Chapter II

The Impact of Low-Level Features in Semantic-Based Image Retrieval

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Abstract

Image retrieval (IR) is generally known as a collection of techniques for retrieving images on the basis of features, either low-level (content-based IR) or high-level (semantic-based IR). Since semantic-based features rely on low-level ones, in this chapter the reader initially is familiarized with the most widely used low-level features. An efficient way to present these features is by means of a statistical tool that is capable of bearing concrete information, such as the histogram. For use in IR, the histograms extracted from the previously mentioned features need to be compared by means of a metric. The most popular methods and distances are thus apposed. Finally, a number of IR systems using histograms are presented in a thorough manner, and their experimental results are discussed. The steps in order to develop a custom IR system along with modern techniques in image feature extraction also are presented.
Introduction

Research in color imaging has recently emerged in a number of different applications, including military, industrial, and civilian, that generates gigabytes of color images per day. Moreover, recent improvements in information and communication technology have led to higher data transmission rates and, consequently, to a boom in networking. Therefore, more and more people have access to an increasing number of images. It is obvious that this will lead to a chaotic predicament, unless the enormous amount of available visual information is organized (Gagliardi & Schettini, 1997). Organization here means that appropriate indexing is available in order to allow efficient browsing, searching, and retrieving as in keyword searches of text databases. Associating a text to each image is one of the most popular and straightforward ways to index (Rowe, 2005). However, this means that prior to submitting each image into a database, a human agent must accompany it with a caption, thus leading to a lack of system automization. In many applications, such as in digital photography, area surveillance, remote sensing, and so forth, the images are labeled with automatically produced computerized names that are totally irrelevant to their semantic content. The best solution to such cases is the extraction and storage of meaningful features from each image for indexing purposes. In order to retrieve these images, a procedure known as query by example is performed; that is, the user has to present an image to the system, and the latter retrieves others alike by extracting features from the query image and comparing them to the ones stored in the database. The extraction of meaningful features, both content (Del Bimbo, 1999) and semantic (Zhang & Chen, 2003), is critical in IR and, therefore, an active field of research (Eakins, 2002; Smeulders, Worrin, Santini, Gupta, & Jain, 2000). Nevertheless, while considering a semantic query (e.g., A Red Round Dirty Car), the descriptive components are based on low-level features; red on color, round on shape, and dirty on texture. Hence, in order for a semantic-based IR system to perform effectively, its lower features

![Figure 1. Block diagram of the basic structure of a generic IR system](image-url)

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