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A New Fuzzy Approach for Brain Tumor Detection and Segmentation Based on Discrete Wavelet Transform and Neural Network

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Abstract:

Automatic segmentation in MR brain images is important for quantitative analysis in large-scale studies with images acquired at all ages. Segmenting brain tumors is a very difficult task. In the first place, there are large class of tumor types, which have a variety of shapes and sizes. Appearance of brain tumors at different locations in the brain with different image intensities is another factor that makes difficult the brain tumor detection and segmentation. This paper presents a method for the automatic segmentation of MR brain images into a number of tissue classes by using Artificial Neural Network. This ensures that the method obtains accurate segmentation details as well as discrete wavelet transform. The method is not dependent on explicit features, but learns to recognize the information that is important for the classification based on training data. The method requires a single anatomical MR image only. Brain input image are taken and preprocessed by using Weiner filter. FCM segmentation is also used in this study for accurate brain segmentation. Neural Network classifier is classifying the brain tumor characterizations.

Keywords: *Brain tumor, Wavelet Transform, FCM Segmentation, Classification, Neural Network*

1. Introduction

Tumor is an unwanted growth of tissues in any part of the body. Tumors are of various classifications and they have different Characteristics and different treatment where the brain tumor is most dangerous compared with the other tumors. In this paper , the system detects the brain tumor and the tumor has been segmented accurately and it will be classified by its features. Automatic segmentation in MR brain images is important for quantitative analysis in large-scale studies with images acquired at all ages. Segmenting brain tumors is a very difficult task. Appearance of brain tumors at different locations in the brain with different image intensities is another factor that makes difficult automated brain tumor detection and segmentation. This paper presents a method for the automatic segmentation of MR brain images into a number of tissue classes by using Artificial Neural Network. To ensure that the method obtains accurate segmentation details as well as discrete wavelet transform.

2. Literature review

In the previous projects the DCT is used. DCT processing time is very slow and at the same time it may cause more complexity. Due to the difficulty scaling will be performed as an additional effort. Also DCT function cannot be adapted to the source data and it cannot be suitable for the binary image.

3. Proposed System

The Proposed system uses DWT (Discrete Wavelet Transform) in the decomposition level for feature extraction. The DWT subdivide the CT image into various sub bands and the segmentation process is done by using Fuzzy Local Informative cluster means algorithm to segment the tumor regions. The Neural network is used for the Classification. The proposed system used Back Propagation Neural network classifier where the tumor is classified as benign or malignant.

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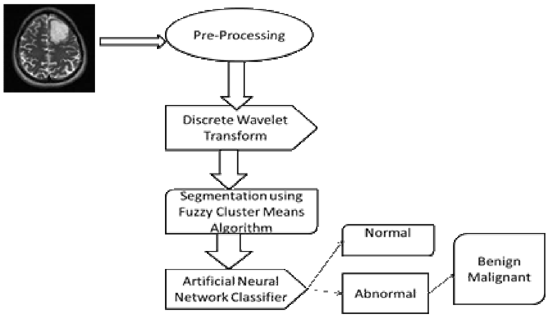

Fig.1Flow diagram of the system

3.1 Preprocessing

Image pre-processing can be used for getting a clear image. Filtering operations enable particular region and make easier and faster the evaluation process. Since theDigitalImaging and Communications in Medicine (DICOM) images with noise uses the reconstruction method to enhance resolution denoising the original images is necessary. Preprocessing of an image refers to the procedure of enhancing the quality and interpretability of the input lung image by reducing the noise and unwanted artifacts. Various types of selective enhancement filters are used to enhance blob like structures and to suppress vessel like structures by recommended a selective enhancement filter to enhance dot like objects and to repress lung vessels. In lung CT scans, preprocessing removes the artifacts and enhancement improves the visibility of pulmonary nodules. Type of filter used in preprocessing and enhancement phase is Weiner filter.

3.2 Weiner filter

The goal of the Wiener filter is to calculate statistical values of an unknown signal using a related signal as an input and filtering that known signal to produce the expected output. For example, the known signal might consist of an unknown signal of interest that has been corrupted by additive noise. The Wiener filter will be used to filter or remove the noise from the corrupted image. The Wiener filter is based on a statistical approach, and that will be depends on mean, average and the variance values. An input signal $w[n]$ is convolved with the Wiener filter $g[n]$ and the result is compared to a reference signal $s[n]$ to obtain the filtering error $e[n]$.

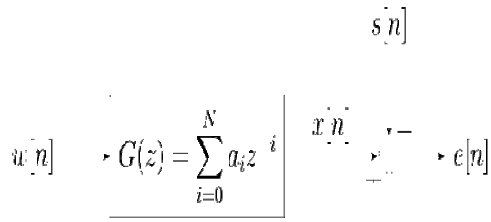

Fig.2Block diagram of the FIR Wiener filter for discrete series.

3.3 Discrete Wavelet Transform

In numerical analysis and functional analysis, a discrete wavelet transform (DWT) is any transform for which the wavelets are discretely sampled. As with other wavelet transforms, the key advantage it has over Fourier transforms is temporal resolution which can capture both frequency and location information (location in time).The discrete wavelet transform (DWT) is an implementation of the wavelet transform using a discrete set of the wavelet scales and translations obeying some defined rules. In other words, this transform decomposes the signal into mutually orthogonal set of wavelets, which is the main difference from the continuous wavelet transform (CWT), or its implementation for the discrete time series sometimes called discrete-time continuous wavelet transform (DT-CWT). [4] proposed a system in which OWT extracts wavelet features which give a good separation of different patterns. Moreover the proposed algorithm uses morphological operators for effective segmentation. From the qualitative and quantitative results, it is concluded that our proposed method has improved segmentation quality and it is reliable, fast and can be used with reduced computational complexity than direct applications of Histogram Clustering. The main advantage of this method is the use of single parameter and also very faster. While comparing with five color spaces, segmentation scheme produces results noticeably better in RGB color space compared to all other color spaces.

