

## A Review on Brain MRI Image Segmentation Clustering Algorithm

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**Abstract :** Currently, Magnetic Resonance Image (MRI) is one of the leading technology being used for detecting brain tumor. Brain tumor is detecting at the advanced stages with the help of MRI image. Diagnosing of brain tumor from MRI is time consuming task. Segmentation of an image is a prime process to remove suspicious region from complicated medical image. Segmentation of brain tumor in MRI image is a difficult task because of the different intensities of an image, locations and shapes. Cluster analysis recognizes a similar object groups and helps in locating distribution of pattern in large data sets. The prime objective of this paper is to compare the different technique which is used for the segmentation. K-means and Fuzzy C-means clustering techniques are compared for their better performance in segmentation. The detection brain tumor is carry out in two stages: First stage is Preprocessing and Enhancement & Second stage is Segmentation and Classification.

**Keywords:** Magnetic Resonance Image (MRI), Brain Tumor, Segmentation, K-means, Fuzzy C-means.

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### I. Introduction

In brain tumor diagnosis, doctors combine their medical knowledge and brain magnetic resonance imaging (MRI) scans while obtaining the nature and feature of brain tumor and to decide on treatment options. However, in today's MRI brain, where a huge number of MRI scans taken from every patient, manually detecting and segmenting brain tumor. Thus, we required computer aided diagnosis of brain tumor and segmentation from MRI image to control the difficult problems in the manual segmentation. The basic goal in Image segmentation is the image partitioning into important region that have powerful correlation with objects or areas of the real world contained in the image. In medical field it is used for detection of brain tumor and other different application. The segmentation of brain tumor is achieved by using the technique such as thresholding, region growing and clustering. The clustering task is to divide or partitioning a given data set into groups such that the data points in a cluster are more close to each other than points in different cluster. The most important unsupervised learning problem can be considered by clustering. In a collection of unlabeled data it deals with to finding a structure.

Algorithms of clustering may be categorized as:

- Overlapping Clustering
- Exclusive Clustering

In the overlapping clustering, to cluster data it uses fuzzy sets, so that every point may belong to two or more clusters with dissimilar degrees of membership. In the exclusive clustering, grouped the data in exclusive way. Fuzzy C-means is an overlapping clustering algorithm and K means is an exclusive clustering algorithm.

The following paper organization is as follows: In section 2 the detail of literature survey is given. For the analysis from where the data base is taken is given in section 3. In section 4 skulls is removed. In section 5 different segmentation methods are discussed.

### II. Literature Survey

Bhagwat et al (2013), they exhibit that DICOM images provide effective results as compared to non medical images. They found that time requirement of Fuzzy C means it was highest for brain tumor detection and that for hierarchical clustering was least of three. K-means algorithm produces more correct result compared to fuzzy c-means and hierarchical clustering.[15]

Ivana Despotovi (2013), introduced a new FCM-based method for spatially coherent and noise robust image segmentation. 1) The spatial information of local image attribute is integrated into both the sameness measure and the membership function to repay for the result of noise and 2) Neighbourhood, based on phase congruency features was established to allow more reliable segmentation without image smoothing. The segmentation results, demonstrate that their method efficiently protect the homogeneity of the regions and is extra robust to noise than comparable to FCM-based methods.

Maoguo Gong (2013), introduced an upgrade fuzzy C-means (FCM) algorithm for image segmentation by introducing a kernel metric and a weighted fuzzy factor. The weighted fuzzy factor depends on the space distance of all neighbouring pixels and their gray-level difference at the same time. The modern algorithm

adaptively determined the parameter by using a fast bandwidth selection rule based on the distance variance of all data points in the group of collection. The results on synthetic and real images show that the new algorithm is powerful and well planned, and is relatively independent of any type of noise.

Charbel Fares et al (2011), measured and evaluated image segmentation algorithms. It consists of differentiating the performance of segmentation algorithms based on three important factors: correctness, stability with respect to image choice, and stability with respect to parameter choice.

A.Sivaramakrishnan and Dr.M.Kaman (2013) proposed brain tumor detection region from cerebral image was done by using Fuzzy C-means clustering and histogram. It is used to calculate the intensity values of the gray level images. By using principal component analysis the decomposition of images was done which was used to reduce dimensionality of the wavelet co-efficient. The result of the proposed Fuzzy C-means (FCM) clustering algorithm extracted successfully the tumor region from MRI brain images.

