Chapter 2
Approach of Using Texture and Shape for Image Retrieval

Gang Zhang
Northeastern University, China & Shenyang University of Technology, China

Zongmin Ma
Northeastern University, China

Li Yan
Northeastern University, China

ABSTRACT

Feature integration is one of important research contents in content-based image retrieval. Single feature extraction and description is foundation of the feature integration. Features from a single feature extraction approach are a single feature or composite features, whether integration features are more discriminative than them or not. An approach of integrating shape and texture features was presented and used to study these problems. Gabor wavelet transform with minimum information redundancy was used to extract texture features, which would be used for feature analyses. Fourier descriptor approach with brightness was used to extract shape features. Then both features were integrated in parallel by weights. Comparisons were carried out among the integration features, the texture features, and the shape features, so that discrimination of the integration features can be testified.

INTRODUCTION

Ever since the 1970s, the further development has been made in content-based image retrieval. The basic idea of content-based image retrieval is to extract and describe the discriminative features from an image, and use these features to index the image. Then similarity measure is used for indexes to locate the same or similar images in an image database. Feature extraction and description is one of important components in content-based image retrieval, and is used to extract a set of discriminative features from an image to describe the content in the image. How these features are described and organized effectively is emphasized to describe the content in the image better. Furthermore, it will affect similarity measure directly. Currently, low level visual features are usual, and

DOI: 10.4018/978-1-61350-126-9.ch002

can be divided into texture features, shape features, color features, etc. According to low level visual features, the feature extraction and description approaches can be divided into texture feature extraction and description approaches (Haralick *et al*, 1973; Won *et al*, 2002; Wu *et al*, 2000; Jhanwar *et al*, 2004; Shi *et al*, 2005), shape feature extraction and description approaches (Zhang & Lu, 2002; Mokhtarian & Bober, 2003; Teague, 1980; Xin *et al*, 2007), color feature extraction and description approaches (Swain *et al*, 1991), etc. As being carried out for single feature, these approaches are called single feature extraction and description approach.

Texture and shape features are the commonly used low level visual features. Texture can describe the details of object surface, and shape can describe the contour of object effectively. That texture and shape are used together can describe the features of the image more effectively. Usually, texture feature extraction and description approaches can be divided into structure approaches, statistic approaches, model approaches, and transform approaches (Materka & Strzelecki, 1998). Gabor wavelet transform is one of commonly used transform approaches. The discovery of orientation-selective cells in the primary visual cortex of monkeys almost 40 years ago and the fact that most of the neurons in this part of the brain are of this type triggered a wave of research activity aimed at a more precise, quantitative description of the functional behavior of such cells (Hubel & Wiesel, 1974). Gabor wavelet transform is a computational model which simulates the principle of operation of these cells. Its basic idea is to use Gabor function as mother wavelet to compute a set of wavelets where each wavelet captures energy of specific frequency and direction in a window. Then energy is used for texture features to index an image. Texture features which are invariant to direction and scale can be extracted and described by the invariance of Gabor function to rotation and of wavelet transform to scale. The wavelet function set from the transformation of mother wavelet forms a set of non-orthogonal basis in Gabor wavelet transform approach, which means that redundancy information are involved in computation of texture features in the feature extraction and description (Arivazhagan *et al*, 2006). To reduce the redundancy information, a set of orthogonal wavelet function basis is introduced into Gabor wavelet transform approach (Manjunath *et al*, 2000; Ro *et al*, 2001). The Gabor wavelet transform approach is of minimum information redundancy, and used for the texture feature extraction and description in the chapter.

Shape feature extraction and description approaches can usually be divided into contour-based and region-based approaches (Zhang & Lu, 2004). Fourier descriptor approach is one of important contour-based approaches. Its basic idea is to use the boundary pixels of object to compute shape signature. Fourier transform is used for these shape signatures to compute Fourier coefficients. Then the Fourier coefficients which are invariant to translation, scale, rotation, and change of initial point are used for shape features. The merits of Fourier descriptor approach (Zhang & Lu, 2003; Kauppinen *et al*, 1995) are as followed. First, the effect of noise and change of boundary on shape feature extraction and description is reduced effectively by analyzing shape in frequency domain. Second, Fourier descriptor approach has low computation. Third, the features from Fourier descriptor approach is a compact description, and easy to be normalized. Besides, simple similarity measure can be used for feature matching. Fourth, the system which uses Fourier descriptor approach has better retrieval performance compared to the systems using many shape feature extraction approaches. In recent years, some modified versions are presented to improve the performance of Fourier descriptor approach further. Zhang *et al* transform an image from Cartesian coordinate system to Polar coordinate system. Then Fourier transform is used for the transformed image to improve the performance of Fourier descriptor approach (Zhang & Lu, 2002). Kunttu *et al* use