MRI Brain Image Segmentation:A Review

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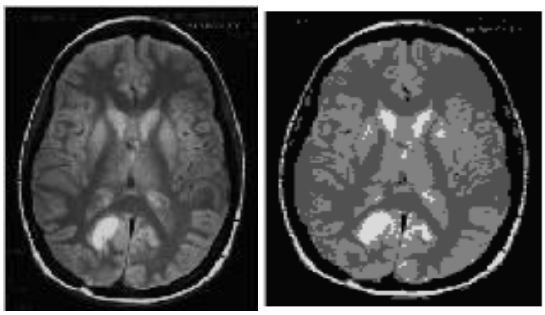
Abstract- *Now a day's medical image processing (MIP) is the most emerging and challenging field. Preprocessing of MRI brain image segmentation is widely used involves accurately and precisely automatic detection of MRI images. The selection of ansuitable method for segmentation therefore depends on the image characteristics.In this paper present a review on MRI brain Image Segmentation with research study of different author. Also describe the different Brain MRI Segmentation techniques used to improve the segmentation of medical images.*

Keywords- MRI, Segmentation, Thresholding, Kmeans, Fuzzy-c means.

I. INTRODUCTION

Image segmentation plays an important role in medical image processing, and is a key technique to analysis,understand and describe medical images in order to diagnosecurious diseases. At present brain MRI segmentation has become popular in medical image analysis because of non-invasive detection and high-contrast [1].Proper segmentation of brain tissue helps in improving the reliability of diagnosis the brain disease treatments. However, MRI Brain images exhibits non uniformity and noise etc., so exact segmentation MRI brain images is a critical task. Segmentation of medical image [2] is the technique of marking each voxel in a medical image dataset to express its anatomical structure. The marking of labels from this technique result in a wide variety of medical research applications. Segmentation is a very general technique and is difficult to segment areas, however a general list consist of following: heart, brain, liver, knee, spine, jaw, prostate and the blood vessels. The fig 1 shows the MRI original brain image and segmented MRI Image.



(a) Original MRI Image (b) Segmented MRI Image
Fig 1: Shows the Original and Segmented MRI Image

In segmentation process, the input is a grayscale digital medical image such as MRI or CT scan. The output is desired is the labels that classify the input grayscale voxels. The arrangement of labels that is delivered through division is likewise called a label map, which quickly tells its capacity as a voxel by voxel manual for the original imagery [3]. As often as possible used to enhance representation of medical images and permit quantitative estimations of image structures, division are additionally critical in building anatomical map , looking into states of anatomical structures, and following anatomical changes after some time.

So MRI is generally used because it provides the better quality of brain images and accurate disorder tissues in comparison to other medical imaging method likewise Computed Tomography (CT Scan) or X-ray. imaging techniques such as X-Ray or Computed As being a non-invasive technique MRI are majorly used[4]. The basic idea behind MRI is to create pictures from MRI check utilizing strong magnetic field and radio waves of the body which helps in exploring the life systems of the body.The rest of the paper is organized as; existing research work is explained in Section II as literature review, segmentation techniques of MRI Brain image in Section III, Comparison of K-means and Fuzzy C-means in section IV and review of MRI Brain image segmentation is described.

II. LITERATURE REVIEW

Anamika et al. [5] have presented a combination of Self Organizing Map (SOM) and Neuro Fuzzy method to automatically extract the brain MRI image region as tumor, WM, GM and CSF. For evaluation of proposed method three normal and abnormal brain MRI images used and axial view images were tested to classify the brain MRI regions. The result were also compared on Keith's data base with parameters such as precision, accuracy, positive & negative predictive value and false positive & negative rate with better effectiveness.

Liu et al. [1] have proposed a new approach to segment brain MRI image using K-means clustering algorithm and wavelet transform was proposed for noise brain image segmentation without reference image. For denoising brain MRI image, the approach firstly uses wavelet transform and

then k-means algorithm used to segment brain MRI images. The result of proposed approach improves the accuracy of noisy segmented MRI brain image as well used for universal noisy image to some extent.

Dawnglianaet al. [6] have proposed a hybrid method for automatic segmentation of brain tumor using multilevel thresholding and level set method. The improvement for this paper is to interface the underlying division from multilevel thresholding and concentrate a fine picture utilizing level set technique with morphological operations. The result of proposed are compared with previous methods and also with radiologist manual segmentation which validate the effectiveness of this hybridized paradigm for brain tumor segmentation.

