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Brain Tumor Segmentation Using K-Means Clustering and Fuzzy C-Means Algorithms

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ABSTRACT

Tumor is an uncontrolled growth of tissue in any part of the body. The tumor is of different types and they have different characteristics and different treatment. Normally the anatomy of the brain can be viewed by the MRI scan or CT scan. MRI scanned image is used for the entire process. The MRI scan is more comfortable than any other scans for diagnosis. It will not affect the human body, because it doesn't practice any radiation. It is centered on the magnetic field and radio waves. After the segmentation, which is done through k-means clustering and fuzzy c-means algorithms the brain tumor is detected and its exact location is identified.FCM with k-means clustering algorithms is used to increase the accuracy ratio of tumor detection system. The tumor area is calculated for accurate result.

Keywords : Magnetic Resonance Image (MRI), Fuzzy C Means Algorithm (FCM), K-Means Algorithm.

I. INTRODUCTION

Analysis of medical images decreases the doctor's workload. It measures the brain tumor variation. But the automatic segmentation of brain tumor is still a tough problem due to various tumors types with difference structure, shapes and size in morphological.
For MRI segmentation numerous techniques have been developed. The most important four classes are region based, model based, threshold-based techniques and pixel classification. In region based segmentation techniques pixels are grouped into homogeneous regions and it Segments the region of homogeneous properties and the connected region are generated. This region growing technique is analogous to an algorithm which is called as split-and merge, but the seed point are not needed. Region growing can also be induced to separate the regions, graceful to noise. This all problems which are coming in region growing techniques can be removed by using homotopic region-growing algorithm. The disadvantage is that it is Expensive in computational time and memory. In model-based segmentation, advanced knowledge of the object like structure, position and situation is used to build a particular anatomic shape. Connected model are also constructs in a continuous manner. These are costly and tough to initialize. The threshold based techniques is one of the older method of segmentation. In this the object of the intensities in the image are differentiate with one or many thresholds intensity and are classified. These threshold techniques are global and local. These methods of segmentation cannot utilize the MRI information. Supervised and Unsupervised are used in pixel classification. It is used as a classifier to cluster pixels in the quality space. Bayes classifiers and artificial neural networks (ANN) are comes under the supervised techniques and K-means and Fuzzy clustering techniques (FCM) comes under unsupervised techniques.

In this paper a method is presented which is a mixture of the K-Means and Fuzzy C-Means Algorithm . The aim is that to learn and improve the segmentation accuracy high, and computational time should be reduced with segmentation technique. For the detection of brain tumour MRI image segmentation Fuzzy C-Means Clustering algorithm is applied. It is a fast technique but it gives segmentation accuracy less. For the enhancement performance of Fuzzy C means clustering algorithm Particle Swarm Optimization

technique is applied. FCM with k-means clustering algorithms is used to increase the accuracy ratio of tumor detection system. The tumor area is calculated for accurate result..

II. METHODS AND MATERIAL

A. Literature Survey

Ruchita A. Banchpalliwar (2016), Analysis and Diagnosis of tumor in MRI Brain images segmentation technique is used. The paper presents standard Fuzzy C Means with Particle swarm optimization technique for the effectiveness of fuzzy C means clustering used to mark the position of brain tumor all the way through MRI. This methodology is tested on 15 MRI images. Fuzzy C means and Fuzzy C means with PSO is compared. Due to the limitation in initialization the FCM algorithm is not efficient. FCM with PSO has the advantage of increasing accuracy over FCM. It has accuracy improvement in segmentation of 26.89 % over FCM and FCM with PSO. And it also detect the stage of MRI brain tumour.

Arnavi A. Patil (2015), brain tumor detection and its analysis are tough tasks in medical image processing because brain image and its structure is complex that can be inspected only by

expert radiologists. Segmentation plays an important role in the processing of medical images. MRI has become a particularly useful medical indicative tool for diagnosis of brain and other medical images. This paper presents a study of segmentation method implemented for tumor detection. The methods include optimized k-means clustering with genetic algorithm. Traditional k-means algorithm is sensitive to the initial cluster centers. Genetic k-means clustering techniques are used to detect tumor in MRI of brain images. At the end of process the tumor is diagnosed from the MRI image and its actual position and the shape are determined. The experimental results indicate that traditional k-means not only eliminate the over segmentation problem, but also provide fast and efficient clustering results.

Ivana Despotovi (2013), presented a new FCM-based method for spatially coherent and noise-robust image segmentation. The contribution was 1) the spatial information of local image features is integrated into both the similarity measure and the membership function to compensate for the effect of noise and neighborhood, based on phase congruency features was introduced to allow more accurate segmentation without image smoothing. The segmentation results, demonstrate that their method efficiently preserves the homogeneity of the regions and is more robust to noise than related FCM-based methods.

