily from brain MR image, but required level of accuracy, reproducible segmentation, abnormalities classification is not predictable and straightforward. The segmentation of brain tumor is composed of many stages. The manual process of doing the segmentation of brain MR images is very time consumption and tedious task, and hence it is associated with many challenges. Therefore, we need automated segmentation method for brain images. There are many techniques presented to investigate the performance of automated computerized brain tumor detection for the medical analysis purpose. In this review paper, our main goal is to present the review of different brain tumor segmentation methods using the MR images. The different methods for segmentation are studied with their advantages and disadvantages in this paper.***

Keywords: brain tumor, Comparative, segmentation, MRI

1. Introduction

In medical practices, the early detection and recognition of brain tumors accurately is very vital. In literature, there are many techniques has been proposed by different researchers for the accurate segmentation of brain tumor. Some discoveries such as X-rays, ultrasound, radioactivity, magnetic resonance imaging (MRI) or computed tomography and the development of tools that can generate medical images have facilitated the development of some of the most efficient exploration tools in medicine. Such tools are capable of exploring the structure, function and the diseases that affect the human brain, and deals with the cancer-affected region of the brain. The main goal for the medical researchers since from last few decades is the curing brain tumors, however the building of new methods for treatments requires more time as well as money.

Medical science yet needs to find all the main causes of different types of cancers and then develop the methods to cure them before brain tumors development starts.

Magnetic resonance imaging (MRI) is high-quality medical imaging, particularly for brain imaging. MRI inside the human body is helpful to see the level of detail. Doctors have major technical and economic importance of reliable and fast detection and classification of brain cancer, based on common practices. Most of the technicians are slow, less responsible, and that's hard to quantify possess a degree of subjectivity.

For the early detection of brain tumors there are many imaging methods for diagnostics purpose are presented. These imaging techniques are Positron Emission Tomography (PET), Magnetic Resonance Imaging (MRI), and Computed Tomography (CT). Among this all imaging techniques, MRI is most efficient for the research of brain tumor detection and classification as compared to other imaging techniques. This is because of high contrast of soft tissues, high spatial resolution as well as it does not produce any harmful radiation Reliable and fast detection and classification of brain cancer. Although MRI and the tumor about the size of being able to provide information, it is unable to classify tumor types, invasive techniques such as biopsy and spinal applications, which are painful and time-consuming methods.

In this paper we are aiming to take review of different methods of brain tumor image segmentation. We are aiming to present the different MRI images segmentation methods.

2. Review of MRI Segmentation Techniques

Objective of this review section is to present literature survey of image segmentation methods. The main goal is to highlight advantages and limitations of these methods. Key image processing techniques for brain MRI image segmentation is classified as thresholding, region-growing, clustering, other methods etc.

2.1 Thresholding

Thresholding is one of the most generally used and oldest methods for image segmentation. In the process of thresholding, image is supposed to be composed of regions and these regions belong to different ranges of grey scale. Histogram of image is consisting of peaks and valleys, where each peak represents one region. The valley between the peaks represents a threshold value. Histogram thresholding method is based on a concept that divides the image into two equal halves and histograms are compared to detect the tumor and cropping method is used to find a proper physical dimension of brain tumor. The threshold technique makes decision based on the local raw pixel information. It helps in extracting the basic shape of an image, overlooking the little unnecessary details.

1) Local thresholding is also known as adaptive thresholding. In this image is divided into sub regions and then choose

threshold value Ts for each sub region.

2) Global thresholding is used when there intensity distribution between the objects of background and foreground are very distinct.

2.2 Region-growing

In this technique the images are partitioned by organizing the nearest pixel of similar kind. It starts with a pixel (initial seed) that having similar properties. Accordingly, the neighboring pixels based on homogeneity criteria are appended progressively to the seed. In splitting process region get divided into sub regions that do not satisfy a given homogeneity criteria splitting and merging can be used together and its performance mostly depends on the selected homogeneity criterion. Without tuning homogeneity parameters, the seeded region growing technique is controlled by a number of initial seeds. If the number of regions was approximately known & used it to estimate the corresponding parameters of edge detection.

1) *Region Growing:* Region Growing is a simple method. It is a pixel based image segmentation. The basic approach is to select a seed point and grow regions.
2) *Region Splitting:* In Region Splitting method we compare the highest and the lowest value and if the subtraction, satisfy the threshold value we don't split the region but if the subtraction does not satisfy the threshold value we split the image in four equal quadrants.
3) *Region Splitting and Merging:* In the split and merge technique is started with a rectangular regions. Then the homogeneity property is checked for each region. If the homogeneity property fails, then split the region into four quadrants. If the region satisfies the homogeneity property, merge it with the adjacent region.

3. Clustering

The method of clustering organizes the objects into groups based on some feature, attribute and characteristic. Hence a cluster consists of groups of similar objects. There are two types of clustering, supervised and unsupervised. In supervised type clustering, cluster criteria are specified by the user. In unsupervised type, the cluster criteria are decided by the clustering system itself.

1) K-Means Clustering:
K-Means Clustering partition the n observations into k clusters in which each pixel belongs to the clusters by minimizing an objective function in a way that the within cluster sum of squares is get minimized. It starts with initial K cluster center and it reassigns the observations to clusters based on the similarity between the observations and cluster centers. Automation of detection and segmentation of brain tumors in MRI images is a very challenging task due to occurrence of high degree of grey-level similarity in the image. In the first step, skull stripping is performed by generating a skull mask from the MRI image and in the second step, an advanced K-means algorithm improvised by two-level granularity oriented grid based localization process based on standard local deviation is used to segment the image into grey matter, white matter and tumor region and then length and breadth of the tumor is assessed.

2) Fuzzy C-Means clustering
Fuzzy C-means (FCM) clustering is a data clustering method in which each data point belongs to a cluster to a degree specified by a membership value. Fuzzy C- means divides a collection of n vectors into c fuzzy groups and finds a cluster center in each group such that a cost function of dissimilarity measure is minimized.

4. Comparative Study of the Methods

Comparative study of different segmentation techniques is summarized in compare table with advantages and disadvantages. Most of the key features of methods are mentioned in Table with respective limitations and benefits that make our work unique

Table 1: Study Analysis

Parameter	Region Based Segmentation		
	Region Based Segmentation	Clustering based Segmentation	Threshold Based Segmentation
Output Image	Black-White	Black-White	Black-White
Speed	Moderate	Moderate	Fast
Accuracy	Good	Moderate	Moderate
Noise Immunity	Less	Less	Less

5. Conclusion

In this comparative study of image segmentation techniques, different image segmentation techniques are described in detailed and comparison is done. These all techniques are suitable for medical image application. This technique can be used for detection. In medical images this technique is used to detect cancer. After the analysis of various techniques, it is observed that a histogram thresholding for image segmentation is the best method to solve the problem of image segmentation. Research studies as well as performance evaluation metrics. For the future work we suggest to present more accurate, efficient as well as faster method for early detection and classification of brain tumors.

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