Amrit et al. [7], proposed tumor detection using FCM. In this brain tumor detection is processing in 6 steps on MR images. The FCM algorithm is applied on Genetic algorithm (GA) parameters for tumor detection. The technique is also applied on abnormal images of various sizes and intensities of tumor either as primary or secondary type.

Zeljkovic [8]have developed an automated computer technique for detection of brain tumor in MRI images. The proposed technique accuracy and reproducibility of segmented tumor tissue is better in compared to manual segmentation. The result of technique shows accuracy of 93.33%on abnormal images and full on healthy brain images. The technique also provides accurate position and shape in its document for tumor detection in MR images. Therefore, proposed method improved the diagnostics efficiency and reduces the chance of misdiagnosis and human error.

Paul et al. [9] proposed a selective brain MRI image segmentation approach using FCM Clustering calculation with image pixel weightage to save unique image critical points of interest.

Kazi et al. [10] proposed another approach for Segmenting MRI images in light of adaptive thresholding for rough background and K means algorithm which is used to get cerebrospinal fluid (CSF), Gray Matter (GM) and White Matter (WM).The accuracy and efficiency of proposed approach are best to generate different clusters of input MRI image.

Laura et al. [11] proposed a framework for image segmentation that includes several clustering algorithms. Using the framework, we showed that clustering algorithms are effective methods for brain image segmentation. In particular, clustering embedded with spatial information succeeds in segmenting the MR images very well. The developed framework offers both qualitative and quantitative evaluation of the segmentation results; hence, it represents a valid support to the analysis of brain images.

III. MRI IMAGE SEGMENTATION TECHNIQUE

The techniques of MRI brain image segmentation for tumor can be classified into: threshold based segmentation, edge based segmentation, region based segmentation and clustering based segmentation techniques [12].The below fig 2 shows the techniques of segmentation.

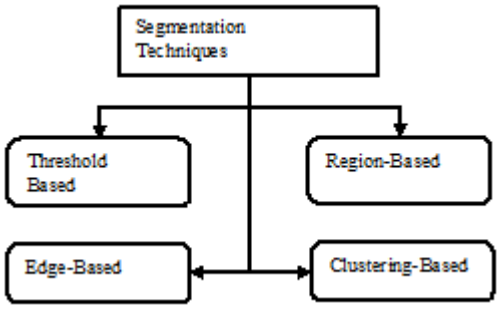


Fig 2. Classification of Segmentation techniques on basis of pixel intensity

A. Thresholding Method

The grey levels differentiation is used in this technique. It is an effective and simple method as it compares the intensities with more than one intensity thresholds. Basically threshold method is divided as Global and Local thresholding [13].

The image is composed pixel to pixel with intensity threshold selected in global thresholding. If an image has high back ground intensity and contains objects with homogeneous intensity, then global thresholding is the best choice of segmentation.

The local thresholding are usually estimated by the prior knowledge of the limited volume of each area to identify the threshold of the each component in the segmentation. The first step in the image segmentation of brain tumor is the thresholding method.

B. Edge Based Method

In this segmentation method, an image is separated based on sudden changes in the pixels intensity of near the edges [14]. The outcome is a binary image with edges of the

objects being detected. The edge based method is described into two methods as:

a) Gray Histogram Method:

The gray histogram method is based on the selection of threshold (T). In this method an image is converted into grayscale image and after that applying gray-level thresholding on the histogram of that image.

*b) Gradient Based Method:*In this method, evaluate the difference the between intensity value of neighboring pixels [15]. In this way, when there is sudden change in the intensity of image region and also very less noise in image then gradient method perform well. For an image method applying gradient operator. The operator used in the method invlove sobel, canny operator, Laplace operator, Laplacian of Gaussian (LOG) operator etc.. For edge detection the better output operator is sobel and canny operator. There is balance maintain in edge detection method for accurate and noise immunity. In edge detection technique, if the exact recognizing edges level is high at that point result in commotion may produce counterfeit edges and if the level of clamor resistance is too high, at that point a few sections of the picture containing critical data may go undetected.

C. Region based Methods:

In this method disjoint regions are formed by absorption of pixels in a neighborhood with uniformity property. Region growing and watershed algorithm are the two methods of region based technique [13]. In this method the segmentation is based on the seed points selected on the convenience of the user, then the pixels are analyzed and added to the region then finally the complete area is calculated.

