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Medical Image Segmentation Using Fuzzy-C Means for MRI Images

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Abstract : *In medical field, CT (Computed Tomography) scan imaging and MRI (magnetic resonance imaging) are the most important for image based visual diagnostics, but applying segmentation to these images is very tedious and requires an adjusting approach. This paper proposes a method for calculating image segments with a new approach based on Clustering. The segmented method proposed assesses the number of segmented image portions according to Fuzzy Code Division (FCD). The proposed method has increased efficiency and reduced iterations as compared to other methods. The quality of image is evaluated by calculating the efficiency in terms of number of rounds and the time which the image takes to make one iteration.*
Keywords *- Clustering , Fuzzy C means, Magnetic Resonance Imaging, Medical images, Segmentation.*

I. INTRODUCTION

Segmentation plays an integral part in partitioning an image into sub regions with respect to a particular application. The image might be having certain characteristics like Gray Level, color intensity, texture information, depth or motion based on the measurement. The traditional methods used for the Medical Image Segmentation are Clustering, Thresholding, Region Based Segmentation, Edge Based Methods and ANN Image Segmentation. In Thresholding technique, the pixel classification depends on its own information such as colour and intensity whereas in Edge Based, it focuses on detecting contours. Region Based Segmentation extracts features from a pixel and its neighbours to derive relevant information for each pixel[1]. ANN Image Segmentation originated from Clustering Algorithms. Clustering is a process of organizing objects into groups based on their attributes[2]. Fuzzy C Means(FCM) has advantages over other techniques that it retains much more data from original image and it assigns pixels without labels. Two approaches to clustering are Crisp Clustering and Fuzzy Clustering.

II. OBJECTIVES

The objective of this paper is to analyze various Segmentation techniques applied in medical field. The segmentation of images obtained using MRI for detection of tumour is done by using Fuzzy C Means. The main motive is to improve the computational time and classification efficiency.

III. LITERATURE SURVEY

In the past few years, research has been going on various segmentation techniques developed for medical images. The main purpose behind segmentation is to divide an image into small subregions with "area of interest" in the image.

Paresh Chandra Barman et.al [3] proposed a medical diagnosis system for image segmentation which illustrates a new variational level set algorithm without re-initialization. It can be easily implemented using a simple finite difference scheme. Thresholding and erosion methods were used to remove noisy element of the image. This technique was used to detect the interior contours (like tumours) automatically.

H.S. Prasantha et.al [4] explained various image segmentation methods by comparing outputs and explored which method is better. The two key parameters for object detection system which allowed the use of a segmentation method are stability and correctness.

Ajala Funmilola A. et.al[5] explained several techniques for medical image segmentation such as Clustering, Thresholding, Classifier, Region Growing, Deformable Model, Markov Random Model etc. But the main focus is on clustering methods, specifically k-means and fuzzy c-means clustering algorithms. These algorithms have been combined to form another technique called fuzzy k-c-means clustering algorithm.

S. Murugavalli et. Al [8] proposed an algorithm called high speed parallel fuzzy c-means to improve the performance of fuzzy c-mean(FCM) algorithm. This algorithm has advantage over other algorithm that it is fast and requires less execution time for larger images and it involves both the sequential FCM and parallel FCM.

Shi juan He et. Al [9] described two methods for an MRI brain image segmentation. The former method is histogram-based fuzzy C-means (FCM) method and the latter is multi-scale connectivity-restrained clustering

method for segmenting the brain image into three major classes of GM, WM and CSF. Histogram based FCM algorithm was used to segment the images.

Yan Li et.al [10] presented an unsupervised MRI segmentation technique based on self-organizing feature map (SOFM). The proposed algorithm explains extra spatial information about a pixel region by using a Markov Random Field (MRF) model. It improves the segmentation results. The MRF into SOFM has shown its great response as MRF explains the smoothness of the segmented regions.

Jianhua Xuan et. Al [11] proposed a method for brain MRI image segmentation that unite region growing and edge detection methods. The region growing algorithm produces an over segmented image, after that a complex and rigid region merging method is applied which is use to handle complex image structures. Edge information is then used on the image to verify.

