## THESIS INFORMATION

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| Title: | Content-based Image Retrieval Using Wavelet-based Feature Extraction |
| Major: | Electronics Engineering |
| Code: | 62 52 70 01 |
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### Abstract

Although researchers have made great efforts in recent years on the study of image retrieval systems, but no efficient algorithms are accepted widely that can extract image features like human visions (can "understand" images as human). This is always the challenge to all researchers.

Compared to the researches of Content-based Image Retrieval (CBIR) systems published before 2000, the difference can be seen in the recent decade of studies are the increasing of many image features. The improvements are based on basic image features (such as color histogram, texture, shape …), to develop new image features based on the transformation such as the wavelets, the contourlets… and combine many mathematical operators to design CBIR systems.

In this thesis, the choice of using wavelet the transform to extract image features and design CBIR systems has achieved certain results. The proposed algorithms can be integrated into the image search engines.


### Research objectives

Research and application of the wavelet transform to design CBIR systems such as wavelet-based feature extractors of images and designing suitable CBIR algorithms and expanded applications of proposed features.

**Contents**

The thesis studies contents as follows:

1. Research matches of the wavelet-based features of images and other popular image features such as color histogram, texture…
2. Research about the design of image features based on the wavelet transform which are published recently.
3. Research combine the wavelet transform and other mathematical tools (for example: the cooccurrence matrix, the Local Binary Pattern operator…) to describe image features.
4. Designing of CBIR systems using proposed image features.
5. Evaluating, comments, conclusions based on the practical experiments.
6. Development of extended applications of proposed features

**Main results:**

The thesis archived main results as follows:

1. To propose the algorithm of global features matching (called the *matching* algorithm) for image retrieval using three image features (including two wavelet-based features and the other feature): the color histogram, the Gabor wavelet and the contourlet (these features have been published in the relevant works). Experiments demonstrate the good accuracy of this algorithm.
2. To propose the new descriptor for the feature extraction of images (called the *contourlet cooccurrence* descriptor) based on combination of the contourlet transform and the Grey Level Cooccurrence Matrix (GLCM). Experimental results demonstrate that the proposed algorithm for image retrieval using this descriptor (called the *CC* algorithm) shows a slightly improvement in the retrieval effectiveness.
3. To propose the new descriptor for the feature extraction of images (called the *phase-based LBP* descriptor) based on combination of phase information of coefficients of steerable pyramid decomposition and the Local Binary Pattern operator (LBP). Experimental results of the proposed algorithm for image

retrieval using this descriptor (called the *pbLBP* algorithm) show the interest comparing with other algorithms.

4. To propose a new detector for interest point detector of images based on the Non-Subsampled Contourlet Transform (NSCT) and the Harris corner detector (called the *contourlet Harris* detector). The algorithm how to extract the image features using the contourlet Harris detector is applied for image retrieval (called the *CH* algorithm). Results demonstrate that the proposed method shows a quite improvement in the retrieval effectiveness.
5. To propose some methods are used to evaluate retrieval effectiveness of selected CBIR algorithms for experimental surveying. These methods support a sufficient survey about the precision, recall, relevance, rank, and the best queries from all queries in a class of database of a CBIR algorithm.
6. To perform many different experiments such as: pre-evaluation of algorithm accuracy, investigation of variable parameters in algorithms, changes of the similarity measurements and their impacts to retrieval effectiveness, surveying of performance evaluation of proposed algorithms comparing with other examined algorithms that were published by other researchers to assess the overall of retrieval effectiveness of proposed algorithms in the thesis.
7. Surveying of the application of the denseSBP feature that is developed by the pbLBP feature for image classification. The experimental results show comparable classification accuracies of proposal methods with the state-of-the-art methods.

**Scientific and practical contribution of the thesis**

- *Scientific contribution*: to propose three new feature extractors of images and four algorithms for image retrieval. All algorithms have a common characteristic is designed using the wavelet-based features and they show better even surpassed results in some cases of performance measures. The experimental results are valuable for references, comparing with other algorithms of image retrieval. The proposed feature (pbLBP) can be developed and applied for image classification with high classification accuracies.

- *Practical contribution*: the software of proposed algorithms and implementation of experimental studies are coded using Matlab, interface designing is kindly and easy using, opening, and easy integration of more new image features and similarity measures… could help researchers design, rapid assessment of retrieval effectiveness of the proposed algorithm which can be integrated and applied to available image search engines.

**Future developments**

Suggestions for the continued studies of the thesis as follow:

1. Continued research designed algorithms of features matching using other wavelet-based features for image retrieval.
2. Research select suitable properties of the wavelet transform (coefficients, subbands, orientations…), and combine appropriated mathematical tools to design image features that can describe optimization of considerable visuals of images.
3. Development of new wavelet-based transforms and design image features.
4. Research of preliminary assessment solutions or proposed algorithms will have good query results correspond to classifications of images (for example, research build sets of parameters for training to select appropriate algorithms for each image class in a database).

In summary, the thesis has introduced and proposed new wavelet-based feature extractors of images. They are used to extract image features for designing of CBIR algorithms. Moreover, these descriptors also can use for applications of image analysis with many different purposes. The proposed algorithms contribute to enrich algorithms for image retrieval. In particular, the potential research of the thesis is still more promising for development in the future.

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