

Automatic Brain Tumor Segmentation Using Modified FCM (MFCM)

Pravina Khandagale¹, Kajal Bile², Monika Raste³, Ujjwala Kamble⁴.

Prof. Dhananjay Linge.

Electronics & Telecommunication Engg.

Fabtech Technical Campus, Sangola, Maharashtra, India.

pravinakhandagale@gmail.com¹, kajalbile910@gmail.com², monika.raste02@gmail.com³, ujjwalakamble218@gmail.com⁴

Abstract— This paper gives brief information about extraction of brain tumor area from MRI images. The brain tumor is one of the serious disease in world. Due to brain tumor number of people lost their life. If we diagnosis tumor in early time then life period of tumor affected patient will be increase. So, the aim of our transaction paper is automatic brain tumor segmentation with the help of image processing. Segmentation of brain tumor is very essential process in medical science. For segmentation we are using Modified FCM. The FCM is one of the segmentation technique used for tumor segmentation. But its speed is less. So we are using modified FCM. The MFCM uses compressed data set so it is faster than FCM. The input images are MRI images. The MRI is one of the important method for scanning the human body. It doesn't require more preprocessing as this are clearer than CT scan images.

Keywords - MRI, MFCM, Segmentation, Cluster.

I. INTRODUCTION

According to the World Health Organization (WHO) estimates, one of the most common brain diseases is tumor and this is the reason for the diagnosis & treatment of the brain tumor have vital importance for more than 400000 persons each year in the world.

Medical image segmentation plays important role in treatment. This is because of field of medical imaging gains its importance with increase in the need of automated and efficient diagnosis in a short period of time.

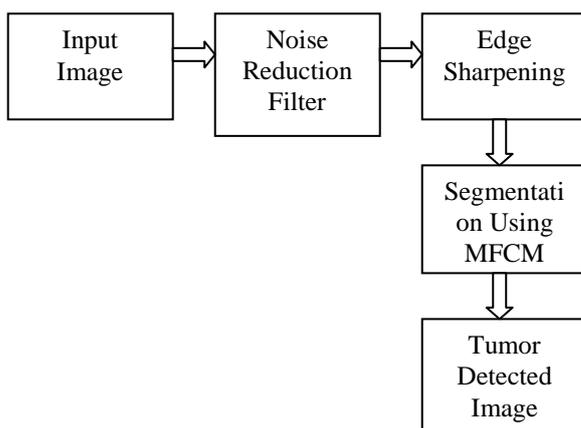
MRI is the most important technique in detecting the brain tumor. In segmentation of tumor MRI is used instead of CT images as it is more accurate and no radiation in it. The automatic segmentation will help to save the time and save the patient's life.

Clustering is used to segmentation of image. Clustering creates group of identical pixels. The modified FCM is one of the best techniques of segmentation which have high speed.

II. PROPOSED SYSTEM

A. BLOCK DIAGRAM

Block diagram of the system is shown below.



B. WORKING

The working is explained as below,

Input Image:

For segmentation we are using MRI images instead of CT scan images as MRI images more clear. MRI is always in black & white images. The MRI has file extension of MRI is not fixed. Depending on scanner its format changes. But the most standard format for export of image is DIOM. There is no unique file extension for the DICOM format. A common one is “dcm”, but there are several other extensions that are used by the different MRI scanner .manufacture .One example of a manufacture specific image in DICOM format is the “ima” format. Each MRI scanner manufacture will have a “DICOM conformance statement” that tell you how this particular company implements the DICOM standard. Most programs that can read DICOM images will accept files with any file extension & will rest whether the file is indeed in DICOM format based on the format of its content rather than on assumptions related to the file extension.

The results of an MRI scan can be used to help diagnose conditions, plan treatments and assess how effective previous treatment has been.

Preprocessing:

Preprocessing used to improvement of tumor intensity, noise, reduction, background removal, filtering and edges sharpening etc. Medical images are difficult to interpret the tumor, therefore preprocessing step is required with a specific end goal to make the picture segmentation and improve the quality of image results more precise.

Filtering:

Image filtering is used to:

1. Remove noise
2. Sharpen contrast
3. Highlight contours
4. Detect edges

Image filters can be classified as linear or nonlinear. Linear filters are also known as convolution filters as they can be represented using a matrix multiplication. Thresholding and image equalization are examples of nonlinear operations, as is the median filter. Median filtering is a nonlinear method used to remove noise from images.