Hui Zhang et al (2008), differentiate supervised evaluation and subjective methodology for segmenting an image. Supervised evaluation and Subjective are infeasible in different application, so unsupervised methods are important. Unsupervised analysis entitles the objective comparison of both the various segmentation methods and various parameterizations of a single method.

### **III. Image Acquisition**

The MRI data base of Brain Tumor has collected from Datta Meghe Institute of Medical Science, Sawangi, and Wardha. Total 60 images have been collected.

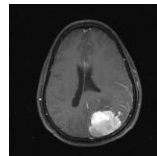


Fig 1. Acquired Image

### **IV. Skull Removal**

Skull stripping is a crucial part sometimes refers in MRI brain imaging applications as a pre-process which refers to the removal of brain non-cerebral tissues. By thresholding the grayscale image is converted to binary image. The output image BW replaces all pixels in the input image is greater than threshold with the value 1 and replaces all other value with 0. where 1 stands for white and 0 stands for black.

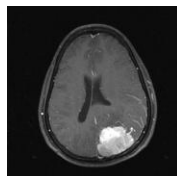


Fig 2. Original Image

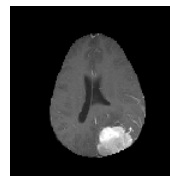


Fig 3. Skull Removed Image

### **V. Segmentation Method**

Segmentation of an Image is the method which is used for dividing an image into its homogeneous or constituent regions. Segmentations change in an image or simplifiers the representation of an image into something that is meaningful and easy to analyze. Segmentation of an image is mostly used to detect boundaries and objects. It provides additional information about the contents of an image by recognizing regions and edges of near about same color, intensity and texture.

Different methods used for image segmentation. Most Commonly used are thresholding, region growing, classifier, artificial neural networks, clustering.

#### **Thresholding**

One of the oldest methods for image segmentation is thresholding. It is method which is used separating pixels in different classes which depending on their gray levels pixels. An intensity value decided by thresholding method, called the threshold. The desired classes are separated. By taking threshold value the segmentation is achieved. Pixels are grouping with intensity greater than the threshold considerable into one class and remaining pixels grouping into another class, based on threshold value. The major disadvantage is that, in the simplest form only two classes can be formed and it cannot be applied to multichannel images. Image having only two values either black or white, in thresholding technique. The grey values 0 to 255 contains MR image. So, the thresholding of brain MRI ignore the tumor cells.

**Region Growing**

Region growing method is a well improved technique for image segmentation. This method extracts image region Based on some predefined criteria which is based on intensity in the image information or edges . An operator randomly selects a seed point and remove all pixels that are connected to the initial seed which is based on some predefined criteria. Region growing algorithm is related to an algorithm which is called as split-and-merge, but there is no need of seed point. Region growing can also be delicate to noise, causing to remove regions having holes or even become separated. By using a homotopic region-growing algorithm, these problems can be removed.

**Classifier**

Classifier or supervised methods are pattern identification techniques that segment a feature which is space derived from the image by using data with known labels. A basic classifier is the nearest-neighbour classifier, in which each and every pixel is classified in the same class as the training with the closest intensity value. The k-nearest-neighbour classifier is a generalization of this approach, which is considered a nonparametric classifier as it makes no underlying belief about the statistical structure.

**Artificial Neural Networks**

Artificial neural networks (ANNs) are equivalent networks of nodes or processing elements that simulate biological learning. In an ANN each node is capable of performing computations. Learning is achieved through the adaptation of weights which is appoint to the connections between nodes. As a classifier it is frequently used in medical imaging in which by using training data the weights are decided. For the segmentation of new data artificial neural network is used. Sometimes it uses as a clustering in an unsupervised method.

**Clustering**

Clustering can be determined as the procedure of organizing objects into groups whose members are homogeneous in some manner. They usually performs as classifiers without using training data., This iteratively rotate between segmenting the image and characterizing the properties of each class is used to compensate for the lack of training data. There are two most commonly used algorithms in clustering: k-means algorithm and FCM algorithm.