IV. PROPOSED METHODOLOGY

The steps involved in this proposed approach of "Fuzzy-mean" method are as follows:-

1. Choose the number of the group of elements needed in the final arranged result. Assume the group of elements is N .
2. Choose N data points randomly in the whole database as the N centroids in N group of elements.
3. Find out the nearest centroid and classify the data points into group of elements where that centroid is located for every single data point. After this step, all data points are divided in a particular group of elements and the total number of elements is always N, as decided in step 1.
4. Calculate the centroid with the data points for every group of elements. The calculation of the centroid is defined by users. It can be the median of the database within the group of elements or it can be the real centre. Again, N centroid of N group of elements are made after step 2.
5. The iteration of step 3 to step 4 are repeated until there is no change in two consecutive iterations.

V. BLOCK DIAGRAM

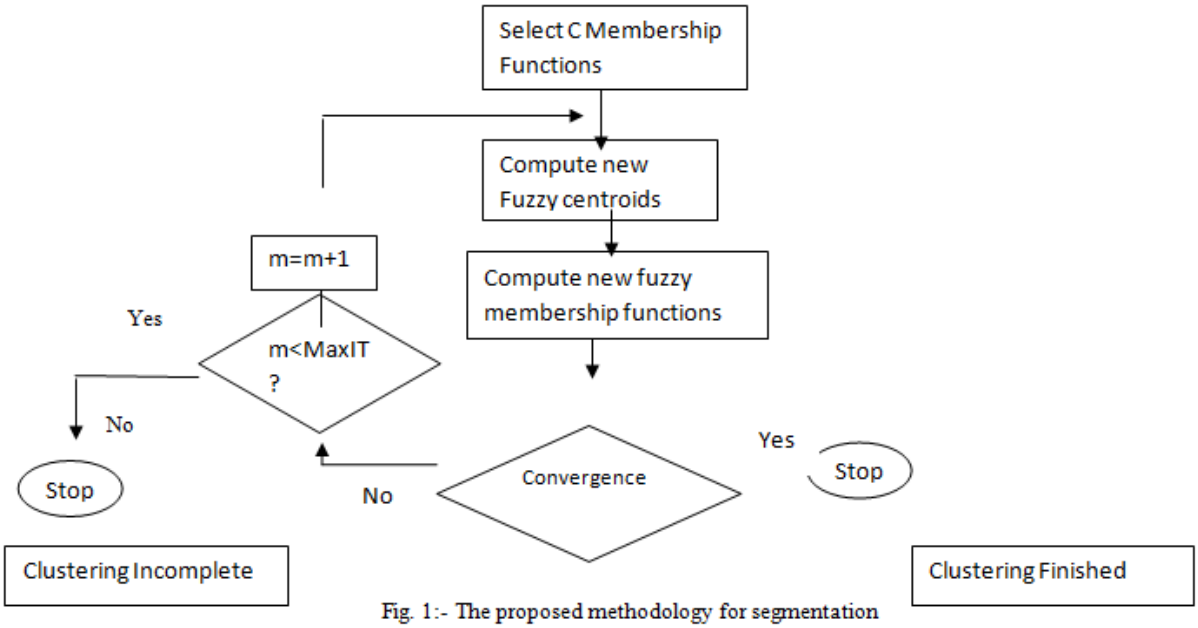

Fig. 1:- The proposed methodology for segmentation

VI. RESULTS AND DISCUSSIONS

The results have been simulated in MATLAB. The images have been taken from the medical database "**M**agnetic **R**esonance – **T**echnology **I**nformation **P**ortal" and the segmentation is done by fuzzy c means which classifies the image into clusters. It is used to evaluate the efficiency of the clusters based on each iteration and the computational time required to simulate the image.

1. KNEE IMAGE

Fig2:- Original image of knee for segmentation

The above image shows the original MRI image to be segmented using Fuzzy C Means Algorithm.

