Research Article

MEDICAL DECISION SUPPORT SYSTEM OF COMMON CAROTID ARTERY USING IMAGE MINING AND DUAL SNAKE SEGMENTATION PROCEDURE

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ABSTRACT

The dual snake segmentation procedure and pruned association rule with improved Apriori algorithm has been used in this paper to develop a common carotid image classification. The low level features extracted from the ultrasound common carotid artery images and high level knowledge from specialists were used to enhance the accuracy in decision process. The experimental results showed 97% specificity, 98% sensitivity and 99% accuracy. The proposed algorithm was required to serve the humans for efficient classification with multiple key features per images.

Keywords: Dual snake segmentation, Image mining, Association rule mining, Shape prior, Apriori algorithm, intima-media thickness

INTRODUCTION

Nowadays billions of medical images have been generated routinely in medical care centers. Usually all these data have been analyzed by the manual method. Even an experienced person finds a difficulty in analyzing the images, so that the computer technologies has been used for this method.

Medical care professionals have faced a challenging task in the decision making with the features extracted from the vast database. The medical image segmentation is a challenging problem. Its results are needed for the estimation of the boundary of an object, classification of tissue abnormalities, shape analysis, contour detection and texture segmentation.

Image mining deals with the implicit knowledge extraction, image data relationships and other patterns which are not explicitly stored in the images. The identification of similar objects from the different images is the essential component in image mining concepts. The proposed approach, multiple keywords has been obtained when a test image is processed and also the most relevant features have been selected.^{1,2}

MATERIALS AND METHODS

There are various methods used to identify the similarity between the images which has been used for the classification in

this method. The following figure 1 explains the overview of the proposed method.

Preprocessing

Before processing an image into an application, the quality of an image has been improved by using the pre-processing techniques^{3,4}. To get a new brightness value in the output image, it uses a pixel value of a neighborhood values an input image. These methods are also called as filtration and resolution enhancement. The medical image quality mainly depends on the two parameters such as Noise and Resolution.

The filters are used to eliminate unrelated neighborhoods from the weighted average used to denoise each image pixel. The filters are based on average gray values as well as gradients, pre-classifying neighborhoods and thereby reducing the quadratic complexity to a linear one and reducing the influence of less-related areas in the denoising of a given pixel. The efforts include the investigation of image characteristics that provide good context classifications for image denoising. Anisotropic diffusion is an efficient nonlinear technique for simultaneously performing contrast enhancement and noise reduction. Speckles are removed and inclusions show clearly. In Anisotropic diffusion method, we don't need know the noise pattern or power spectrum, this is the advantage over Wiener filter.

The Figure 1 shows the results of original image and noise removed using wiener filter and anisotropic diffusion method.

Figure 1: Overview of the Proposed System

Figure 1a. Original Image, b. Wiener Filtered image, c. Anisotropic diffusion filtered image

Shape Prior

The statistical shape information in image has many segmentation problems. The many training samples are needed in order to obtain a satisfactory shape prior for a particular class, when the intra-class variability of the object shapes is high⁵. To deal this problem, the shape prior has an elegant variational formulation that allows local adaptations of the parameters associated with a trained shape prior. It enables us to obtain accurate segmentation results with a limited amount of training shapes.

To deal with this problem, other variation approaches have been proposed where the shape prior is included as a weighted term in the energy functional that is to be minimized, thus allowing solutions that deviate from the trained shape distribution. The prior method is thereby given as the Gaussian shape distribution by the mean shape of the Gaussian distribution, a mean shape combined with spatially varying shape variances, or a nonlinear shape statistic obtained by Kernel density estimation. All of these approaches have in common that they still make use of a statistical model which has a global influence on the shape evolution. Hence, in those image regions where the variations of a specific shape class are not accurately represented through the model, the segmentation result is only determined through image features and not guided by the trained shape distribution. Rousson and Paragios tried to address this problem by modeling the shape variation as independent Gaussian distributions in each pixel. However, this has the drawback that no spatial dependencies of neighboring pixels are represented through their model.

Color and Texture-Based Image Segmentation

Retrieving images from large and varied collections using image content as a key is a challenging and important problem^{6,7}. A new image representation is improved which provides a transformation from the raw pixel data to a small set of image regions which are coherent in color and texture space. This so-called “blobworld” representation is based on segmentation using the Expectation-Maximization algorithm on combined color and texture features.

The Expectation-Maximization (EM) algorithm is used in the dual snake model to perform automatic segmentation based on image features. It uses various functions these functions are iteratively models the joint distribution of color and texture with a mixture of Gaussians; the resulting pixel cluster memberships provide a segmentation of the image. The input image is segmented into regions, a description of each region's texture, spatial characteristics and color is produced. The user can access the regions directly by the querying method, in order to see the segmentation of the query image and specify which aspects of the image are important to the query. The user sees the blobworld representation of the returned images when the query results are returned; this assists greatly in refining the query.