It is widely used as it is very effective at removing noise while preserving edges. The median filter works by moving through the image pixel by pixel, replacing each value with the median value of neighboring pixels.

The pattern of neighbors is called the "window", which slides, pixel by pixel over the entire image. The median is calculated by first sorting all the pixel values from the window into numerical order, and then replacing the pixel being considered with the middle (median) pixel value.

EDGE SHARPENING:

Digital images need sharpening to overcome the effects of interpolation and anti-aliasing filters. Additional sharpening is often needed for creative effect, and a third round of sharpening is often needed for optimal reproduction, whether that is on screen or in print. For sharpening we use spatial sharpening filters. There are two spatial filters, First order spatial filter and second order spatial filter.

The second order filters are more used as they preserve edges. Also they work better in case of noise affected images.

Segmentation using MFCM:

Segmentation

It is a process of dividing an image into more understandable format. Manual Segmentation is also possible but it is not accurate and a time consuming one. This also leads to variations in report between two observers for a same image. Therefore, automatic segmentation of cells is done by experts to avoid inaccuracy. It is an interesting factor to do automatic segmentation because there will be no human intervention and it involves things such as tumor location, volume detection, size, similar patterns of growth, extent edema. An automatic segmentation includes soft computing methods such as fuzzy computing.

Following are the types of segmentation

1. Edge based Segmentation: It uses discontinuity between pixels.

2. Region based Segmentation: It uses similarity between pixels.

3. Pixel based Segmentation: This is again classified in 2 types,
a) Thresholding: In Thresholding 2 main types are used fixed & variable. One threshold value is decided and group of pixels are formed based on specific criteria

b) Clustering

Clustering technique can be seen as data compression technique. In this dimensionality of input is reduced to good extent. Here huge number of input samples is converted to less number of representative clusters.

The modified FCM algorithm is based on the concept of data compression where the dimensionality of the input is highly reduced. The data compression includes two steps: (a) quantization (b) aggregation. Since the modified FCM algorithm uses a reduced dataset, the convergence rate is highly improved when compared with the conventional FCM. The modified FCM algorithm uses the same steps of conventional FCM except for the change in the cluster updation and membership value updation criterions.

FCM TECHNIQUE

This algorithm divides collection of pixels into collection of clusters according to some criteria. Depending on the data and the application, similarity measures like distance, connectivity, and intensity may be used to distinguish classes.

FCM algorithm is based on minimization of objective function given below,

$$J(U, c_1, c_2, c_3, \dots, c_c) = \sum_{i=1}^c J_i = \sum_{i=1}^c \sum_{j=1}^n \mu_{ij}^2 d_{ij}^2 \quad (1)$$

Where U is membership value of jth input sample in ith cluster center. The membership values satisfy the following conditions,

$$0 \leq \mu_{ij} \leq 1 \quad (2)$$

$$\sum_{i=1}^c \mu_{ij} = 1 \quad (3)$$

$$0 < \sum_{j=1}^n x_j < n \quad (4)$$

C_i is the centroid of cluster i ; d_{ij} is the Euclidian distance which is measured between i th centroid (C_i) and j th data point. $m \in [1, \infty)$ is a weighting exponent. In many applications $m = 2$ is normally preferred. In crisp clustering $m = 1$.

The above conditions imply the followings:

- The membership values of each sample belonging to a particular cluster should be between 0 and 1
- Each sample must belong to at least one cluster and the sum of the membership values to each cluster should be 1.

• Each class must have at least one sample and all the samples cannot belong to a particular class. Iterative optimization of the objective function given above is carried and fuzzy partitioning of data is done, with the update of membership μ_{ij} and the cluster centers by C_i by,

$$\mu_{ij} = \frac{1}{\sum_{k=1}^c \left(\frac{d_{ij}}{d_{kj}}\right)^{2/(m-1)}} ; C_i = \frac{\sum_{j=1}^n \mu_{ij}^m x_j}{\sum_{j=1}^n \mu_{ij}^m} \quad (5)$$

Algorithm for this is explained below,

This algorithm has following steps,

- 1) Initialize $U = [\mu_{ij}]$ membership matrix.
- 2) At k th step, Calculate the center vectors C_i with μ_{ij} .
- 3) Update membership matrix at k th ($k+1$ th step)

$$\mu_{ij} = \frac{1}{\sum_{k=1}^c \left(\frac{d_{ij}}{d_{kj}}\right)^{2/(m-1)}} \quad (6)$$

Where $d_{ij} = x_i - c_i$

- 4) If $\|U(k+1) - U(k)\| < \epsilon$ then STOP; otherwise return to step 2.

