Application of Fuzzy Neural Network for Image Tumor Description

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Abstract—This paper used a fuzzy kohonen neural network for medical image segmentation. Image segmentation plays a important role in the many of medical imaging applications by automating or facilitating the diagnostic. The paper analyses the tumor by extraction of the features of (area, entropy, means and standard deviation).These measurements gives a description for a tumor.

Keywords—FCM, Features Extraction, Medical Image Processing, Neural Network .Segmentation.

I. INTRODUCTION

MEDICAL imaging is a vital component of a large number of applications. The imaging modalities can be divided into two global categories: anatomical and functional. Anatomical modalities, employed can be divided into two global categories: anatomical and functional. Anatomical modalities, depicting primarily morphology, include X-ray, CT (Computed Tomography), MRI (Magnetic Resonance Imaging), US (ultrasound), portal images, and (video) sequences [1].Image segmentation algorithms, play a role in biomedical imaging applications such as the quantification of tissue volumes diagnosis, localization of pathology study of anatomical structure, treatment planning, partial volume correction of functional imaging data, and computer-integrated surgery[2]. The methods for performing segmentations vary widely depending on the specific application For example; the segmentation of brain tissue has different requirements from the segmentation of the liver. In general, there are two main approaches to clustering which is crisp clustering and fuzzy clustering techniques .One popular fuzzy technique involves using fuzzy c-means (FCM) for medical image segmentation [3]. The neural network approaches have been introduced in which relay on neural network architecture for image segmentation, also the hybrid of neural network with fuzzy used in image segmentation [4]. Nicolaos B. Kkarayiannis had been developed fuzzy algorithm with learning vector quantization (LVQ) for MRI brain segmentation [5]. The paper proposes fuzzy c-means clustering using neural network for medical image segmentation .The use of fuzzy c-means with kohonen neural network in MRI medical image segmentation are no hard boundaries brain due to tissue mixing . Easily recognize the tumor region from MRI brain medical image in this work after applied the fuzzy Kohonen clustering network for medical image segmentation. .The extraction of a different types of features from region of interest (ROI) .It is a region of tumor, the measurement help the doctor for diagnostic the type of tumor.

II. FUZZY KOHONEN CLUSTERING NETWORKS

Bezdek, Pal and Taso [6] considered this approach, they extended the ideas of FCM and Kohonen neural network to a new family of algorithms called Fuzzy Kohonen Clustering Network (FKCN). The Kohonen Clustering Network (KCN) clustering is closely related to the Fuzzy C-Means (FCM) algorithms. Since Fuzzy C-Means algorithms are optimization procedure because the objective function is approximately minimized. The integration of FCM and KCN is one way to address several problems of KCN. They combine the ideas of fuzzy membership values for learning rates, the parallelism of Fuzzy C-Means, and update rules of KCN. FKCN is self-organizing algorithm, since the "size" of the updated neighborhood is automatically adjusted during learning, and FKN usually terminates in such a way of minimized objective function of FCM.

III. SEGMENTATION WITH FUZZY KOHONEN CLUSTERING ALGORITHM

The algorithm of FKCN is summarized as following [7] [8]:

Step1: Given sample space $X = \{x_1, x_2, x_3, \ldots, x_n\}$ distance $\|\cdot\|$ Cluster c and error threshold $\varepsilon > 0$.

Step2: Initialized the weight vector v (0), set fuzzy parameters m_0 iteration limit t_{max} ,initial iteration counter t=0.

Step 3: Update all memberships $\{u_{ij}\}$ and calculate learning rate $\{\alpha_{ij}\}$.

$$u_{ij} = \cfrac{1}{\sum_{k=1}^{c} (\cfrac{\|x_i - v_i\|}{\|x_j - v_k\|})^{\frac{1}{(m_t - 1)}}} \qquad (1)$$

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$$\alpha_{ij}(t) = (u_{ij}(t))^{mt} \qquad (2)$$

$$\text{where } m_t = m_0 - t\delta m, \delta m = \frac{m_0 - 1}{t_{max}}$$

Step 4: Update all the weight vectors.

$$v_i(t) = v_i(t-1) + \frac{\sum_{j}^{n} \alpha_{ij}(x_j - v_i)}{\sum_{s=1}^{n} \alpha_{js}(t)} \qquad (4)$$

Step5: Compute the function

$$E(t) = \left\| v(t) - v(t-1) \right\|$$

Step6:If $t+1 > t_{max}$ or if $E(t) < \varepsilon$, and terminate the

Iteration; otherwise, return step3.

