

A Feature Library Approach to On-line Image Querying and Retrieval for Topographic Applications

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Abstract

In this paper we address the problem of content-based image retrieval using queries on shape and topology. We focus on the particularities of image databases encountered in typical topographic applications, and present the development of a spatial data management system that enables such queries. The query uses as input user-provided sketches of the shape and spatial configuration of the object (or objects) which should appear in the images to be retrieved. The objective of the search is to retrieve images that contain a configuration of objects sufficiently similar to the one specified in the query. Our novel approach introduces the design of a structured feature library that is linked to an integrated image database in addition to the development of the necessary matching tools. We discuss our overall strategy and focus on the use of the feature library to support our queries.

1. INTRODUCTION

The intelligent retrieval of images from large databases is the focus of substantial research efforts within the computer vision community [12;13;11;7;10;3;9]. The objective is to retrieve specific images from a large database by querying on properties of these images. As a result of pioneering research efforts, some prototype systems have been reported, with few notable examples being Virage [8], Chabot [11], IBM's QBIC [6], VisualSeek [14], ImageRover [13], and PicHunter [4].

Most of these efforts address the problem within the context of multimedia applications, and therefore they

focus on general-use, multimedia-type image databases. In such applications, low-level image properties (e.g. color and texture) are often adequate for information retrieval, since the image members of the database display substantial differences in these properties and can be distinguished by them alone. However, in a variety of applications we have databases containing large numbers of images which are often extremely similar in terms of general low-level image properties. Databases of aerial and satellite image databases are one such example. Therefore, general-purpose image retrieval approaches like the ones mentioned above are not sufficient for information retrieval in topographic image databases. Instead, what distinguishes images in a topographic database is their actual content: the *shape* and *configuration* of the objects they contain.

In this paper we present the strategy and design considerations behind *I.Q.* (Image Query by Sketch), our prototype system for image retrieval (section 2), emphasize on the role and organization of feature libraries for image retrieval (section 3), and discuss some digital image analysis issues related to matching sketches to images for querying (section 4). It should be mentioned that while our research originates from topographic applications, the developed methodology can be applied to any type of imagery.

2. STRATEGY AND SYSTEM DESIGN

A description of the operation environment for our system is shown in Fig. 1. Our searchable topographic database comprises images (typically aerial or satellite), outline (edge) information for physical entities depicted in

