SUMMARY OF Ph.D. DISSERTATION

School Information & Computer Science	Student Identification Number	SURNAME, First name SUN Yongqing

Title

Research on Semantic-meaningful Content-based Image Retrieval Using Wavelet Transform

Abstract

Digital image libraries are becoming more widely used as more visual information is put in digital form as well as on-line. To improve human access, however, there must be an effective and precise method for users to search, browse, and interact with these collections and to do so in a timely manner. As a result, content-based image retrieval (CBIR) has been a fast growing research area recently. There are two major challenging problems in this research. The first one is *Feature Extraction*, where a set of features, called image signatures, is generated to accurately represent the content of each image in the database. The second task is *Similarity Measurement*, where a distance between the query image and each image in the database using their signatures is computed so that the top best images can be retrieved.

This dissertation makes contributions to *Feature Extraction* and *Similarity Measurement* in the field of CBIR for semantic-meaningful image retrieval. This research is based on wavelet transform because its decomposition property is very similar to human visual system. Both feature extraction and similarity measurement in wavelet domain have been proven to show good performance in content-based image retrieval.

First, a new low-level image feature is proposed for image indexing, which outperforms the previous low-level features used in CBIR systems by emphasizing the local feature of image with the combination of salient points in wavelet domain. Salient points representing sharp parts of images such as edges were detected and combined into the Low-Low (LL) frequency subband. As a result, the features extracted from the modified LL subband both preserve the necessary image content and yet have enough discriminating power for image retrieval.

Second, a region-based image retrieval scheme is proposed, in which image segmentation is carried out very fast in low-resolution frequency subbands in wavelet domain and hierarchical image features are extracted finely by using the information of all frequency subbands. This system makes a good tradeoff between efficiency and effectiveness of image retrieval.

To further improve retrieval results by dynamic querying, the problem that how relevance feedback can be used to improve the performance of region-based image retrieval is addressed. Employing our hierarchical region feature vector, a progressive step-wise indexing mechanism is proposed, which includes two learning methods (in the form of labeled examples): *learning the weights for feature vector and learning the importance of regions*.

The experimental results demonstrate that our image retrieval algorithms significantly improve retrieval accuracy, computational cost, and storage space in a general image database, and show good retrieval performance in retrieval accuracy, robustness and effectiveness.