FKCN is the heuristic learning neural network .It can find the clusters center and partition the feature by distance, to overcome the problem of KCN for updating the non winner prototypes in the determination of learning rate.

IV. SEGMENTATION SYSTEM AND IMPLEMENTATION

Image segmentation is defined as the partitioning of an image into non-overlapping regions which are homogeneous with respect to some characteristic such as intensity [9], that not easily happen in the medical image because most of medical image have a tissue (overlapping region) but the fuzzy kohonen neural network have ability to segmentation the MRI brain. The figures show the results:
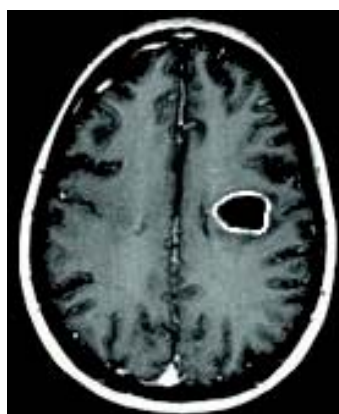

Fig. 1 (a) Magnetic Resonance (MR) image of brain

Fig. 1 (b) Magnetic Resonance (MR)image of the brain after applying Fuzzy Kohonen neural network

Fig. 1 (c) Tumor from Fig. 1
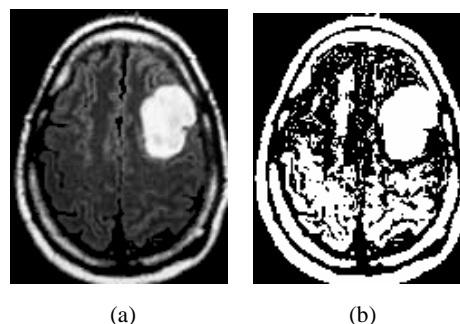

(a)　　　　　　　　　(b)

Fig. 2 (a) Sample 2 is a Magnetic Resonance (MR) image of the brain
(b) Magnetic Resonance (MR) image (a) after applying Fuzzy Kohonen neural network

Fig. 2 (c) Tumor from (a)

V. TUMOR REGION MEASUREMENTS

Some of features used for the detection and classification of region are shown in[10] like: (1) Gray level statistics: (first order and second order statistics like mean, standard deviation computed from the histogram of the gray values of the inner core region and also the outer region of the region and contrast between the core part and the outer shell region) (2) Geometric features are: (circularity of the shape ,average eccentricity, kurtosis area, perimeter) (3) Other features are (texture, angular second moment ,entropy) .In this paper had been selected a specific features from above (Area, mean, standard deviation and entropy). These features had been extracted from ROI (Region-Of-Interest) the region of tumor. The measurement features computation for gray segmentation is shown in the Table I.

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TABLE I
DESCRIPTION OF TUMER

	Sample1	Sample2
Area	32291 pixel	209761 pixel
Mean	82.5857 pixel	139.376 pixel
Standard deviation	14.6303 pixel	27.5729 pixel
Entropy	1.000 pixel	0.8324 pixel

VI. SIMULATION AND CONCLUSION

The segmentation of medical image is not easily because the utility of segmented MR images in the medical diagnostic process depends on the combination of two often conflicting requirements, that is ,the elimination of the redundant information present in the original MR images and the preservation of the important between redundant and useful information is based on the number of intensity levels present in the segmented images, or equivalently ,the number of clusters created during the clustering process .The selection of a small number of clusters can result in the loss of detail necessary for the diagnostic process, while the selection of a large number of intensity levels can undermine the effectiveness of the segmentation process by producing segmented images with a large volume of redundant information.

Accurate medical image segmentation it still a difficult problem, the algorithm of Fuzzy Kohonen Clustering Network (FKCN), based on the integration of Fuzzy C-Mean (FCM) and Kohonen Clustering Network (KCN), the FKCN is non-sequential, unsupervised and used fuzzy membership values from FCM as learning rate. This yield automatic control of both the learning rate distribution and update neighborhood .The parameter m affected in the result of fuzzy kohonen neural network, the large value gave bad results ,the parameter m changed in each iteration of algorithm, it is adaptive

parameter during the processing sometime the medical image processing needs per-processing like enhancement by median filter. The measurement of tumor by unit of pixel gives another indication to the doctor for diagnosis because the doctor depends in the view, we can developed this algorithm for diagnosis the type of malignant tumor .

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