MODIFIED FUZZY C-MEANS ALGORITHM IN MEDICAL IMAGES

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Abstract- Image segmentation is a common area of image processing. The research work done in this paper is based on image segmentation using improved fuzzy c-mean (FCM)algorithm. The improved fuzzy c-mean algorithm is composed by modifying the distance measurement ofthe original fuzzy c-mean algorithm. The originalEuclidean distance in the fuzzy c-mean algorithm isreplaced by correlation distance.As a result the new improved fuzzy c-means algorithm is obtained. The acquired algorithm is more robust when associated with core fuzzy c- mean algorithm. The exploration done on the real MR images exhibits that the proposed algorithm has enhanced performance.

Keywords-fuzzy c means, clustering,MRI

1. Introduction

Image segmentation is a stimulating task in imagescrutining. There huge number of methods available in image segmentation process.The fuzzy c-mean procedurethat has been effectively applied to analysis,clustering of data points in the field of industries, astronomy, geology,medical image, target recognition, image segmentation, pattern recognition.An image can be appearing in different feature spaces, andfuzzy c-mean method classifies by grouping the similardata points in the feature space into clusters.Image segmentation plays important role in medicalimage. In the field of medical diagnosis an extensivediversity of imaging techniques is presently available,such as radiography, computed tomography (CT) and Magnetic resonance imaging (MRI) [1],[2]. In therecent times, magnetic resonance image is the mosteffectively used for diagnostic image examinantforbrain diagnostic image examination for brain diseasessuch as tumor. Even through original fuzzy c-meanalgorithm yields good results for segmenting noise freeimages, it fail to segment image corrupted by noise,outliers and other imaging art if acts.

Medical image segmentation is an essential step formost successive image analysis task. This paperpresents an image segmentation approach usingimproved fuzzy c -mean algorithm [3], [4].

2. Data Mining

Data mining, *the extraction of hidden predictive information from large databases*, is a powerful new technology with great potential to help companies focus on the most important information in their data warehouses.

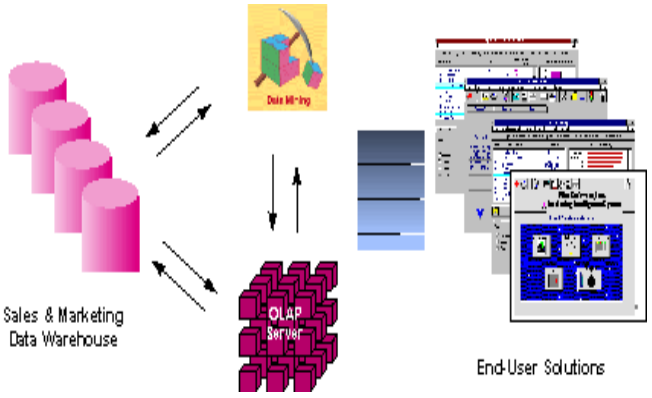


Fig1: Data Mining Architecture

3. Clustering

The process of grouping a set of physical or abstractobjects into classes of similar objects is calledclustering. A cluster is a collection of data objects thatare similar to one another within the same cluster andare dissimilar to the objects in other clusters.There are two properties in clustering:

• Homogeneity inside clusters: the data, which belongsto one cluster, should be as similar as possible.

• Heterogeneity between the clusters: the data, whichbelongs to different clusters, should be as different aspossible.

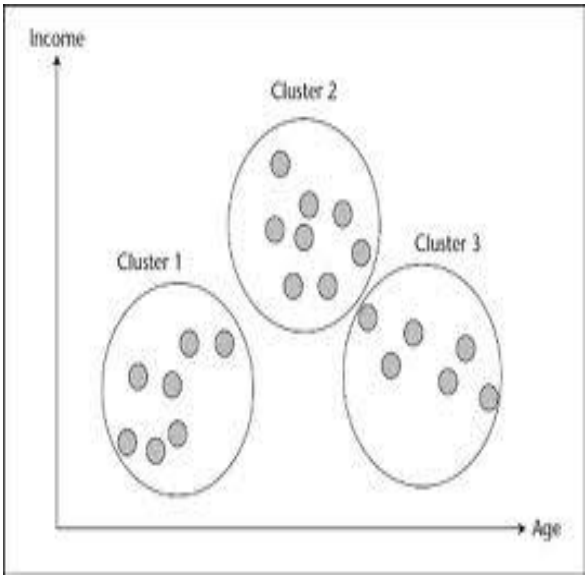


Fig2:Clustering Example

4. Definition of clustering

Clustering has been defined in many forms by their by various authors.

> Clustering is *"the process of organizing objects into groups whose members are similar in some"*.

Clustering is an unsupervised data miningtechnique, which groups the input into K regions based on some similarity/dissimilaritymetric.The main objective of any clustering techniqueis to produce a K n partition matrix U(X) of thegiven data set X, consisting of n patterns,
$X = x1, x2 \ldots x_n$.

5. Improved fuzzy c-mean algorithm

Fuzzy c-mean (FCM) algorithm, also known asfuzzy ISODATA, was introduced by Bezdek [6] as anextension to Dunn's algorithm [7]. The fuzzy c-meanbased algorithms are the most commonly used fuzzyclustering algorithms in practice.Let, $X = x1, x2 \ldots N$where$x_i \epsilon R^n$present agiven set of feature data.