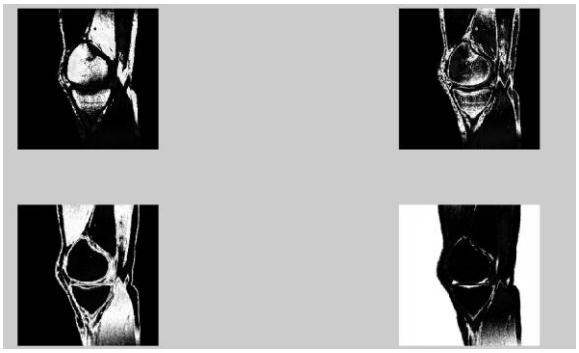

Fig 3:- Segmented image with four region divisions

The above MRI image is divided into segments of four layers for a total of 50 iterations and the values are accumulated in the form of efficiency and are represented in terms of efficiency/round of segmentation.

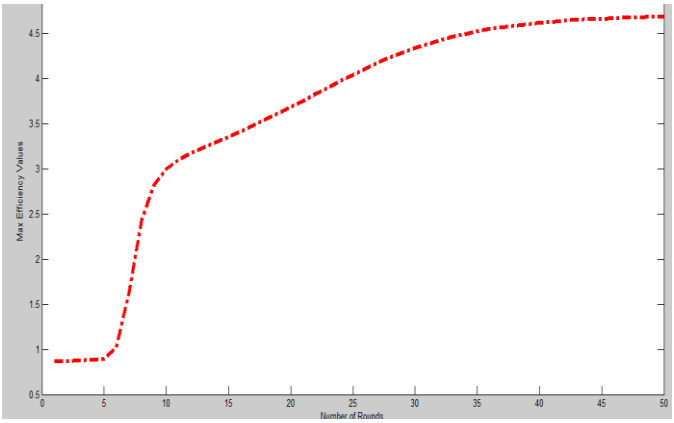

Fig 4:- The efficiency of the process with respect to a number
Total Time = 8.388993e+00, Average Time = 0.083890

2. BRAIN IMAGE

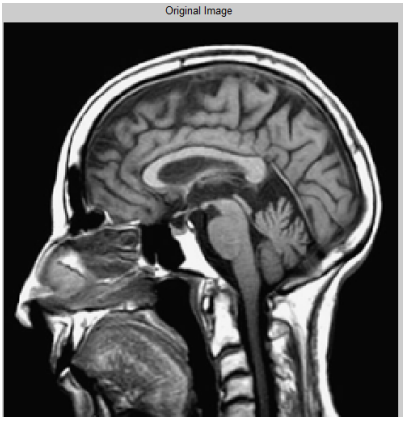

Fig 5:- Original image of brain for segmentation

The above image shows the original MRI image to be segmented using Fuzzy C Means Algorithm.

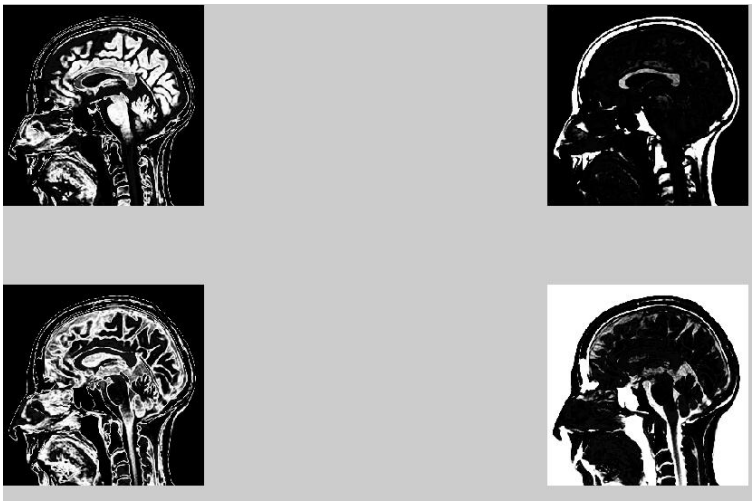

Fig 6:- Segmented image with four region divisions

The above MRI image is divided into segments of four layers for a total of 50 iterations and the values are accumulated in the form of efficiency and are represented in terms of efficiency/round of segmentation.

