Automated retrieval of radiological images in large medical image archives

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Motivations

Keywords:
• Content-Based Image Retrieval
• Medical Images (DICOM)
• Semantic Terms
• Relevance Feedback

Context: Diagnostic radiologists need to maintain high interpretation accuracy while maximizing efficiency with increasing volumes of images. They are now confronted with the challenge of efficiently interpreting cross-sectional studies that often contain thousands of images. Image interpretation is largely an unassisted process and there are significant variations in the interpretation of medical images by different radiologists. A promising approach to maintain interpretative accuracy in this “deluge” of data is to integrate computer-based assistance into the image interpretation process. An emerging technique is content-based image retrieval (CBIR) that could assist users in finding visually similar images within large image collections.

Purpose: Based on this notion, we developed a platform that enables the radiologist to explore medical image databases and to retrieve images similar to the one being interpreted. The similarity between images is computed by considering quantitative “image-based” features and semantic terms associated with the images. Once the retrieval results have been provided, the system will ask the radiologist for its feedback in order to refine the results in accordance to the radiologist’s expectations.

Images can be described using various features

“Image-based” features:
1. Lesion measurements
2. Shape, color indexes
3. Texture features (Gabor, LBP)

Semantic features:
1. Things radiologists say about images
2. Anatomy, regions of interest
3. Semantic terms (image annotations)

Integration of “Relevance Feedback” in LIRE

Workflow:
1. Given a query image, retrieve similar database images based on visual and semantic features
2. Based on the retrieved images, collect the radiologist’s opinion in order to refine the image retrieval results
3. Iterate the algorithm taking into account the radiologist’s feedback

Perspectives:
• Refine the search by proposing new terms to the radiologist
• Evaluate quantitatively the relevance of this approach in a clinical environment on a very large number of images
• Save in log files the radiologist’s feedback for a given query image

Experiments and Results

Data: We have applied this methodology on a dataset of 79 DICOM images (CT images of the liver) and we are able to look for similarities for a given image in all the dataset. Once the retrieval results have been obtained, it is possible to mark the retrieved images as relevant or irrelevant and iterate the algorithm with this feedback.

Experiments: We have evaluated different types of image features provided by LIRE such as histogram features or bag of visual words.

Preliminary results: The results obtained showed that our system is able to deal with DICOM images and is ready for further implementations of new Relevance Feedback strategies.

LIRE Library

The LIRE (Lucene Image REtrieval) Java library provides a simple way to retrieve database images based on their color and texture characteristics.

We have extended this library:
1. to manage DICOM images extracted from the Picture archiving and communication system (PACS)
2. to retrieve images based on various types of image features (“Image-based” and semantic features)
3. to allow the radiologist to provide his feedback (“Relevance Feedback”) in order to refine the retrieval results using positive (and/or negative) image examples

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