

## **A Study of Segmentation Methods for Detection of Tumor in Brain MRI**

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### **Abstract**

Segmentation is a vital role in medical image processing, where clustering technique widely used in medical application particularly for brain tumor detection in magnetic resonance imaging (MRI). We use MRI because of it's provide accurate visualize of anatomical structure of tissues. In this paper various clustering methods that have been used for segmentation in MRI are reviewed.

**Keywords:** MRI of Brain; Segmentation; Automated segmentation Methods

### **1. Introduction**

Normally, the anatomy of brain tumor can be examined by MRI scan or CT scan. The main advantage of MRI over CT scan is, it is not contain any radiation. MRI provide accurate visualize of anatomical structure of tissues. Because of that's MRI not affect human body. So fundamentally MRI is better compared to CT scan. MRI is a one type of scanning device, which use magnetic field and radio waves. It is also use computer to create images of the brain on film. Brain tumors may be benign or malignant. Primary brain tumors are originated in the brain, and they do not spread or affect the surrounding tissues. Primary brain tumors also be malignant and affect surrounding tissues and its contain cancerous cells. Common primary brain tumors types are Glioblastoma, astrocytoma, meningioma etc [2] [10]. The secondary brain tumors are spread to the brain from another place in the body. Brain tumors affect the normal brain activity. So accurate detection of tumor is important for human and increase the

lifetime of the 1 to 2 years. In medical imaging, an image is captured, digitized and processed for doing segmentation and for extracting important information. Due to the complex structure of brain tissues such as white matter (WM), gray matter (GM) and cerebrospinal fluid (CSF) in the brain images, extracting of useful feature is a fundamental task. Manual segmentation is method for segmenting an MR image. These methods are time consuming. Its take at least 3 hours to complete. Segmentation by expert is variable [5]. Therefore, there is a strong need to have efficient computer based system that accurately examine the boundaries of brain tissues along with less interaction of user interface. In this paper a brief study of the various segmentation techniques for the MR image segmentation are reviewed and discuss advantage and disadvantage about particular methods.

## 2. Structure of Brain

Generally, human brain includes three major parts controls different activity.

### 2.1 Cerebrum

The cerebrum controls learning, thinking, emotions, speech, problem solving, reading and writing. It is divided into right and left cerebral hemispheres. Muscles of left side of the body control by right cerebral hemispheres and muscles of right side of the body control by left cerebral hemispheres.

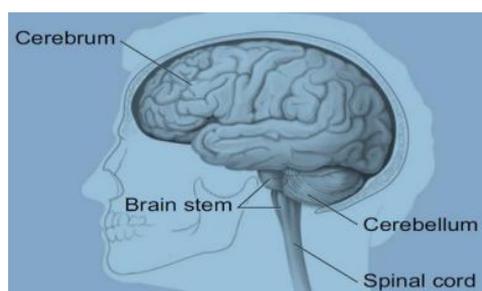
### 2.2 Cerebellum

The cerebellum controls movement, standing, balance and complex actions.

### 2.3 Brain stem

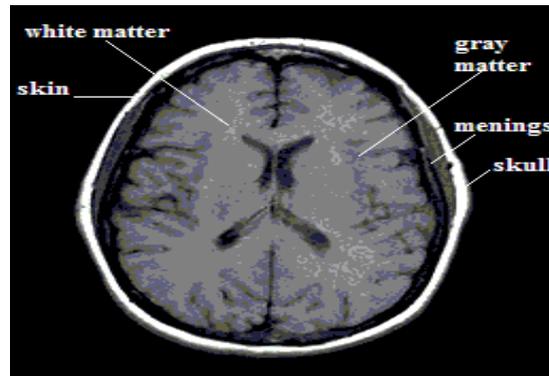
Brain stem joints the brain with spinal cord. Brain stem controls blood pressure, body temperature and breathing and controls some basic functions [10].

Fig.1 Indicate the brain structure [9].



**Fig. 1:** Structure of Brain [4]

MR image provide details information about human anatomical structure and tissues. Also MR image is safe compare to CT scan and X- Ray Image. It is not affect the human body. MR Image is providing information for use of further treatment and research area. Fig.2 shows the brain MRI image with the information about different tissues [9].



**Fig. 2:** Brain MR Image [4]

### 3. Segmentation Methods

Now a days, image segmentation play vital role in medical image segmentations. The segmentation of brain tumor from magnetic resonance images is an important task. Manual segmentation is one of the techniques for finding tumor from the MRI. This method is time consuming but also generates errors. Segmentation by expert is variable [5]. Manually segmentation takes at least three hours to complete. Several automated technique have been developed for MRI segmentation. In this paper several automated segmentation techniques are discussed below.