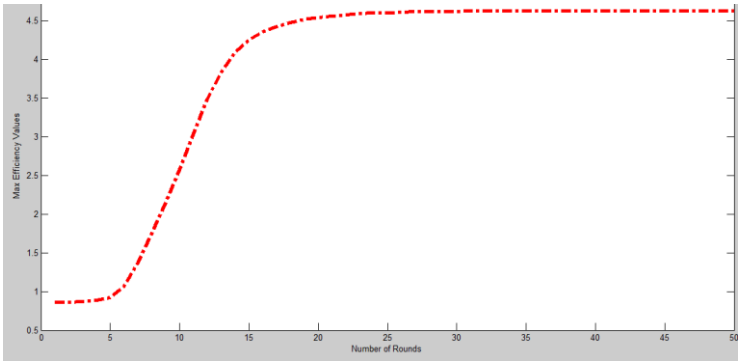

Fig 7 :- The efficiency of the process with respect to a number
Total Time = 7.664027e+00, Average Time = 0.076640

A normal image as an input of the medical diagnosis system is taken and the result of the implementation is as follows:

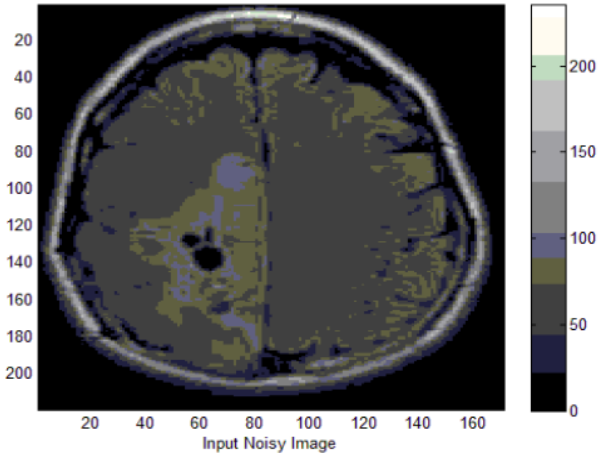

Fig 8:- Input noise image of a brain

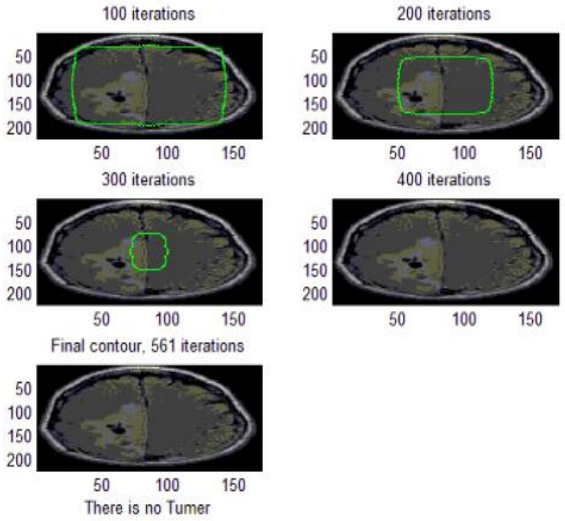

Fig 9: Result for different iterations

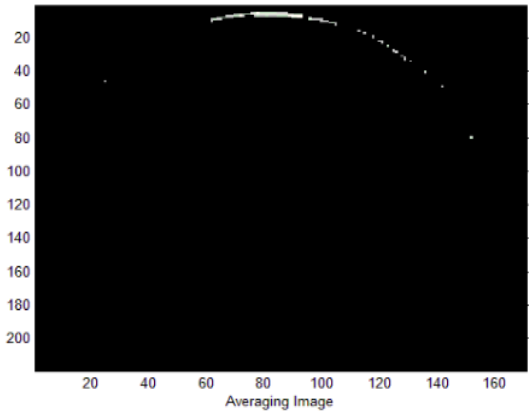

Fig 10: Calculation of time per no of iterations

VII. CONCLUSION

Image segmentation remains a challenging problem in image processing and computer vision. To solve the problem of image segmentation, it is seen that a hybrid solution comprising of two or more methods is the best approach. Our scheme has used a mixture of the automatic Fuzzy coding algorithm and the thresholding method. In this method, an attempt has been made to change the fuzzy coding method with combination of adjusting thresholding algorithm for segmentation process. Our evaluation has shown an improvement in image segmentation in comparison to similar method.

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