COMPASS[1]: Computer Aided Search System

Roberto Brunelli & Ornella Mich
ITC–irst
Via Sommarive, 18
I–38050 Povo (TN), Italy
{compass, brunelli, mich}@itc.it

Abstract

COMPASS is a distributed image retrieval system which provides novel solutions to the emerging problem of searching multimedia databases by content. Statistical methods are used to quantify image descriptor effectiveness, to simplify user queries and to select an image comparison strategy which optimizes search speed while preserving answer quality.

The application context

Retrieving information from multimedia repositories requires the development of techniques to supplement traditional methods based on textual descriptions and searches. The reason for this necessity is twofold: associating textual descriptions to multimedia data can be very expensive, and, what is even more important, textual descriptions may not characterize data adequately for subsequent retrieval. An attempt to overcome this limitation is through query by example where non textual queries are formulated by the user using multimedia items related to the material he/she is looking for. This means that image searches could be done by formulating queries through image examples.

COMPASS innovative features

COMPASS, Computer Aided Search System, is an image retrieval system which allows a user to search images in multiple distributed databases using the 'query–by–example' paradigm: users rely on the images themselves to formulate queries. The system is configured as a client–server architecture in which a client application can submit a user query to multiple image servers. The answers from multiple image servers are then merged and proposed to the user as a single result.

While not unique in the use of the 'query–by–example' paradigm, COMPASS features a unique combination of several state–of–the art characteristics that make it one of the most flexible systems for querying image databases using iconic queries. These characteristics are:

– The possibility of querying multiple databases distributed over the internet at the same time with the same set of samples, obtaining a synthetic answer.
– The possibility of switching on/off any image server before submitting a new query: the user can then effect a first coarse search on all available image servers, selecting the most promising for further refinement.
– The possibility of using images locally available to the client application, which is able to compute the required image descriptors.
– The possibility of choosing among several query strategies for varying ratios of search speed versus search quality. Image comparison strategies are adapted to user goals on a query by query basis using relevance feedback techniques. Whenever the system presents to the user a set of images considered to be similar to the provided examples, the user can pick among them the images most relevant to the submitted query and COMPASS modifies the image comparison routines to highlight the similarities within the query images, providing more focused results.
– The possibility of using a common interface for different specialized image classes. COMPASS currently offers specialized search engines for generic images (posters, art representations,

1 `http://compass.itc.it`

  landscapes, photographs, etc.), face photographs, and font images. For each image class, specifically tuned image descriptors have been developed to ensure fast yet meaningful image comparisons:
    - font image descriptors characterize stroke, width, height, layout, direction, and profile;
    - generic images are described by their luminance, colour distribution, and textureness;
    - face photographs are described through a compact characterization of their main features: hair, eyes, nose, mouth, and chin.
- Advanced coding techniques make the search in very large databases (up to a million images) possible on current personal computers.

Figure 1: COMPASS browsing and searching interface

Besides database query by example, COMPASS also supports another very important activity: database browsing. This operation is important in the case of multimedia databases used as repositories of material to be creatively (re)assembled into new multimedia products such as cd–rom, composite images, footage, etc. Browsing support requirements differ from those of querying: database items should be organized and presented to the user in such a way that exploration of content is possible. The solution adopted by COMPASS is the organization of databases in clusters of similar images. Each cluster is represented by the client with a key image and all the cluster elements can be displayed on user demand providing a more detailed view of available images. As the number of clusters is usually much smaller than the number of images in the database, computationally expensive algorithms can be applied to organize the visual presentation of the key images to reduce browsing stress. COMPASS is able to arrange key images on the screen in such a way that nearby images are visually similar, making database exploration easier.

A new version of COMPASS is currently under development and it will feature use of negative examples to better refine user queries of complex patterns, adaptive image size (and quality) transferred by the image servers to the client applications for optimal use of the available bandwidth, and support for textual queries.