Content–Based Image Indexing and Retrieval with Mobile Agents

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1 Introduction

At present, the de–facto platform for providing contents in the Internet is the World Wide Web. A technology, which is now emerging on the Web, is *content–based retrieval* (CBR). A content–based query matches examples or prototypes to known instances of a certain media type based on a measure of similarity. For efficiency, similarity measures are frequently computed on sets of discriminant features (so–called *feature vectors*) being extracted a–priori from the stored media. Smith et al. [5, 6] developed a CBR system for the World Wide Web. Scarloff et al. [4] developed a content–based image query system including a *gatherer* collecting images from the Web. Beigi et al. [2] already applied the principle of meta–searching to a number of available image search engines.

We propose an alternative architecture and model for commercial distributed indexation and searching of images (the essentials are outlined in Figure 1) that combines CBR, mobile agent technology [3], and digital watermarking (see for instance [1]).

2 CBR with Mobile Agents

We anticipate image brokers running a CBR service. This service is queried using example images or feature vectors already extracted from them. The CBR service returns a list of image descriptors of images matching the query in the order of similarity. Each image descriptor consists at least of a thumbnail, the image identifier of that image and the URL of the provider's agent server from which the image can be retrieved. The images themselves must be retrieved from the providers. This ensures that providers may identify customers and may apply digital watermarks to retrieved images. *Image indexation is done with mobile agents, which transport the CBR feature vector extraction and collection algorithm to the servers of image providers.* Image searches can also be done using mobile agents that may visit multiple brokers and/or image providers to query for images matching a given one.

This approach has a number of advantages. Multiple (complementary) indexing and retrieval mechanisms are supported in a single framework; such mechanisms are easily replaceable as the field of CBR evolves towards more robust and applicable mechanisms. Software distribution, installation and removal is easy and painless. Image indexing is decentralized. It is computed "near" the image database by index agents migrating to the agent servers of image providers. Images must not be transported across networks for index generation any more. Retrieved images can be "personalized" by watermarking them with the identity of the purchaser.

We are particularly investigating and thriving to solve security implications of this framework involving indexation, search and purchase and payment of image (licenses) with mobile agents (see for instance [7] for a good coverage of mobile agent security issues).
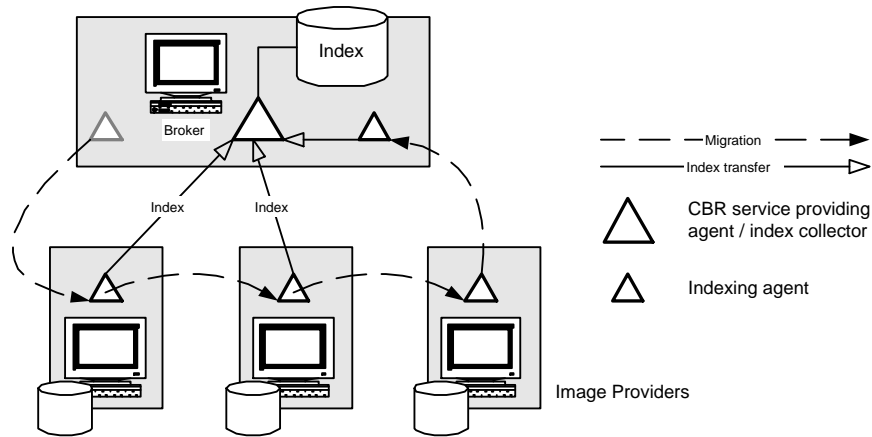

Fig. 1. The index collection part of the model.

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