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Image Segmentation using Fuzzy C Means Clustering: A survey

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Abstract: This paper presents a latest survey of different technologies used in medical image segmentation using Fuzzy C Means (FCM).The conventional fuzzy c-means algorithm is an efficient clustering algorithm that is used in medical image segmentation. To update the study of image segmentation the survey has performed. The techniques used for this survey are Brain Tumor Detection Using Segmentation Based on Hierarchical Self Organizing Map, Robust Image Segmentation in Low Depth Of Field Images, Fuzzy C-Means Technique with Histogram Based Centroid Initialization for Brain Tissue Segmentation in MRI of Head Scans.

Keywords: Image segementation;clustering; fuzzy c-means; Image analysis; HSOM,;Low Depth of Field(DOF); Tumor detection

I. INTRODUCTION

Image segmentation is one of the most widespread means to classify correctly the pixels of an image in a decision oriented applications. Image segmentation is a technique that partitions an image into uniform and non-overlapping regions based on some likeness measure.

Clustering, the unsupervised classification of patterns into groups is one of the most important tasks in exploratory data analysis [1]. Primary goals of clustering include gaining insight into data (detecting anomalies, identifying salient features, etc.), classifying data, and compressing data. Clustering has a long and rich history in a

variety of scientific disciplines including anthropology, biology, medicine, psychology, statistics, mathematics, Engineering and computer science.

Fuzzy C-means (FCM) algorithm is one of the most popular fuzzy clustering methods widely used in various tasks of pattern recognition, data mining, image processing, gene expression data Recognition *etc*. Modifying and generalizing the FCM algorithm is a prevailing research stream in fuzzy clustering in recent decades.

Fuzzy C-Means (FCM)

FCM partitions a set of n objects x {x , x ,..., xn} in R^d dimensional space into $c(1 < c < n)$ fuzzy clusters with y = { y_1, y_2 , y_3 ,..., y_c} cluster centers or centroids [6]. The fuzzy clustering of objects is described by a fuzzy matrix μ with n rows and c columns in which n is the number of data objects and c in the number of clusters. μ_{ij} , the element in the i^{th} row and j^{th} column in μ , indicates the degree of association or membership function of the i^{th} object with the j^{th} cluster. The objective function of FCM algorithm is to minimize the following equation.

$$J_m = \sum_{j=1}^{c} \sum_{i=1}^{n} u_{ij}^m d_{ij}$$

Where

$$d_{ij} = \left\| x_i - y_j \right\|$$

In this servey there are various latest techniques used in image segmentation which are very useful in medical field for diagnosis of a problem.$m(m > 1)$ is a scalar termed as weighting exponent. M controls the fuzziness of the resulting clusters and d_{ij} is the Euclidian distance from object i x to the cluster center y_j.

The y_j , centroid of the jth cluster, is obtained as:

$$y_j = \frac{\sum_{i=1}^{n} u_{ij}^m x_i}{\sum_{i=1}^{n} u_{ij}^m}$$

The FCM algorithm is iterative and can be stated as follow [3]:

1. Select$m(m > 1)$; initialize the membership function values μ_{ij} , $i = 1,2,...,n$; $j = 1,2,...,c$.
2. Compute the cluster centers y_j , j = 1,2,..., ,c . according to equation (3)
3. Compute Euclidian distance d_{ij} , i=1,2…,n $j=1,2,...,c$.

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Imaging characteristics of MRI scans

The images produced by MRI scans are usually gray images with intensity in the range 0-255. The GM of the brain consists of the cortex that lines the external surface of the brain and the gray nuclei deep inside of the brain, including the thalami and basal ganglia. WM is comprised of the neuronal axons that interconnect different regions of the brain and serve as the interface between the brain and the rest of the body. The watery fluid, CSF acts as a cushion for physical shocks. The WM constitutes a connected region that is bordered by GM and CSF as shown in Fig.1. In Fig.1, for the
display purpose WM is shown in gray color, GM as white color and CSF as black color. In MRI of head scans, the picture of organ is usually surrounded by air particles, known
as background (bck) in order to make a matrix representation.This bck is another major ROI in MRI of head scans.

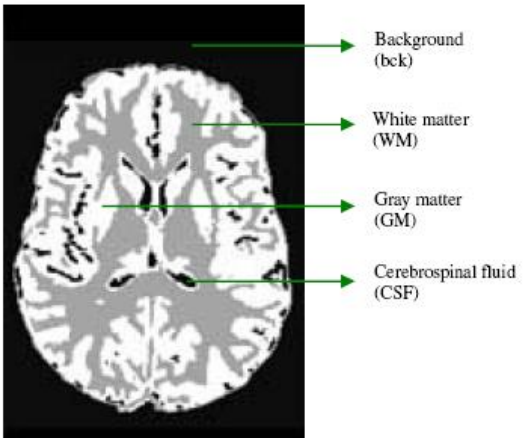

Fig 1.Segmentation results of MRI of axial head scan

Low depth of Field method

Low Depth of Field(DOF) is a method used to give special importance to a part of image which is essential or which has to be focused. This method can be used in the fields like sports, photography & medical. In medical field problem diagnosis can be very easy by making focus to a problematic area such as Brain tumor, Cancer etc. the area which is focused i.e. Object of Interest (OOI) helpful to provide new information & help in research as well.