IMPROVED APRIORI ALGORITHM FOR ASSOCIATION RULES

There are several mining algorithms that are used for association rules. The most popular algorithm is Apriori that is used to extract frequent itemsets from large database and getting the association rule for discovering the knowledge. Based on this algorithm an improved Apriori was proposed by reducing that wasted time depending on scanning only some transactions.

Association Rule Mining

Association Mining is one of the most significant data mining's functionalities. It is employed to detect the similarity between the images in a quick timely manner^{8,9}. It was the procedure of mining association rules in database of transactions between items. The advantages of these rules are engendering results which can perform substratum for decision making, prognostication and detecting unknown relationships. The discovery of association rules is divided into two phases. The first phase is segmentation of common carotid artery ultrasound image. It consist of speckle noise removal and quality enhancement. The dual active contour segmentation method is used to segment the interesting are of the image and extract the pattern from the image. Second phase is image mining to find frequent image patterns present in common carotid artery images using association rule.

Dual Snake Model

The automated IMT measurement system was developed for the common carotid artery ultrasound images using dual snake model^{1,2}. The snakes examined simultaneously and it maintains the collapsing and diverging. The dual snake model was totally automatic and the single snake model was totally semi-automatic.

This method was based on the pixel classification. It was able to detect the LI and MA values without a user interaction and that was robust to image noise. This interface creates the snake initialization. This method produces the automatic segmentation and this can be done by using the dual snake model with the axial spatial resolution to improve the quality of the images. This technique was used for automatic initialization and it does not require any parameter values. This overcomes the two most important problems related to snake implementation.

Dual methods can avoid local minima through the comparison between the two contours energy and positions but they were at least two times more expensive than single approaches. Therefore, the ultrasound images seems to be the main target for the application of dual snakes because the difficulties inherent to the segmentation of these images force the application of a more robust approach against local minima. Figure 2 shows the dual active contour snake model with different iterations.

Figure 2 (a) Initial Snake Initialization, (b) 100 Iterations, (c) 300 Iterations

Apriori Algorithm

Apriori algorithm is one of the classic algorithm used in data mining to find association rule. It an influential algorithm for mining frequent itemsets for Boolean association rules. The algorithm creates several searches in the database to find frequent itemsets. Each itemset must be greater than or equal to the minimum support threshold to be frequent. In the first iteration of this algorithm, the database was perused to find frequency of 1-itemsets that contains only one item by counting each item in the database. If an itemset is not frequent, some large subset of it is also non-frequent. Based on this condition, prune search space in database. Iteratively find frequent itemsets with cardinality from 1 to k (k-itemset). Use the frequent itemsets to generate association rules.

The Improved Apriori

In the process of Apriori, the following definitions are needed: Definition 1: Suppose $T = \{T_1, T_2, \dots, T_m\}$, ($m \geq 1$) is a set of transactions, $T_i = \{I_1, I_2, \dots, I_n\}$, ($n \geq 1$) is the set of items, and k-itemset = $\{i_1, i_2, \dots, i_k\}$, ($k \geq 1$) is also the set of k items, and k-itemset $\subseteq I$.

Definition 2: Suppose σ (itemset), is the support count of item set or the frequency of occurrence of an itemset in transactions.

Definition 3: Suppose A_k is the candidate itemset of size k, and B_k is the frequent itemset of size k.

The improvement of algorithm can be described as follows:

Step 1: $B_1 = \text{find_frequent_1_itemsets}(T)$;

Step 2: For ($k = 2$; $B_{k-1} \neq \emptyset$; $k++$) {

Step 3: $A_k = \text{candidates generated from } B_{k-1}$;

Step 4: $x = \text{Get_item_min_sup}(A_k, B_1)$;

Step 5: $T_{gt} = \text{get_Transaction_ID}(x)$;

Step 6: For each transaction t in T_{gt} Do

Step 7: Increment the count of all items in C_k that are found in T_{gt} ;

Step 8: $B_k = \text{items in } A_k \geq \text{min_support}$;

Step 9: End;

RESULTS AND DISCUSSION

In this paper, decision making has been considered by the physicians using pre diagnosed databases. When the dual snake segmentation method has been done, the wiener filter was used for preprocessing the ultrasound image by the noise reduction in an image. Before performing higher level processing, the preprocessed ultrasound image results have been classified in the following table 1.

Table 1: Sample images of the dataset and their suggestions

Images
Category	Normal Subject	Beginning Stage	Malignant Subject
Symptoms	Hypertension	Diabetes	Stroke
Suggestions	No Need Treatment	Treatment Needed	Immediately Treatment Needed

CONCLUSION

The dual snake segmentation procedure and association rule mining with improved Apriori algorithm has been developed and the performance was evaluated for an image. Experimental results showed 97% specificity, 98% sensitivity and 99% accuracy. The proposed algorithm was expected to assist the humans for efficient classification with multiple key features per images.

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