# Interactive and progressive image retrieval on the WWW. Application on building product search.

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**Abstract.** The INTERNET represents an enormous and non-structured knowledge that is easily accessible by people. Text search engines are the principal accesses to this large knowledge base. A precise search, like a search for a technical information on a product, is not easy to lead. In order to fill in the imperfections of text search, we propose to use the image, present in great number in the WWW, as a new search support. After analyzing the advantages and the disadvantages of the early image search engines available on the INTERNET, we present the principle of an interactive and progressive search of images and its application in building technical documentation in the framework of the HYPERCAT project.

## 1 Introduction

An enormous knowledge base is now accessible by people with a connection to the network of the networks, the INTERNET. This knowledge has the particularity to be non-structured and to have an immense quantity of information. These particularities make difficult to find a precise piece of information with the use of traditional text search engines, which represent the only entrance points to this large knowledge base. To fill this lack of precision, various experiments are carried out. One consists in completing the work done by the engine with adequate terms extracted from knowledge in the search domain [1]. Other creates engines that are specialized in a specific domain.

Because of the multimedia characteristic of the INTERNET, some search engines are specialized in search with other media such as image, sound, and video. The image is presented in great quantity on the INTERNET, accessible for everyone, and remains independent from language and culture.

Our approach consists in proposing an interactive and progressive image retrieval as a support to a technological information search. This search is interactive, because it rests on the manipulation of images, and progressive, because we invite the user to choose and reject images in order to refine his demand and to understand his need. We propose this approach in the field of the building product. The sites exploited are those of the architects and the providers of products which, like the INTERNET, evolve in number and size. The main objective is to find products or services with the manipulation of image.

## 2 The INTERNET image search engines

The image indexing systems and image retrieval systems currently available on the INTERNET can be classified in two main categories according to the technique used.

The first category gathers the systems that exploit the physical characteristics of the image. These systems use techniques of image analysis in order to extract some of the physical features like colors, textures, forms, and spaces. They are also called feature-based or content-based image retrieval systems. The majority of the engines present on the INTERNET use these techniques, because the indexing can be automated more easily. The search mode for these systems proposes a mosaic of images in which an image should be chosen. Then the system uses it as a request to select the next images. The process stops when the user wishes to see the site where the image has been selected. Excalibur Visual RetrievalWare™ SKD 2.1 is an example of this type of system (cf. Fig. 1). It uses the color, the forms, the texture, and the luminosity as characteristics of search by similarity [2].

The disadvantage of this search process is that one can find only images that have similar hues, similar textures, or similar forms to the selected image. This type of search can be interesting when the user's need is rather fuzzy and that it rests on aesthetic aspects and not on a precise topic or even a precise technical aspect.

IBM proposes, with the QBIC (Query By Image Content) project [3], a similar approach illustrated by an example of use in search of logo (cf. Fig. 2). This example is interesting, because it highlights that these techniques are usable when the objective

of search is rather exploratory where the user is in a phase of search for idea without precise objective.

**Fig. 1.** The Excalibur search engine

The systems of the second category use textual indexing associated with the images [4]. These systems are also called text-based, caption-based, or semantic-based image retrieval systems. The images are indexed and retrieved by their linguistic context information such as title of image, the caption of the photograph, or the paragraphs in which the image appears.

Other systems combine the two technologies. It is the case of the system WebSeer [5]. The objective is to build a robot traversing the maximum of sites. This robot is not yet currently available. However, in our opinion, it will be confronted with the same problems of inaccuracy that currently meet the text search engines.

