

Content Based Medical Image Retrieval Using Fuzzy Gaussian Mixture Model with Relevance Feedback

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Abstract— Content Based Medical image retrieval can assist physicians in binding information supporting their diagnosis. Systems that allow to search for medical images need to provide tool for quick and easy navigation as the time for information search is very easy to find the images. Relevance feedback is a powerful tool for information retrieval. Content-based image retrieval with relevance feedback schemes based on Method Fuzzy Logic Gaussian Mixture model didn't require much time when compared to GMM. Also FLGMM gives efficient clustering. It gives best result for overlapped data sets. It is used to retrieve the medical image effectively and efficiently. Results show the potential of relevance feedback techniques in medical image retrieval and the superiority of the proposed algorithm over commonly used approaches. This technique users to retrieve a similar query images from a database.

Keywords— Content Based Image Retrieval, shape and texture extraction, fuzzy logic Gaussian mixture model, similarity measurement, relevance feedback, SVM classification.

1. Introduction

Content Based Image Retrieval uses the visually content of an image such as color, shape, texture, and spatial layout to represent an index of an image. In addition to their development, efforts are also being made to evaluate the development and performance of image retrieval systems. There are different ways to retrieve the images in CBIR. A well known technique try to improve search results by user interaction is relevance feedback. Relevance Feedback allows the user to search results returned in a previous search step as relevant or irrelevant to the initial query images.

In this paper, we propose to apply Support Vector Machine to two classes (positive and negative examples) learning. This results are further used to help automatically decide preference weights for the positive images.

A query image is De-noised using a non-linear filtering technique which is useful to find the edge of an image efficiently. An image can be corrupted during the transmission of image from one place to another place due to the moisture present in the environment. A De-noised image can effectively extract the image feature such as shape and texture.

Here the proposed methodology uses Fuzzy Gaussian mixture model (FGMM) for image modeling. normally Gaussian mixture modeling is a time consuming where as Fuzzy Gaussian mixture modeling didn't require much time when compared to GMM. Also FGMM gives efficient clustering. It gives best result for overlapped data sets. Hence by using fuzzy Gaussian mixture modeling in the proposed system, visually pleasing image can be obtained in less time.

Image contrast enhancement using Fuzzy Gaussian modeling is an adaptive image equalization algorithm that is effective in terms of improving the visual quality of a different types of input images. Images with low contrast are automatically improved in terms of an increase in the dynamic range. Images with sufficiently high contrast are also improved but not as much. Firstly the pixel values of an input image are modeled using the Fuzzy Gaussian mixture model (FGMM). The similarity between two images is calculated by sum of the distances of individual low-level features with fixed weights.

The learning results are utilized to automatically calculate the each image preference weights. In this way we have to make the retrieval procedure simpler images easily retrieved.

2. Related Work

[1] J. Mukherjee and S. Mitra, "Enhancement of color images by scaling the DCT coefficients,".

This paper presents a new technique for color

enhancement in the compressed domain. The proposed technique is simple but more effective than some of the existing techniques reported earlier. The novelty lies in this case in its treatment of the chromatic components, while previous techniques treated only the luminance component. The results of all previous techniques along with that of the proposed one are compared with respect to those obtained by applying a spatial domain color enhancement technique that appears to provide very good enhancement. The proposed technique, computationally more efficient than the spatial domain based method, is found to provide better enhancement compared to other compressed domain based approaches.

Advantages

- Simple and more effective.
- Provide better enhancement.

Disadvantages

Require appropriate parameter settings that might otherwise result in image degradations.

[2] Ji, Ze-xuan ; Xia, Yong ; Sun, Quan-Sen Sen; Chen, Qiang ; Xia, De-shen ; Feng, David Dagan “fuzzy Local Gaussian Mixture Model for Brain MR Image Segmentation”.

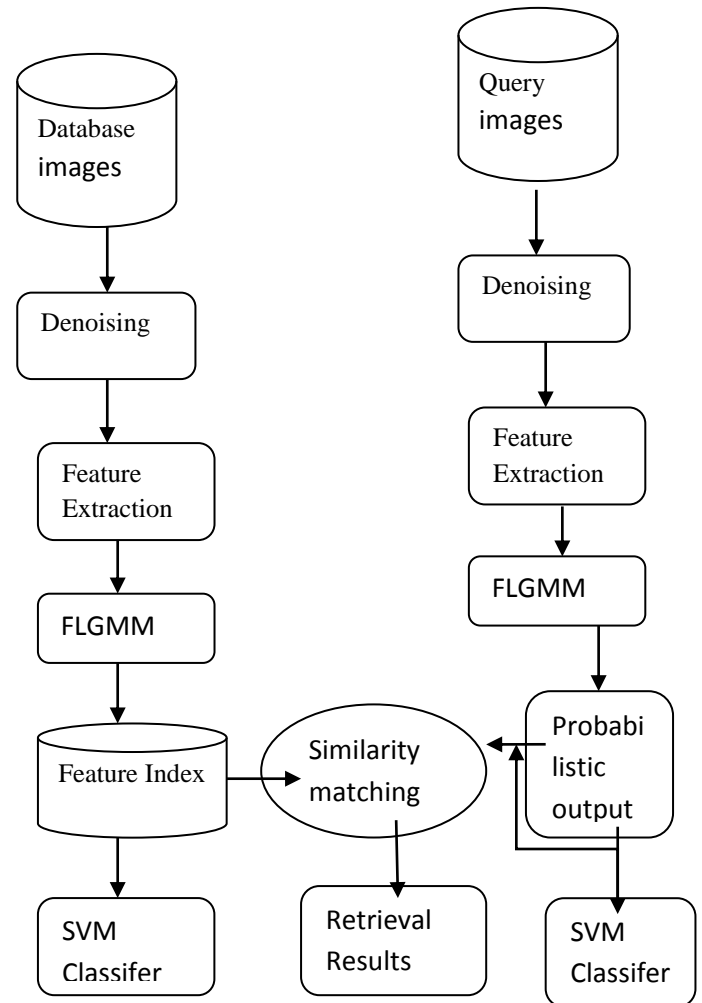
Accurate brain tissue segmentation from magnetic resonance (MR) images is an essential step in quantitative brain image analysis. However, due to the existence of noise and intensity in homogeneity in brain MR images, many segmentation algorithms suffer from limited accuracy.