Maoguo Gong (2013), presented an improved fuzzy C-means (FCM) algorithm for image segmentation by introducing a weighted fuzzy factor and a kernel metric. The weighted fuzzy factor depends on the space distance of all neighboring pixels and their gray-level difference simultaneously. The new algorithm adaptively determined the kernel parameter by using a fast bandwidth selection rule based on the distance variance of all data points in the collection. Experimental results on synthetic and real images show that the new algorithm is effective and efficient, and is relatively independent of any type of noise. Charbel Fares (2011), compared and evaluated image segmentation algorithms.

It consists of comparing the performance of segmentation algorithms based on three important characteristics: correctness, stability with respect to parameter choice, and stability with respect to image choice.

Salem Saleh Lamari et al (2010),present methods for edge detection techiniques for satellite images. They used seven techiniques for this category; Sobel operator technique, Prewitt technique, Kiresh technique, Laplacian technique, Canny technique, Roberts technique and Edge Maximization Technique (EMT). They found that Kiresh, EMT and Prewitt are the edge detection technique best techniques for satellite image.

B. K-Means Clustering Algorithm

The K-Means algorithm initially defines the number of clusters k. Then k-cluster center are chosen randomly. The distance between the each pixel to each cluster centers are calculated by using Euclidean function. Single pixel is compared to all cluster centers using the distance formula. Then pixel is moved to particular cluster which has shortest distance among all. Then the

centroid is re-estimated. Again each pixel is compared to all centroids. The process continues until the center converges.

Algorithm steps for K-Means:

Step 1.Give the no of cluster value as k.

Step 2.Randomly choose the k cluster centers.

Step 3.Calculate mean or center of the cluster.

Step 4.Calculate the distance between each pixel to each cluster center.

Step 5.If the distance is near to the center then moveto that cluster.

Step 6.Otherwise move to next cluster.

Step 7. Re-estimate the center.

C. Fuzzy C Means Algorithm

Fuzzy C-means (FCM) clustering is a data clustering method in which each data point belongs to a cluster is having its 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.

Algorithm Steps For FCM:

Let $X = \{x_1, x_2, x_3 ..., x_n\}$ be the set of data points and $V = \{v_1, v_2, v_3 ..., v_c\}$ be the set of centers.

Step1: Randomly select *'c'* cluster centers.

Step 2:Calculate the fuzzy membership $'\mu_{ij}'$ using:

$$\mu_{ij} = \frac{1}{\sum_{k=1}^{c}\left(\frac{d_{ij}}{d_{ik}}\right)^{\frac{2}{m-1}}}$$

Step 3:Compute the fuzzy centers $'v_j'$ using:

$$v_j = \frac{\left(\sum_{i=1}^{n}\left(\mu_{ij}\right)^{m} x_i\right)}{\left(\sum_{i=1}^{n}\left(\mu_{ij}\right)^{m}\right)}$$

Step 4: Repeat step 2) and 3) until the minimum *'J'* value is achieved or $||U^{(k+1)} - U^{(k)}|| < \beta$.

where,

k' is the iteration step.

β' is the termination criterion between [0, 1].

$U = (\mu_{ij})_{n*c}$*'* is the fuzzy membership matrix.

J' is the objective function.

III. RESULTS AND DISCUSSION

The Proposed System

The proposed system has mainly four modules namely Pre-processing, tumor location detection, segmentation using k-means and fuzzy c-means and Feature extraction.According to the need of the next level the pre-processing step converts the image. It performs filtering of noise and other artifacts in the image and sharpening the edges in the image. RGB to grayconversion and Reshaping also takes place here. It includes a median filter for noise removal. The feature extraction is extracting the cluster, which shows the predicted tumor at the FCM (Fuzzy C-means) output. The extracted cluster is given to the threshold process. It applies a binary mask over the entire image. That is the image having only two values either black or white (0 or 1). Here 256x256 JPEG image is a maximum image size. The binary image can be represented as a summation of total number of white and black pixels. Pre-processing is done by filtering. Segmentation is carried out by advanced K-means and Fuzzy C-means algorithm and finally, feature extraction is done by considering the threshold. The proposed method is combinations of two algorithms were established for segmentation. But they are not decent for all kinds of the MRI images.