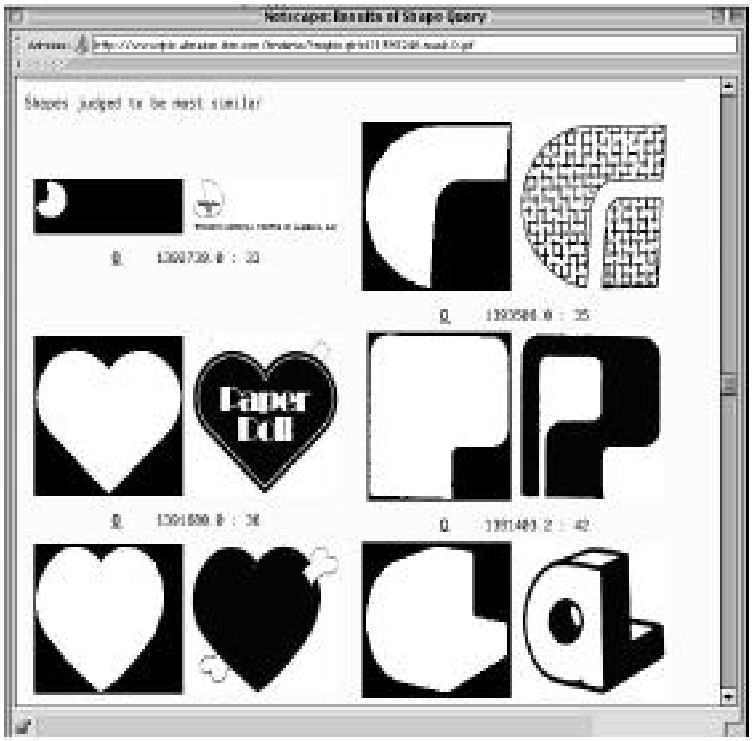


**Fig. 2.** Example of the project QBIC by IBM.

## 3 Interactive & progressive image retrieval

The analysis of these various systems shows us that a precise image search engine, necessary to any technical information search, cannot be carried out only starting from the physical characteristics of the image. The analysis of the legends seems significant to understand the concepts present in the image. A dialogue between the user and the system can improve the comprehension of the image search engine.

The interactive and progressive image retrieval is the approach that better uses the interactivity of the image [6]. The technique of the “Relevance feedback” makes possible for the system to understand the user's need more precisely.

The principle of the search process is following (cf. Fig. 3):

- the user formulates a simple demand,
- the system analyses the demand and proposes a first set of images to the user,
- the user chooses or rejects images. He can also stay indifferent on an image,
- the system analyses these choices and reformulates a request in order to select new images which are proposed to the user, etc...

The process stops when the user obtained a set of images, which he considers relevant. This process has been used in the prototype RIVAGE [7] on images of the ancient Paris and also for the interrogation of the Iconographic Base of Art nouveau [8] using platform DLIB [9]

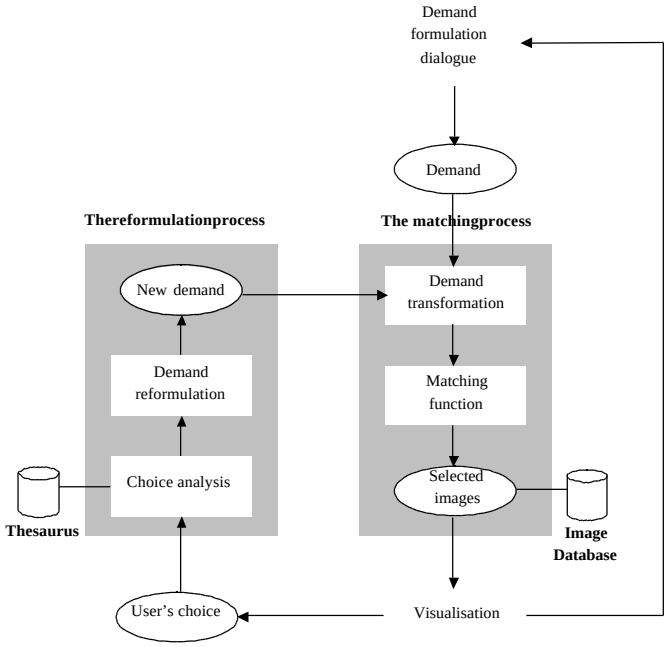


**Fig. 3.** The process of interactive and progressive image retrieval

## 4 the HYPERCAT Project

The interactive and progressive search based on images extracted the WWW is a component of HYPERCAT project (HYPERmedia CATalogue of the products of the building industry).

In France, there are approximately 10,000 French companies of building products. Today, according to the socio-professional context, the users, designers, and the architects must consult the catalogues of products of each company. This search can be carried out via papers catalogues, or more advanced support like CD-ROM, CD-INTERNET, or INTERNET.

HYPERCAT system uses the INTERNET to allow the users, the designers, and the architects to consult a database containing many French building companies in an interactive way. Thanks to an evolutionary database and a user-friendly search mode adapted to the needs of the professionals of the EAC, the users can rapidly find information necessary to the realization of their projects.

HYPERCAT currently contains DOCMAT database [10] which proposes several search modes for products or providers of products starting from a thesaurus on the trades, materials, constructive functions, shapes and types of products of the buildings.

We will integrate a new database BATIMAGE [1](Base of architecture and the building images extracted from the WWW) into HYPERCAT system. BATIMAGE contains images, extracted from sites of the architect and providers of building products, indexed by the words contained in their legends. These are the images, which are used for interactive and progressive search.

The images extracted present on the WWW are numerous in forms and varied aspects. All are not relevant and exploitable for an interactive search.

### 4.1 Type of image

VENDRIG J [11] proposes a classification of the images presented on the Internet based on five categories of images :

**a. The photographic images** which represent objects of the real world. Cameras or computer are necessary for the acquisition or respectively the synthesis of these images.

[1] Le BATIMent en imAGE : http://www.crai.archi.fr/batimage

**b. The alphanumeric images** represent a character string. The meaning of the image is covered by the text.

**c. The icon images** contain a symbolic notation, which can be a fixed symbol (known of all), or a mark of a product.

**d. The legends bearing images** contain one or more symbols but also text. Some images are an alphanumeric combination of image and icon image.