In this paper, we assume that the local image data within each voxel's neighborhood satisfy the Gaussian mixture model (GMM), and thus propose the fuzzy local GMM (FLGMM) algorithm for automated brain MR image segmentation.

This algorithm estimates the segmentation result that maximizes the posterior probability by minimizing an objective energy function, in which a truncated Gaussian kernel function is used to impose the spatial constraint and fuzzy memberships are employed to balance the contribution of each GMM. We compared our algorithm to state-of-the-art segmentation approaches in both synthetic and clinical data. Our results show that the proposed algorithm can largely overcome the difficulties raised by noise, low contrast, and bias field, and substantially improve the accuracy of brain MR image segmentation.

3. System Architecture

Fig. 1 shows the scheme of image retrieval from a database using relevance feedback. In CBIR, each image that is stored in the database has its features extracted and compared to the features of the query image.



The purpose of this work was to improve the accuracy (precision) of a CBIR application by allowing the system to retrieve image similar to the source image.

3.1 De-Noising:

De-noising process can be done by using filtering technique. It is corrupted image to remove noise of an image which is mostly introduced due to external noise. Mainly focus on pre-processing the medical images is important since the noise issues changes image pixel value will be reduced.

In this Thesis, we use Adaptive median filter. It is a non-linear digital filtering technique, often used to remove external noise. Such noise reduction is a typical pre-processing step to improve the results for later processing. Median filter is better for medical image based upon MSE (Mean Square Error) and PSNR(Peak Signal Noise Ratio)value.

3.2 Feature Extraction:

The second step in the process is extracting image features to a distinguishable extent.

The features extracted are carefully chosen from the given input images and expected that the features set will be extract the relevant information from the input data in order to perform the determined task to using this reduced representation instead of the full size input images.

3.3 Similarity Matching:

This step involves matching the features to give a perfect result that is visually similar and retrieval process is being easy to navigate the relevant images and Content Based Image Retrieval use Euclidean distance to calculate similarity between a query image and images in a database..

4. Fuzzy Logic Gaussian Mixture Model Algorithm

Fuzzy Logic Gaussian mixture modeling in the proposed system, visually pleasing image can be obtained in less time. Image contrast enhancement using Fuzzy Gaussian modeling is an adaptive image equalization algorithm that is effective in terms of improving the visual quality of different types of input images.

Algorithm:

Input: $X \subset \mathbb{R}^p$

Choose: $1 < c < n$, $1 < m < \infty$, $\epsilon =$ tolerance, max iteration = N

Guess : V_0

Begin

$t \rightarrow 1$ tol \rightarrow high value

Repeat while ($t \leq N$ and $\text{tol} > \epsilon$)

Compute U_t with V_{t-1} using(1)

Compute V_t with U_t using..... (2)

$$\text{Compute } \text{tol} = \frac{\|V_t - V_{t-1}\|}{p \times c}$$

End Repeat

Output: V_t, U_t

5. Relevance Feedback

Relevance feedback is a technique that takes advantage human-computer interaction to refine high level queries represented by low level features. It is used in traditional document retrieval for automatically adjusting an existing query using information fed back from the user. In the application of image retrieval [6], the user selects relevant images from previous retrieved results and provides a preference weight for each relevant image. During the process of relevant feedback, the similarity between the query (relevant images) and those in the database are calculated.

6. SVM Classification

Support Vector Machines (SVM) is an approximate implementation of the structural risk minimization (SRM)

principle. It creates a classifier with minimized Vapnik-Chervonenkis (VC) dimension. SVM minimizes an upper bound on the generalization error rate. The SVM can provide a good generalization performance on pattern classification problems without incorporating problem domain knowledge.

Consider the problem of separating the set of training vectors belonging to two classes: where x_i is an input pattern, and y_i is the label, +1 denotes positive example, -1 denotes the negative example. If those two classes are linearly separable, the hyper plane that does the separation can be easily calculated a bias.

