Segmentation Of Medical Image Using Fuzzy Neuro Logic

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Abstract: The field of medical imaging gains its importance with increase in the need of accurate and efficient diagnosis over a short period of time. MR imaging has become a widely-used method of high quality medical imaging, especially in brain imaging where MR’s soft tissue contrast and non-invasiveness are clear advantages. MRI segmentation is an important image processing step to identify anatomical areas of interest for diagnosis of many disorders such as brain tumor, multiple sclerosis, etc. Segmentation approaches have met with only limited success because of overlapping intensity distributions of intracranial and extracranial tissues in order to make robust automatic brain tumor and healthy tissue segmentation. Hence the extracranial tissues should be removed in brain MR images and making use of only intracranial tissue regions for segmentation of tumor and normal tissues for further analysis. In this paper, from the abnormal MR images, the features are extracted. Here, the feature extraction includes the first order and second order features. First order texture measures are statistics calculated from the original image values, like variance, and do not consider pixel neighbour relationships. Second order measures consider the relationship between groups of two (usually neighbouring) pixels in the original image. The principal components are selected. Then, an efficient segmentation algorithm for magnetic resonance images of brain tissues using fuzzy logic is proposed. The fuzzy logic output will be compared with K-means, Neural Network for segmentation. The comparative analysis will be done in terms of performance measured parameters.

Keywords: Image segmentation, k mean, fuzzy logic, clustering, neural network.

1. INTRODUCTION

Magnetic resonance imaging (MRI) is used as a valuable tool in the clinical and surgical environment because of its characteristics like superior soft tissue differentiation, high spatial resolution and contrast and it does not use harmful ionizing radiation to patients. The data obtained from MR images are used for detecting tissue deformities such as tumors, cancers and injuries. In order to understand MRI contrast, it is important to have some understanding of the time constant involved in relaxation processes that establish equilibrium following RF excitation. Time constants involved in MR images are T1 (relaxation time), T2 (relaxation time) and T2f (flair). The tumour detected using MRI are the following Primary malignant tumour (glioma and meningioma) and secondary malignant tumours (metastatic brain tumor). MRI segmentation is an important image processing step to identify anatomical areas of interest for diagnosis of many disorders such as brain tumour, multiple sclerosis, etc.

1.1. Feature extraction: To classify an object in an image, we must first extract some features out of the image. Feature extraction is a special form of dimensionality reduction and features reflect properties measured at the pixel-level that can aid in discriminating between normal pixels and tumor pixels. First order texture measures are statistics calculated from the original image values, like variance, and do not consider pixel neighbour relationships. Second order measures consider the relationship between groups of two (usually neighbouring) pixels in the original image.

2. Overview of other method

Clustering can be considered the most important unsupervised learning problem, so it deals with finding a structure in a collection of unlabeled data. A cluster is therefore a collection of objects which are “similar” between them and are “dissimilar” to the objects belonging to other clusters. Clustering algorithms may be classified as listed below

2.1. K-Means segmentation

K-means is one of the simplest unsupervised learning algorithms that solve the well known clustering problem. The main advantages of this algorithm are its simplicity and speed, which allows it to run on large datasets. The procedure follows a simple and easy way to classify a given data set through a certain number of clusters fixed a
priori. The main idea is to define k centroids, one for each cluster. These centroids should be placed in a cunning way because of different location causes different result. So, the better choice is to place them as much as possible far away from each other. The next step is to take each point belonging to a given data set and associate it to the nearest centroid. When no point is pending, the first step is completed and an early group age is done. At this point we need to re-calculate k new centroids as bary centers of the clusters resulting from the previous step. After we have these k new centroids, a new binding has to be done between the same data set points and the nearest new centroid. A loop has been generated. As a result of this loop we may notice that the k centroids change their location step by step until no more changes are done. In other words centroids do not move any more. Disadvantage of this algorithm is that the resulting clusters depend on the initial assignments. But it does not ensure that the solution given is not a local minimum of variance. Several misclassified data points after segmentation of brain image. The K means algorithm is given below

Step1: Choose K Initial Centers Z(k)1, Z(k)2, . . ., Z(k)k—They are arbitrary

Step2: At the Kth iterative Step, distribute the sample {X} among the K Cluster domain using the relation

\[ X \in S_j(k) \text{ if } \| X - z_j(k) \| < \| X - z_i(k) \| \]  

Where sj(k)-the set of samples whose cluster center is zj(k)

Step3: from the result of step 2, calculate the new clusters zj(k+1),j=1,2, . . .,k, where k2(k+1)=1/nj \sum x X \in S_j(k) where nj number of samples in s_j(k), cluster centers are sequentially updated.

Step4: if zj(k+1)= zj(k) , the algorithm has converged and procedure is terminated otherwise go to step 2.

3. PROPOSED METHOD

3.1. Fuzzy Logic

Fuzzy set theory provides a host of attractive aggregation connectives for integrating membership values representing uncertain information. These connectives can be categorized into the following three classes union, intersection and compensation connectives. The membership function of a fuzzy set in a functional form, typically a bell-shaped function, triangle-shaped function, trapezoid-shaped function, etc.

When fuzzy systems are applied to appropriate problems, particularly the type of problems described previously, their typical characteristics are faster and smoother response than with conventional systems. This translates to to efficient and more comfortable operations for such tasks as controlling temperature, cruising speed, for example. Furthermore, this will save energy, reduce maintenance costs, and prolong machine life. In fuzzy systems, describing the control rules is usually simpler and and easier, often requiring fewer rules, and thus the systems execute faster than conventional systems. Fuzzy systems often achieve tractability, robustness, and overall low cost.

The procedure for obtaining the fuzzy output of such a knowledge base can be formulated as 1. The firing level of the i-th rule is determined by

\[ A_i(x(t)) \times B_i(y(t)) \]

2. The output of of the i-th rule is calculated by

\[ C_i(w) := A_i(x(t)) \times B_i(y(t)) \rightarrow C_i(w) \]

for all w \(\in\) W.

3. The overall system output, C, is obtained from the individual rule Outputs C,w by

\[ C(w) = \sum C_i(w) \]

for all w \(\in\) W.

The methodology proposed in this paper is as explained in Fig:

Here, in this paper, basically, the clustering of abnormal brain MR images is done using fuzzy logic which is the proposed method. From the abnormal brain MR images the first order and the second order features were extracted. First Order Features include mean, variance, skewness, Kurtosis, entropy and energy while the second order features include angular second momentum, entropy, contrast, cluster shade, cluster prominence, inertia, and local homogeneity. The features were extracted and using them a feature vector was formed. Then the selected features are segmented using Fuzzy logic. Then, a comparative study is made using K-means, neural network and Fuzzy logic.

4. Result and Conclusion:

The various clustering methods are analyzed. These methods are used to perform tissue classification in MRI. The experimental results are shown in figure 4.1. The major disadvantage of K means algorithm had several misclassified data points after segmentation of brain image.
The following table shows the misclassification rate performed by K-means and Fuzzy Logic methods.

<table>
<thead>
<tr>
<th>Method</th>
<th>MR White</th>
<th>MR Gray</th>
<th>MR CSF</th>
</tr>
</thead>
<tbody>
<tr>
<td>K-Means</td>
<td>30</td>
<td>35</td>
<td>99</td>
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</tbody>
</table>

**Table 1: Misclassification rate**

**References**