#### 3.1 Thresholding

Threshlodng is one of simple image segmentation technique. It is process of separating pixels in different classes depending on their pixels gray levels. A thresholding method determines an intensity value, called the threshold, which separate the desired classes. The segmentation is achieved by taking threshold value. Based on threshold value, pixels are grouping with intensity greater than the threshold into one class and remain pixels grouping into another class. The mains disadvantage are that, in the simplest form only two classes are generated and it cannot be applied to multichannel images. In thresholding technique, image having only two values either black or white. MR image contains 0 to 255 grey values. So, thresholding of MR images ignores the tumor cells [1].

#### 3.2 Region growing

It is a region based segmentation method. This process is first requirement of manually select seed points. Selection of seed points is based on user criteria. It is also iteration based method, like clustering algorithms. The algorithm steps for region growing technique are below: [3]

1. In the first step manually select seed points.
2. In the next steps pixels in the region of seeds are examined and added to the region accordance with the homogeneity criteria. This process is continued until all pixels belong to some region.

3. and in last step the object illustration is done by growing regions of pixels.

The region growing technique applied in medical image segmentation. In medical field, it can be applied in kidney segmentation, extraction of brain surface, cardiac images etc. the main disadvantage of this method is, it require user interface for selection of seed points.[2] Thus for each region that selection of seed is require user interface and very time consuming process.

### 3.3 Mean shift

A mean shift is a non-parametric clustering technique. Mainly it used for cluster analysis in computer vision and image processing. Mean shift algorithm used for clusters an n- dimensional data set. First defining spherical window of radius  $r$  in data points and calculate the mean of points which located within the window. That means, each points algorithm computes its peak. Second, the spherical window move to the next means and repeats until convergence. At the each iteration, the spherical window will move dense portion of data set until maximum peak is reached.

### 3.4 Clustering techniques

Clustering the process of collection of objects which are similar between them and are dissimilar objects belonging to other clusters. Clustering is suitable in biomedical image segmentation when the number of cluster is known for particular clustering of human anatomy.

Clustering algorithm are classified two types:

- Exclusive clustering
- Overlapping clustering

In exclusive clustering, one data (pixel) is belonging only one cluster then it could not belong to another cluster. K-mean is example of exclusive clustering algorithm. In overlapping clustering, one data (pixel) is belonging two or more clusters. Fuzzy C-mean is example of overlapping clustering algorithm. [7]

## 4. K-means Clustering

K mean is the unsupervised algorithms that solve clustering problem. The procedure for k mean clustering algorithm is simple and easy way to segment the image using basic knowledge of cluster value. In k mean initially randomly define k centroids. The selection of this k centroid is placed in cunning way because different location makes different clustering. So, better is to place centroid value will be as much as far away from each other. Secondly calculate distance between each pixel to selected cluster centroid. Each pixel compares with k clusters centroids and finding distance using distance formula. If the pixel has shortest distance among all, than it is move to particular cluster. Repeat this process until all pixel compare to cluster centroids. The process continues until some convergence criteria are met [7].

## 5. Fuzzy C-means Clustering

Fuzzy C-means is an overlapping clustering technique. One pixel value depending on two or more clusters centers. It is also called soft clustering method. One of the most widely used fuzzy clustering algorithms is the Fuzzy C-means (FCM) algorithm (Bezdek 1981). The FCM algorithm is partition of  $n$  element  $X=\{x_1, \dots, x_n\}$  into a collection of  $c$  fuzzy clusters with respect to below given criteria.[6][7]

It is based on minimization of the following objective function:

$$J = \sum_{i=1}^N \sum_{j=1}^c u_{ij}^m |x_i - y_j|^2$$

Where,

$m$  = level of fuzziness and real number greater than 1.

$u_{ij}$  = degree of membership of  $x_i$  in the cluster  $c_j$

$x$  = data value

Fuzzy C-means is a popular method for medical image Segmentation but it only considers image intensity thereby producing unsatisfactory results in noisy images. A bunch of algorithms are proposed to make FCM robust against noise and in homogeneity but it's still not perfect.

In 2012, J. Selvakumar, A. Lakshmi and T. Arivoli [1] proposed a technique for brain tumor segmentation using k-means and fuzzy c-means algorithm. Its use pre-processing step for filtering noise and other artefacts in image and apply K-means and fuzzy c-mean algorithm. This purposed algorithm, fuzzy c-mean is slower than K-means in efficiency but gives accurate prediction of tumor cells which are not predicted by K-means algorithm.

## 6. Conclusion

Image processing plays vital role in today's world. Now a day the applications of image processing can be found in areas like electronics, remote sensing, bio-medical and so on. If we focus bio-medical applications, image processing is widely used for diagnosis of different tissues purpose. By use of appropriate image segmentation method and use of accurate input image is very important. In this paper various existing segmentation methods for brain MR image have been discussed.

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