Chapter VII

Object-Based Techniques for Image Retrieval

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ABSTRACT
To overcome the drawback of using only low-level features for the description of image content and to fill the gap between the perceptual property and semantic meaning, this chapter presents an object-based scheme and some object level techniques for image retrieval. According to a multi-layer description model, images are analyzed in different levels for progressive understanding, and this procedure helps to gain comprehensive representations of the objects in images. The main propulsion of the chapter includes a multi-layer description model that describes the image content with a hierarchical structure; an efficient region-based scheme for meaningful information extraction; a combined feature set to represent the image at a visual perception level; an iterative training-and-testing procedure for object region recognition; a decision function for reflecting common contents in object description and a combined feature and object matching process, as well as a self-adaptive relevance feedback that could work with or without memory. With the proposed techniques, a prototype retrieval
system has been implemented. Real retrieval experiments have been conducted; results show that the object-based scheme is quite efficient and the performance of object level techniques have been confirmed.

INTRODUCTION

Fast technique advancement and the rapid information increments mark the new century. Along with the progress of imaging modality and the wide utility of digital image in various fields, many potential content producers have emerged, and many image databases have been built. How to quickly access and manage these large, both in the sense of information contents and data volume, databases has become an urgent problem to solve. In the past 10 years, image retrieval techniques have drawn much interest, and content-based image retrieval (CBIR) techniques are proposed in this context to search information from image databases quickly and efficiently (Kato, 1992). With the advantage of comprehensive descriptions of image contents and consistence to human visual perception, research in this direction is considered as one of the hottest research points in the new century (Zhang, 2003).

Though many efforts have been put on CBIR, many techniques have been proposed and many prototype systems have been developed, the problems in retrieving images according to image content are far from being solved. Most of current techniques and systems for image retrieval just take into consideration low-level visual features, such as color and texture of image, or shape of objects and spatial relationships among different regions in images, to describe image contents. However, there is a considerable difference between the users’ interest in reality, and the image contents described by only using the above low-level image features. In other words, there is a large gap between such image content description based on low-level features and that of human beings’ understanding. As a result, these low-level feature-based approaches often lead to unsatisfying querying results in many cases.

In this chapter, a general scheme and some object-based techniques are proposed to efficiently fill the gap between the low-level feature and high-level semantic description of images. This is in the hope of making content-based image retrieval more like its real meaning, instead of just considering the visual perception. Throughout this chapter, several techniques are proposed, and all these techniques are gathered together into an object-based framework for image retrieval.

The proposed structure of this chapter is as follows: Background, (1) Extraction of Interesting Regions, (2) Object-level Processing, (3) Self-Adaptive Relevance Feedback; Main Thrust of Chapter, (1) Multi-Layer Description Model, (2) Meaningful Region Extraction, (3) Perceptual Feature Extraction, (4) Object Recognition, (5) Object Description and Matching, (6) Experiments and Discussions; Direction of Future Research; and Conclusion.

BACKGROUND

In content-based image retrieval, how to represent and describe the content of an image is a central issue. Many methods have been used, three broad categories are: synthetic, semantic and semiotic (Bimbo, 1999; Vailaya, 2000; Djeraba, 2002).
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