**e. The images of decoration**. Although they do not have sense, the images of decoration are used to illustrate HTML documents. They are the multi-colors features (used in the place of black feature) or the transparent images (used to locate the text).

However, it seems significant to supplement this classification with two new categories which we identified in the technological sites (architects and of the providers of building products) :

**f. The composite images**. They were built by the combination of several images often of different types. They are of very big size and often associated with an interaction HTML map.

**g. The technical drawing images** contain drawings, which represent a technical design (architectural), and brings technical information on a building or a product of the building.

For this first experimentation, we are interested exclusively in the images of the category **a.** and **g.** (photographic images and technical drawings). Indeed, the images of category **a.** are easily to identify: they are in general in JPEG format, they have many colors. Those of the category **g.** are usually of GIF format, and they use a few of color. These two categories of images are of square form and have an average size.

Another forms of images (**c. and f.**) which seem interesting to us will be taken into account in the next versions.

### 4.2. Image and legend

The photographic images and technical drawings presented in the technological sites are often associated with text. HTML tags enable us to identify their presence as well as the type of positioning of the text compared to the image.

Three types of relations between an image and its legend were identified, each one corresponds to a particular layout of tags:

- the image is inserted on the right or the left and its legend on the left, respectively the right,
- the legend is placed under the image, or above the image,
- the images and their legends were inserted in a table.

Only these three forms of relations were retained, because they represent a relation of sufficient proximity, which justifies the association of the text and the image.

As soon as a pertinent image (category **a.** or **g.**) is detected, using its format, its size, its colors, and its dimension, and there is a close text, this one is identified as a legend, and then indexed. The image, its indexing and the reference of the page are then added into BATIMAGE.

By a periodical extraction and indexing of the images coming from the technological web sites, we follow the evolution of these sites and thus carry out a form of technological survey.

For this first study, the images were manually extracted in order to be able to determine the criteria making it possible to identify the “relevant” types of images known as for the HYPERCAT project. For the next version, we currently develop a robot charged to extract the images and carrying out a semi-automatic indexing from the legends.

## 5 The prototype, the process implementation

A first prototype was produced by using a sample of the images. These images were extracted manually from the web sites of French building products. This prototype implements the interactive and progressive image retrieval process:

- a first window request the user to choose a topic, the type and the number of the images he wishes to visualize, (the first request),
- this request allows the selection of a first set of images. These images will be displayed in a new window in the shape of a mosaic (cf. Fig. 4),
- the user can choose or reject images. He can also not give an opinion on certain images,
- this choice carried out, other images are presented after the analysis of his selection and the submission of a new request to BATIMAGE.

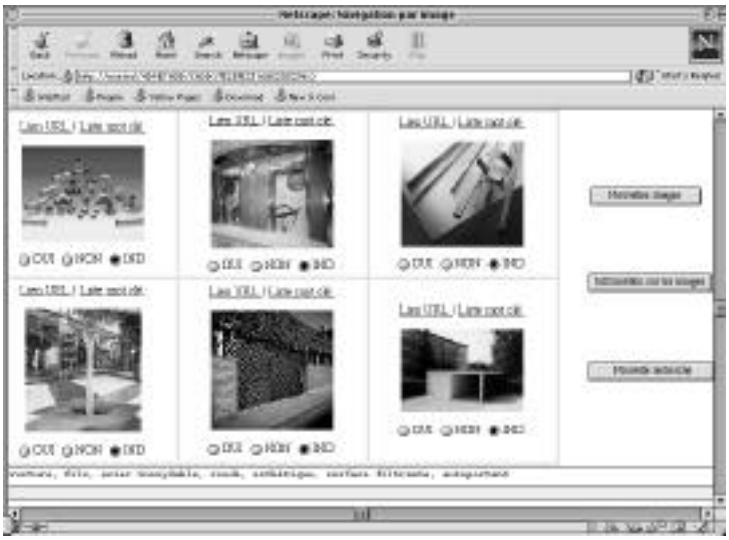

**Fig. 4.** User's Choice

At any time, the user has also the possibility to visualize further information on the images that he chose:

- the web site where the image stays,
- the DOCMAT associated products,
- the list of its key words.

## 6 Conclusion

The image can be a new support of a technical information search, if the search process uses the maximum of its interactivity. Some engines specialized in the manipulation of the image appear. However, their retrieval performance remains either too general, or too specific. Moreover, the current technology do not try do understand the users' real needs during the image retrieval. The interactive and progressive image retrieval is proposed to fill this imperfection of the contemporary image search engines

Our approach consists in using the image, coming from WWW sites, as a support of the technical documentation search. We apply this new media on the architectural and building product search. This makes it possible to develop the process that implements a progressive and interactive image retrieval. The user's need is then defined by the analysis of choice using matching process.

This formulation was integrated into HYPERCAT project (HYPERmedia CATalog for technical documentation) by the construction of a new database BATIMAGE.

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