7. Results:

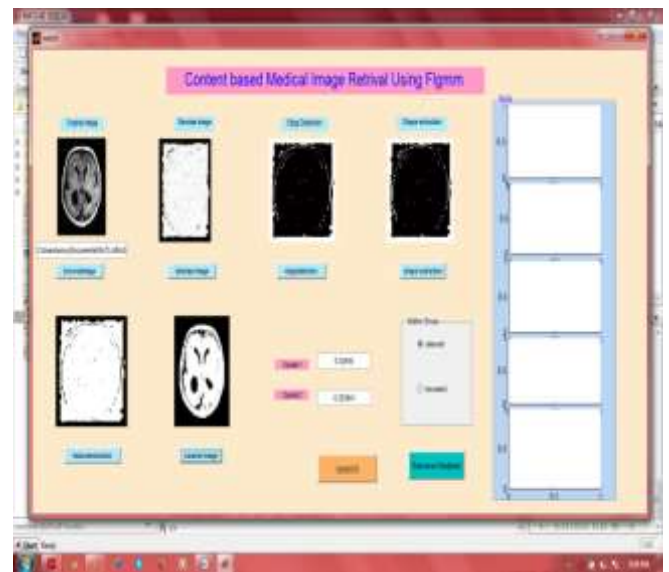


Fig 2: Denoising the query image in Fig 2.using filtering technique to remove noise in the image and extract the features of selected image.

After that extract the image features like edge detection, shape and texture extraction in the segmentation process we use canny edge detection to detect edge in the image and extract the image features.

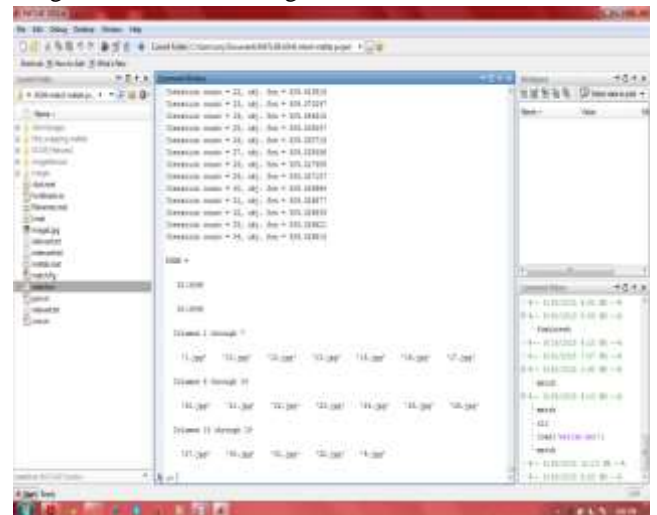


Fig 3: Fcm with Flgmm form the nearest clustering values compare with the clustered image and retrieved similar images from database.

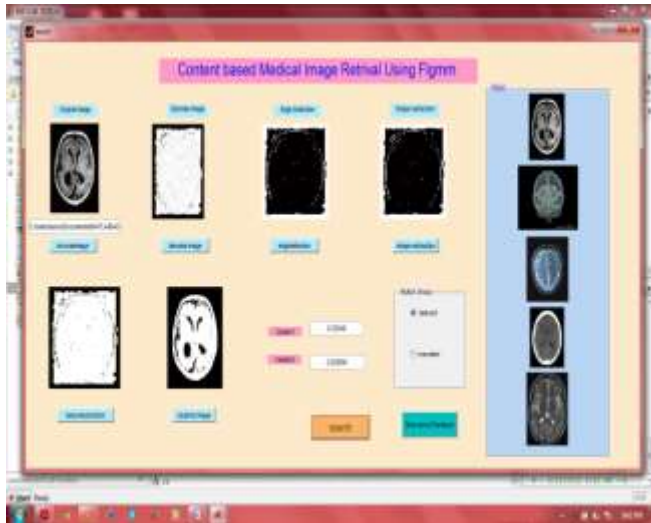


Fig 4: calculated the threshold values of an image that values compare with each and every image in the dataset and finally retrieved similar images from database and displayed top 5 images.



Fig 5: During the process of relevant feedback, the similarity between the query (relevant images) and those in the database are calculated.

Depending on whether the user manually provides the feedback to the system (e.g. by marking results) or the system obtains this information automatically.

8. Conclusion and Future work

This paper proposes the use of multimodal information when applying relevance feedback to medical image retrieval. An experiment is used to set up and simulate the relevance feedback of a user on a number of medicine (related topics from Image CLEF 2012). In general, all the techniques evaluated in this study improve the performance, which shows the added value of relevance feedback. Text based relevance feedback showed consistently good results. Visual based techniques showed competitive performance for small shortlist sizes, under performing in the rest of the cases.

The proposed multimodal approaches showed promising results slightly outperforming the text-based one but without statistical significance.

Future steps include integrating semantics into relevance feedback techniques to benefit of the structured knowledge of ontology's and experimenting on the fusion of text and visual information.

9. References:

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