- The advantage of this method is that segmentation of the regions with similar properties can be done correctly and connected region is generated.
- The disadvantage is the reduction of the accuracy because of the incomplete volume effect in the brain images.

a) Water Shed segmentation

This technique depends on the dissimilar gradient values as diverse heights. The time and precision is improved in the multi-scale watershed transformation with some disadvantages particularly over segmentation problem. To overcome this disadvantage, a few multi parameters waters hed algorithms were proposed. Because of some disadvantages the conventional methods are used as preprocessing step in the brain tumor segmentation.

D. Clustering Methods

Clustering is the technique which is most frequently used in the MRI Segmentation, where it divides pixels into classes, without having prior information or training [16]. It classifies the pixels having largest probability into the same class. In the clustering technique, the training is done by utilizing the pixel characteristics with properties of each class of classified pixels.

1. K-means:

K mean is the unsupervised algorithms that solve clustering problem. The methodology of k mean algorithm is easy and simple approach to segment an image using essential knowledge of cluster value [18]. In k mean at first arbitrarily characterize k centroids.The determination of this k centroid is put in sly way in light of the fact that diverse area makes distinctive grouping. In this way, better is to put centroid esteem will be as much as far from each other. Also compute remove between every pixel to chose group centroid. Every pixel contrasts and k groups centroids and discovering separation utilizing separation recipe. On the off chance that the pixel has briefest separation among all, than it is move to specific group. Rehash this procedure until the point that all pixel contrast with bunch centroids. The procedure proceeds until the point that some union criteria are met [17].

Fuzzy C-means:In this method the clustering is done by dividing the group of data into two or more clusters. Advantage of FCM is mostly used in pattern reorganization. This method gives better result on overlapped data set than the means algorithm. Unlike the other method i.e., means method the data point can be in more than one cluster center. Disadvantages are, this method is time consuming algorithm because it has iterative procedure in segmentation. But to decrease this time consumption the fast generalized FCM (FGFCM) and bias corrected FCM (BCFCM) were proposed which support the virtual brain endoscopy for brain tumor image segmentation. To reduce the non-uniformity noises, a modified FCM based method was proposed with mixed noises. A combined method of k-means and Fuzzy c-means algorithm

2. Self-organizing map :

A self-organizing map (SOM) or self-organizing feature map is a type of artificial neural network for

unsupervised learning. SOMs organize in two modes: training and mapping [19]. Training process is also ca*lled as vector quantization.* A SOM comprises of neurons each of which are related a weight vector of same measurement as the info information vectors and a position in the guide space. A SOM portrays mapping from higher dimensional information space to a lower dimensional guide space. The objective territory was divided utilizing HSOM and the assessment of this instrument from the specialist was certain and this device helped specialists in determination, treatment design making and condition of the tumor observing [19].

3. Atlas based algorithm:

This method is used for the registration of different images to limit the tumor location, guiding brain tumor segmentation and classification of models. 3 steps in atlas based algorithm is ,bringing the patient and the atlas together by registration, a unreal cancer cells are seeded into the brain image atlas , by optical flow principles. Advantages are, Atlas provides spatial constraints and probabilities information about the tissue model. Disadvantages are, the variability of such prior information is difficult to account for .A Multi reference and multi range model was proposed to overcome this problem [20].

IV. COMPARISON BETWEEN K-MEANS AND FUZZY CLUSTERING

TABLE 1 Comparison between K-means and Fuzzy Clustering[2]

K-means Clustering	Fuzzy C Means Clustering
It is known as Hard Clustering	It is known as extended form of hard c-means clustering
This algorithm is applied to analyze data and treat observations of the data. The data are based on the locations and distance between various input data points.	This algorithm is applied for analysis based on distance between various input data points
Each cluster has centre point known as centroid	Cluster has a cluster centre based on the distance between the data points.
May not be successful to find overlapping clusters	Objects may be associated with different clusters.

V. CONCLUSION

Medical image processing is the challenging area in the research field. The objective of MRI image segmentation is extracted the different tissue structure of brain image for proper analysis and diagnosis of brain disease with accuracy. In this paper review of existing literature on segmentation ofbrain MRI images has been discussed. Hence, a thorough understanding of image under consideration and the segmentation methods is necessary for proper segmentation of the image.

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