Themain aim of fuzzy c-meanalgorithm is to minimize the fuzzy c-mean costfunction.

$$J\,U,V = \sum_{J=1}^{C}\sum_{I=1}^{N} \mu_{ij} m \| x_{i-Vj} \| 2$$

$V = v_1, v_2, \ldots, v_c$

are the cluster centers.

$U = \mu_{ij} Nx\ c$is a fuzzy partition matrix, in whicheach member μ_{ij}indicates the degree of membershipbetween the data vector x_i and the cluster J. the valuesof matrix U should satisfy the following conditions:

$\mu_{ij} \epsilon 0, 1, \forall i = 1 \ldots N, \forall j = 1 \ldots, C$ 2

$\sum_{j=1}^{c} \mu_{ij} = 1, \forall i = 1, \ldots N$ 3

The exponent $m \epsilon 1, \infty$ is the weighting exponent,which determines the fuzziness of the clusters. Themost commonly used distance norm is the Euclideandistance $d_{ij} = \| x_i - v_j \|$, although Babuska suggeststhat other distance norm could produce better results[8]. The Euclidean distance in improved fuzzy c-meanalgorithm is replaced by the correlation distance. Andthis improved fuzzy c -mean algorithm is to be morerobust than the original fuzzy c -mean algorithm.

Minimization of the cost function J(U,V) is anonlinear optimization problem, which can beminimized with the following iterative algorithm:

Step 1: Initialize the membership matrix ***U*** with random values so that the conditions (2) and (3) aresatisfied. Choose appropriate exponent m and thetermination criteria.

Step 2: Calculate the cluster centers ***V*** according to theequation:

$$vj = \frac{\sum_{I=1}^{N} \mu ij \quad m_{xi}}{\sum_{i=1}^{N} \mu ij \quad m}, \forall j = 1, \ldots c$$

Step 3: Calculate the new distance by correlation:

$$d_{ij} = \rho x, y = corr x, y = \frac{cov\, x,y}{\sigma x \sigma y}$$

Step 4: Update the fuzzy partition matrix **U**:

If $d_{ij} > 0$(indicating that $xi \neq vj$

$$\mu_{ij} = \frac{1}{\sum_{k=1}^{c} (\frac{dij}{djk})^{\frac{2}{m-1}}}$$

Else

$$\mu_{ij} = 1$$

Step 5:

If the termination criteria have been met, stop.

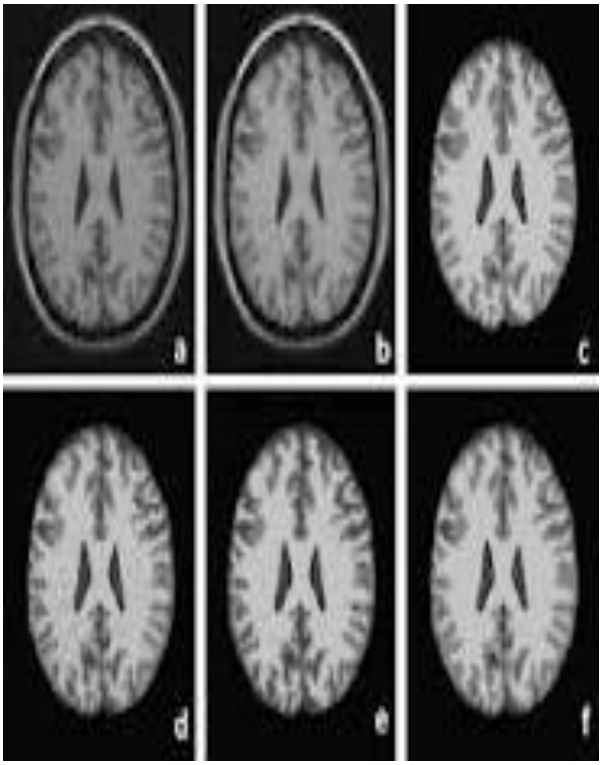
Else go to **Step 2**

A suitable termination criterion could be tocalculate the cost function (Eq. 1) and to see whether itis below a certain tolerance value or if its improvementcompared to the previous iteration is below a certainthreshold [9]. Also the maximum number of iterationcycles can be used as a termination criterion.Experiments are conducted on real images toexamine the performance of the proposed improvedfuzzy c-mean technique in segmenting the MR-images.

6. Experimental results

The proposed improved fuzzy c-mean algorithm isimplemented using MATLAB and tested on realimages to explore the segmentation accuracy of theproposed approach.

The proposed approach of image segmentationusing improved fuzzy c-means algorithm eliminates theeffect of noise greatly.



I. *Fig (a) & (b) are original images.***II.** *(b)&(c) are results of core fuzzy c mean algorithm.***III.***Images (e)&(f) are results of proposed algorithm.*

7. Conclusion

Images corrupted by noise, outliers and other imagingartifact. In the proposed improved fuzzy c-meanalgorithm, are incorporated to control the trade-offbetween them. The algorithm is formulated bymodifying the distance measurements of the standardfuzzy c-mean algorithm to allow the labeling of a pixelto be influenced by other pixels and to control the noise effect during segmentation. The experimental resultssuggested that the proposed algorithm performed wellthan other fuzzy c-mean extension, segmentationalgorithm.

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[10]International Journal of Engineering Research & Technology (IJERT)Vol. 1 Issue 3, May – 2012ISSN: 2278-0181