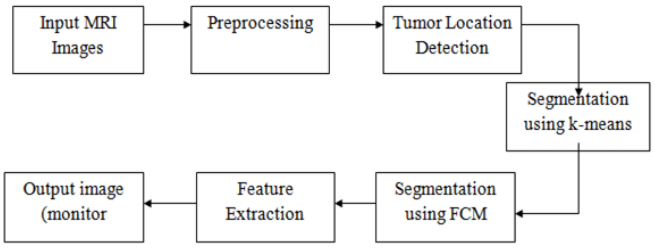
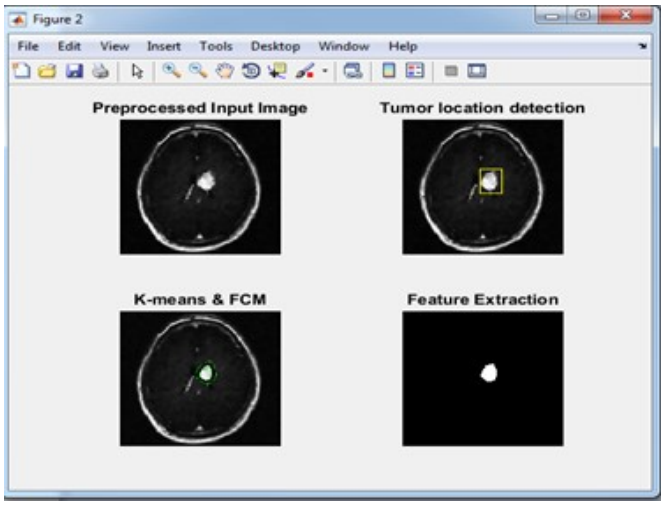


Figure 1. The proposed methodology for Brain Tumor Segmentation

Output of K-Means and FCM algorithm on MRI Brain Image:



IV.CONCLUSION

There are different types of tumors available. They may be mass in the brain or malignant over the brain. Suppose if it is a mass, then K- means algorithm is enough to extract it from the brain cells. If there is any noise present in the MR image it is removed before the K-means process. The noise free image is given as input to the k-means and tumors are extracted from the MRI image. The performance of brain tumor segmentation is evaluated based on K-means clustering. Thus, the pre-processing is done by filtering. Segmentation is done by advanced K-means algorithm and fuzzy c means algorithm and finally, feature extractions is done by threshold. This method scans the RGB or grayscale, converts the image into binary image by binarization technique and detects the edge of tumor pixels in the binary image. The brain Tumor will be detected in an early stages.

V. REFERENCES

[1]. Ruchita A. Banchpalliwar 1, Dr. Suresh S. Salankar, "Diagnosis of Brain Tumor Through MRI Image Processing using Clustering with Optimization Technique" , ", IEEE Vol (4), Issue 4, April 2016

[2]. Ganesh S. Raghtate, Suresh S. Salankar, "Modified Fuzzy C Means With Optimized Ant Colony Algorithm For Image Segmentation" 2015 International Conference on Computational Intelligence and Communication Networks.

[3]. Mohammed Sabbih Hamoud Al-Tamimi Ghazali Sulong, "Tumor Brain Detection Through Mr Images: A Review Of Literature", Journal Of Theoretical And Applied Information Technology 20th April 2014. Vol. 62 No.2.

[4]. Sayali D. Gahukar et al Int. Journal of Engineering Research and Applications Vol. 4, Issue 4(Version 5), April 2014, pp.107-111

[5]. K.Selvanayaki, Dr.P.Kalugasalam Intelligent Brain Tumor Tissue Segmentation From Magnetic Resonance Image (Mri) Using Meta Heuristic Algorithms Journal Of Global Research In Computer Science Volume 4, No. 2, February 2013 Research , Volume 2,Issue 6,June 2013,Pp 626-632.

[6]. S.Roy And S.K.Bandoyopadhyay, "Detection And Qualification Of Brain Tumor From Mri Of Brain And Symmetric Analysis", International Journal Of Information And Communication Technology Research, Volume 2 No.6, June 2012, Pp584-588

[7]. A.R.Kavitha, Dr.C.Chellamuthu, Ms.Kavin Rupa, "An Efficient Approach for Brain Tumour Detection Based on Modified Region Growing and Network in MRI Images",Information Forensics and Security, IEEE Transactions on, Vol.9 (2), May 2012.

[8]. Wen-Liange, De-Hua Chen, Mii-Shen Yang, "Suppressed fuzzy-soft learning vector quantization for MR Segmentation", Elsevier Ltd, Vol 52, Issue 1,Pag: 33-43, May2011.

[9]. R.B.Dubey, M.Hanmandlu, Sr.Member, Shantaram Vasikarla, "Evaluationof Three Methods for MRI Brain Tumor segmentation", IEEE Digital Object Identifier: 10.1109/ITNG.2011.92,2011.

[10]. Shaheen Ahmed, Khan M.Iftekharuddin, "Efficacy of Texture, Shape and Intensity Feature Fusion for Posterior Fossa Tumor Segmentation InMRI", IEEE Vol (2), pag: 206-13, Mar 2011.

[11]. David Rivest-Henault, Mohamed Cheriet," Unsupervised MRI segmentation of brain tissues Using a local linear model and set", Elsevier,Vol 29, Issue 2, pag.243-259, Mar2011.

[12]. Vida Harati, Rasoul Khayati, Abdolreza Farzan, "Fully automated tumor segmentation based on animproved fuzzy connectedness Algorithm in BrainMR Images", Elsevier Ltd,Vol 7, pag: 483-92, May 2011.