The wavelet can be constructed from a scaling function which describes its scaling properties. The

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restriction that the scaling functions must be orthogonal to its discrete translations implies some mathematical conditions on them which are mentioned everywhere, e.g. the dilation equation,

$$\phi(x) = \sum_{k=-\infty}^{\infty} a_k \phi(Sx - k)$$

In the following figure, some wavelet scaling functions and wavelets are plotted. The most known family of orthonormal wavelets is the family of Daubechies. Her wavelets are usually denominated by the number of nonzero coefficients ak, so we usually talk about Daubechies 4, Daubechies 6, etc. wavelets.

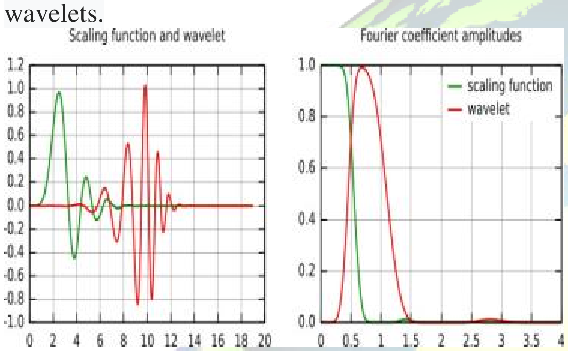

Fig.3 Daubechies 20 scaling function and wavelet (left) and their frequency content (right).

3.4FCM Segmentation

Fuzzy clustering also referred to as soft clustering is a form of clustering in which each data point can belong to more than one cluster.Cluster analysis involves assigning data points to clusters (also called buckets, bins, or classes), or homogeneous classes, such that items in the same class or cluster are as similar as possible, while items belonging to different classes are as dissimilar as possible. Clusters are identified via similarity measures. These similarity measures include distance, connectivity, and intensity. Different network, it is propagated forward through the network, layer by layer, until it reaches the output layer. The output of the network is then compared to the particular output, using a loss function, and an error value is calculated for each of the neurons in the output layer. The error values are then propagated backwards. In which the error values will feed backward to the layers and with respect to the loss

similarity measures may be chosen based on the data or the application.

In the field of bioinformatics, clustering is used for a number of applications. One use is as a pattern recognition technique to analyze gene expression data from microarrays or other technology. In this case, genes with similar expression patterns are grouped into the same cluster, and different clusters display distinct, well-separated patterns of expression. Use of clustering can provide insight into gene function and regulation. Because fuzzy clustering allows genes to belong to more than one cluster, it allows for the identification of genes that are conditionally co-regulated or co-expressed. For example, one gene may be acted on by more than one Transcription factor, and one gene may encode a protein that has more than one function. Thus, fuzzy clustering is more appropriate than hard clustering. Fuzzy c-means has been a very important tool for image processing in clustering objects in an image. In the 70's, mathematicians introduced the spatial term into the FCM algorithm to improve the accuracy of clustering under noise. Alternatively, A fuzzy logic model can be described on fuzzy sets that are defined on three components of the HSL color space HSL and HSV; The membership functions aim to describe colors follow the human intuition of color identification.

3.5Classification using Back Propagation Network

The classification purpose is solved using the neural network classifier. In which the type of the classifier is back propagation. Where the back propagation classifier will be performed by the concept of artificial neural networks and used with an optimization method like gradient descent. Thus the classifier repeats a two phase cycle. They are propagation and weight update. When an input vector is presented to the

function the error values will be calculated and minimized.

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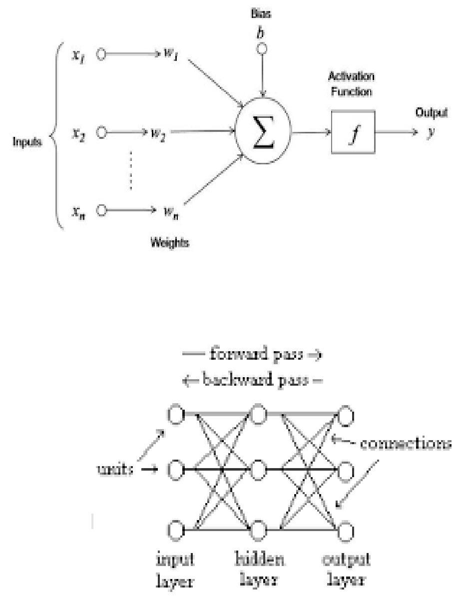

Fig.4 Back Propagation Network

4. Results and discussion

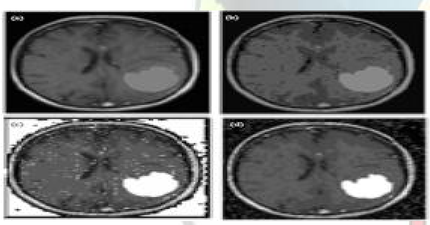

Fig.5 Segmentation results of the FCM

(a) Original abnormal real MRI brain image obtain from IBSR

The segmented results shows that Discrete wavelet Transform with FCM Segmentation provides satisfactory results and the Back propagation neural network classify the segmented tumor into Benign or Malignant.

5. Conclusion

Nowadays the tumor identification and segmentation is more sensitive. Even though the tumor is found, the stages of the tumor identification are very difficult. By this study the tumor regions are identified and the classification is made accurate. Appearance of brain tumors at different locations are also identified and classified with automated brain tumor detection and classification.

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