**The K-Means Algorithm**

K-Means clustering forms a specific number of K flat, disjoint clusters. For the generating globular clusters it is well suited. This method is numerical, non-deterministic, unsupervised, and iterative. K-Means are i)every time K clusters, ii) at least one item in each cluster are always present, iii) non-hierarchical and they do not overlap, iv)Each member of a cluster is closer than any other cluster as their closeness does not always need the clusters of centers.

```

Input:
// gray values of image pixels
dataset = { zp1, zp2, ..., zpn }
Nc // number of clusters
Start:
• Generate (m1, m2, ... mk) centroids randomly
Repeat:
• Assign each pixel to the class with the closest centroid
• Recalculate the Nc centroids, using


$$m_j = \frac{1}{n_j} \sum_{z_p \in C_j} z_p \quad (1)$$


Where  $n_j$  is the number of pixels that belongs to cluster
j, and  $C_j$  is the subset of pixel vectors that form cluster j
Until:
the cluster labels of the image does not change
anymore OR fixed number of iterations.
Output:
Nc pieces of clusters
    
```

Fig 4. Code for K-means

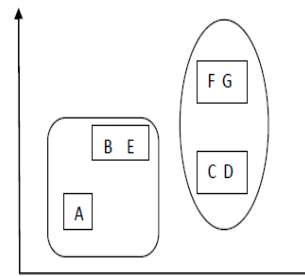


Fig 5. The K-means algorithm

**Fuzzy C-Means Algorithm**

The use of a clustering analysis is to split a given objects into a cluster or set of data, which shows a group or subsets. The dividing or part itioning should have two ways one is the homogeneity inside clusters data, which belongs to the one cluster, should be as identical as realizable and one more is heterogeneity in between the clusters data, which belongs to dissimilar clusters, should be as dissimilar as possible. The actual data distribution in the input and the output do not replicate the membership function. They may not be suitable for

fuzzy pattern recognition. From the data present to generate membership function, a clustering technique is used to split the data, and then produce membership functions from the resulting clustering. It is an improvement version of earlier clustering methods.

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Step1: Initialize  $U=[u_{ij}]$  matrix,  $U^{(0)}$ 
Step2: At k-step: calculate the centers
vectors  $C^{(k)}=[c_j]$  with  $U^{(k)}$ 

$$c_j = \frac{\sum_{i=1}^N u_{ij}^m \cdot x_i}{\sum_{i=1}^N u_{ij}^m}$$

Step3: Update  $U^{(k)}, U^{(k+1)}$ 

$$u_{ij} = \frac{1}{\sum_{k=1}^c \left( \frac{\|x_i - c_j\|}{\|x_i - c_k\|} \right)^{2/m-1}}$$

Step4: If  $\|U^{(k+1)} - U^{(k)}\| < \epsilon$  then STOP;
otherwise return to step 2.
    
```

Fig 6.Code for FCM

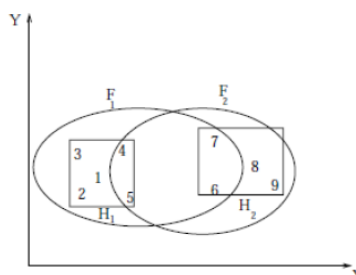


Fig 7. Fuzzy Clusters

### VI. Time And Accuracy Comparison

In order to partitioning the tumor and non tumor pixels the MRI test image is segmented by applying the segmentation algorithm. Image has to give accuracy high accuracy in organization to better performance analysis. The partitioning tumor pixels are considered as True positive Clusters. If non tumor pixels segmented, those pixels are considered as True negative clusters. During this process of segmentation, if tumor pixels are not segmented properly, those mixed pixels are considered as False positive clusters. By using MATLAB programming language this was implemented on a computer. The K-means & Fuzzy C means algorithm was implemented. The parameter such as time and accuracy are calculated for both the techniques. Table 1 shows the comparison of both the algorithm K-means and Fuzzy C-means.

Method	Average Time in sec	Segmentation Accuracy(%)
K-means	0.1746	82.33
Fuzzy Cmeans	3.6435	92.67

Table 1: Comparison of K means and Fuzzy C means algorithm

### VII. Conclusion

This paper compares K-means and Fuzzy C means clustering image segmentation algorithm. The time required of FCM is greater than K-means. Thus FCM is more suitable for application where accuracy is more important than timing as in the medical diagnosis. Though FCM have greater accuracy but it is still less. So, to increase this segmentation accuracy we can use the optimization technique.

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