Here, image segmentation algorithm is useful to separate Object of Interest (OOI) from the rest of the image.

The algorithm for developing such type of images divided into five parts Deviation Scoring, Score Clustering, Mask Approximation, Color Segmentation and Region Scoring. In the initial stage of the algorithm i.e. Deviation scoring the Guassian Blur algorithm is used. According to this the image divided in two ways ie. Original image & surface cut of OOI & the difference is calculated from these images which gives a score value.

In the second stage of the algorithm

In the second stage, called Score Clustering, all pixels with a score value above a certain threshold are clustered by using a density-based clustering algorithm. Thus, isolated sharp pixels are recognized as noise and only large clusters are processed further. The third stage named Mask Approximation generates a nearly closed plane (containing almost no holes) from the discrete points of each remaining cluster. This is achieved by computing the convex hull from all neighbors of all dense pixels. Any so-created polygon is then filled and the union of these filled regions represent the approximate mask of the main focus region. In the next two stages this approximate mask is going to be refined. Hence, the fourth stage, called Color Segmentation divides the approximate mask into regions that contain pixels with similar color in the
original image.

In the fifth stage named Region Scoring, a relevance value is calculated for each region. This relevance value is directly influenced by the score values of the pixels surrounding the according region. The final segmentation mask is then created by removing all regions that have a relevance value below a certain threshold.

Self Organizing Map (SOM) algorithm

This is another important method proposed for medical image segmentation.the method is devided in to two parts. First part consist of capturing an image from the database & second part consist of accurately identify
the principal tissue structures in these image volumes. A tumor is a mass of tissue that
grows out of control of the normal forces that regulates growth [6]. Brain tumor is a group of abnormal cells that grows inside of the brain or around the brain. Brain tumor responsible for damage of brain tissues & causes brain cancer. For image segmentation, the important part is to produce an image which is noiseless.So to produce such kind of image without noise there is a use of filters.i.e.pre process the image by using weighted Median Filter (WM). WM filters belong to the broad class of nonlinear filters called stack filters. This enables the use of the tools developed for the latter class in characterizing and analyzing the behavior and properties of WM filters[7], e.g.noise attenuation capability.

CONCLUSION

Segmentation is an important step in advance image analysis and computer vision and therefore is an ongoing research area although a dense literature is available. The

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incorporation of spatial information in to the objective function of standard FCM yields successful results for robust and effective image segmentation of noisy images [2, 3, 4, 5] & techniques like DOF(depth of field) be applied to segment colored images.The techniques [1, 2, 3 and 4] reviewed in this survey are applicable to analysis of MRI images and in future can be applied to other medical image types like CT and PET for better analysis.Furthermore in future a hybrid technique based on clustering algorithms and classifiers like Neural Networks and etc can be combined to work on input data set for better results and previously designed algorithm can be modified to work for color image segmentation.

REFERENCES

[1] A. K. Jain, M. N. Murty, P. J. Flynn, Data Clustering: A Review, ACM Computing Surveys 31 (3) (1999)264–323.

[2]G.Dong., M.Xie, "Color clustering and learning for image segmentation.based on neural networks, "IEEE Transactions on Neural Networks,Vol.16, No.4, pp. 925–936, 2005.

[3]Image Segmentation Using Kernel Fuzzy C-Means.Clustering on Level Set Method on Noisy Images

[4]Robust Image Segmentation in Low Depth Of Field Images

[5]Fuzzy C-Means Technique with Histogram Based Centroid Initialization for Brain Tissue Segmentation in MRI of Head Scans.

[6] Lin, W., E. Tsao and C. Chen, 1991. "Constraint satisfaction neural networks for image segmentation", In: T.Kohonen, K. Mkisara, 0.Simula and J. Kangas (eds.), Artificial Neural Networks (Elsevier Science Publishers), pp: 1087-1090.[14]

[7] Pal, N.R. and S.K. Pal, 1993." A review on image segmentation techniques", Pattern Recognition 26(9): 1277-1294.

[8] T.Logeswari and M.Karnan -An Improved Implementation of Brain Tumor Detection Using Segmentation Based on Hierarchical Self Organizing Map International Journal of Computer Theory and Engineering, Vol. 2, No. 4, August, 2010 1793-8201

[9] S Z Beevi and M.M. Sathik, " A robust Segmentation Approach for Noisy Medical Iamges Using Fuzzy Clustering With Spatial
Probability," European Journal of Scientific Research, Vol. 41 No. 3 pp.437-451, 2010

[10] S.Kirindis and V. Chatzis, " A Robust Fuzzy Local Information CMeans Clustering Algorithm," IEEE Trans. Image Process. Vol.19, No.5 , pp. 1328-1337,May 2010

[11]S.R.Kannan,S.Ramathilagam, R.Pandiyarajan and A.Sathya, " Fuzzy Clustering Approach in Segmentation of T1-T2 brain MRI," Int. Journalof Recent Trends in Engineering, Vol2, No.1, pp. 157-160, Nov.2009

[12] S.Z.Beevi, M.M. Sathik and K.senthamarakannan, " A Robust fuzzy Clustering Technique with Spatial neighborhood Information for Effective Medical Image Segmentation," Int. Journal of Computer Science and Information Security, Vol 7. No. 3, pp. 132-138, March
2010