MFCM TECHNIQUE

The modified FCM algorithm uses the same steps of the conventional FCM except for the change in the cluster updation and membership value updation criterions. The modified criterions are shown in Eqn (7).

$$\mu_{ij} = \frac{1}{\sum_{k=1}^c \left(\frac{d_{ij}}{d_{kj}}\right)^{2/(m-1)}} ; C_i = \frac{\sum_{j=1}^n \mu_{ij}^m y_j}{\sum_{j=1}^n \mu_{ij}^m} \quad (7)$$

Where y is reduced data set.

As modified FCM uses reduced dataset convergence rate in improved as compared to normal FCM technique.

Tumor detected image:

At this stage we get the segmented image at the output side. As shown in figure. The extracted area of tumor will be represented as a separate cluster from background region. The background region contains edge of brain from MRI image.



Fig- Segmented image

C. ACKNOWLEDGEMENT

It gives me a great pleasure to submit this Project. This is the only page where I have the opportunity to express my emotions and gratitude from the bottom of my heart.

I express my sincere thanks to my guide Prof.D.H.Linge for guiding me at every step in making of this project. He motivated us and boosted my confidence and I must admit that the work would not have been accomplished without his guidance and encouragement.

I would like to extend my special thanks to HOD Prof. Pawar S.L. and Principal Dr. Vageesha Mathada for spending their valuable time to go through my report and providing many helpful suggestions. Lastly I would like to thank all the staff member of electronics department and my friends without whom the project report would not have been completed.

D. REFERANCES

- [1] Aparna M. Nichat, S. A. Ladhake “Brain Tumor Segmentation and Classification Using Modified FCM and SVM” International Journal of Advanced Research in Computer and Communication Engineering Vol. 5, Issue 4, April 2016.
- [2] S. Dhivya, J. Preethi, M. Kirthikaa “Brain Tumor Segmentation using FCM in MRI Images” South Asian Journal of Engineering and Technology Vol.2, No.15 (2016) 44–50 ISSN No: 2454-9614.
- [3] A Pugazhenth, G.Sreenivasulu, A Indhirani “Background Removal by Modified Fuzzy C-Means Clustering Algorithm” 2015 IEEE International Conference on Engineering and Technology (ICETECH’15), 20th March 2015, Coimbatore, TN, India.
- [4] Mohsen Firoozbkht, Neda Hajibabaei “Image Segmentation using Modified FCM Clustering”.International Conference on knowledge-Based Engineering & Innovation (KBEI) Nov-2015.
- [5] Maheshkumar S.Badmera, Ajinkya P. Nilawar, Dr. Anil R. Karwankar “Modified FCM approach for MR brain image segmentation” 2013 International Conference on Circuits, Power and Computing Technologies [ICCPCT-2013]
- [6] Heena hooda, Om prakash verma and tripti singhal “brain tumor segmentation: A performance analysis using k-means, fuzzy c-means and region growing algorithm” IEEE International conference on advanced communication control and computing technologies, 2014.
- [7] Ajala funmilola A, oke O.A, adedeji T.O, alade O.M, adewusiE.A, “Fuzzy k-c-means clustering algorithm for medical image segmentation”, journal of information engineering and applications, ISSN 2224-5782,ISSN 2224-0506. Vol 2, no.6, 2012.
- [8] Gauri P. Anandgaonka and Ganesh .S. Sable “Detection and identification of brain tumor in brain MR images using Fuzzy c-means segmentation”, international journal of advanced research in computer and communication engineering vol. 2, issue 10, October 2013.

-
- [9] Jin liu, min li, jianxin wang, fangxiang wu, tianming liu and yipan, “A survey of mri- based brain tumor segmentation methods”, Tsinghua Science and Technology, Volume 19, Number 6, December 2014, pp 578-595.
- [10] M. Shasidhar ,V.Sudheer Raja, B. Vijay Kumar“MRI brain image segmentation using modified fuzzy C-means clustering algorithm” International Conference on Communication Systems and Network Technologies 2011.