A Survey of User Interfaces in Content-based Image Search Engines on the Web

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ABSTRACT
Content-based image retrieval or CBIR technique has been researched for over a decade, and most researches have been focusing on image matching technologies such as feature extraction and similarity measurement. Recently, there has been an attempt to build content-based image search engines on the web in such a way that they could be as popular as their text-based counterparts. In order to do so, other key issues including user interface should also be explored. This paper presents the user interfaces of current content-based image search engines on the Internet, and analyzes their advantages and disadvantages.

Categories and Subject Descriptors
H.5.2 [Information Interfaces and Presentation]: User Interfaces – evaluation/methodology, graphical user interfaces (GUI).

General Terms
Design

Keywords
User Interface, Usability, CBIR, Content-based Image Search Engine

1. INTRODUCTION
Content-based image retrieval or CBIR technique analyzes the actual contents of an image and searches for other images with similar visual features such as colors, shapes, and patterns. CBIR technique has been studied for over a decade [18], and numerous image matching methods and algorithms have been proposed in literature [2, 4, 8, 11, 15]. Content-based image search is useful in many fields including online social networking, E-commerce, E-health, and virtual museums. While the image matching technique is still under improvement, researchers and developers have already started to build content-based image search engines on the web that are expected to be as popular as their text-based counterparts.

The current content-based image search engines on the web can be classified into two broad categories, i.e., domain-specific image search engines and general image search engines. Domain-specific image search engines are designed for a certain purpose within a certain range. For example, Like.com [13] searches for similar looking products from its partner E-commerce websites, and Retriever [17] allows its users to search and explore in a selection of Flickr [9] (Flickr is an image and video hosting website) images by drawing a rough sketch. Domain-specific image search engines focus either on a specific category like people search or product retrieval, or within a limited range such as a specified image database; thus they are relatively easier to implement.

General image search engines provide their users with the power of searching the same or similar looking images on the whole Internet. For example, both TinEye [19] and GazoPa [10] aim on looking for similar images on the entire web. They provide various ways for image search including searching by query image, searching by keywords, and searching by sketch. General content-based image search engines need to differentiate images by categories and index gigantic number of images (e.g., TinEye has indexed more than 1,500,000,000 images from the web [19]); thus they are much harder to construct than domain-specific ones.

Although the above-mentioned content-based image search engines are available on the web, the total number of such search engines is far less than that of text-based ones. And they are not as widely used as their text-based counterparts. This is due to many reasons including low precision ratio, low recall ratio, and unfriendly user interface.

Usability of a system refers to how much effort a user has to take in order to use the system and get results. The usability of a system can be evaluated by user satisfaction, the likelihood of user return, and the frequency of use [16]. It is a comprehensive concept and contains many aspects like system design, user interface, and visualization (searching results display).

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User interface decides how users interact with the system and how they feel about the system in terms of outlook and easiness of use. A friendly and artistic user interface would attract and retain users, while an unfriendly or dry one could drive users away. This paper conducts a survey and analyzes the user interfaces of current content-based image search engines on the web.

The rest of this paper is organized as follows. The next section makes a brief review of the previous and current literatures on usability of web-based CBIR systems. Section 3 explores the user
interfaces of the current content-based image search engines. And section 4 concludes the entire paper.

2. BRIEF REVIEW
Usability has also been researched for over a decade, and it is an important part of information systems. Palmer [16] did a thorough survey on how usability was defined in website construction. In [16], it is indicated that website success is significantly associated with factors including navigation, interactivity, and responsiveness. User interface in a large degree decides how users interact with information systems and the easiness of navigation; thus the popularity of a system is significantly affected by its user interface. This is especially the case for online search engines since online users have full freedom of choosing which search engine to use. If they feel one engine is too complicated to use, they will switch to another user-friendly one.

In [7], Datta et al. pointed out that the current need in CBIR area is to establish how CBIR technology can reach out to the common man in the same way text retrieval techniques have. This implies a very important principle of user interface design, i.e., the design should adapt to users’ behavior, not shape users’ behavior. However, the study of users’ behavior in content-based image search and how to design user interface accordingly have traditionally had lesser consideration [6].

In current literatures like [14], Massanari discussed three different approaches to system design, i.e., system-centered, user-centered, and user-participated. System-centered design expects users to conform to the system requirements when using the system, user-centered design intends to minimize users’ efforts, while user-participated design emphasizes on respecting users’ behavior and goals in every detail of system design. The more concerned the system is to its users, the more likely the system will succeed.

As for content-based image search engines on the web, their users are usually web surfers with diverse behavior or goals, e.g., reading online news, visiting web-based social networks, shopping online, or just browsing; thus they are interested in different images such as news image, people’s photos, or product pictures. They may want to search for similar looking images to the image in a news report, or the photo in a person’s profile, or the picture of a product on an E-commerce website. Then what is the most convenient way for them to conduct similar image search process?

In the next section, different user interfaces of current content-based image search engines on the web are introduced, and their advantages and disadvantages are analyzed. The evaluation of the user interfaces is user-centered, i.e., whether the user interface can best fit users’ behavior and goals.

3. USER INTERFACES OF CONTENT-BASED IMAGE SEARCH ENGINES
Although different users are interested in different images as described previously, their expectation of an excellent or successful content-based image search engine is the same. They expect to use the least effort to find the most accurate and complete results. This expectation is natural, and the system design should try to meet it.

The following summary and analysis of the user interfaces in the current content-based image search engines on the web are therefore based on satisfying users’ needs.

3.1 Hybrid System is Better
A hybrid CBIR system refers to a CBIR system that allows its users to search by either text or image at any point of the searching process. A hybrid system provides the users with a more flexible and powerful way of searching, and its performance should be at least as good as its text-based counterparts since it can also use keywords to search images. Therefore, a hybrid image search engine would be more powerful and popular than purely text-based or image-based ones.

One example of a hybrid content-based image search engine is Like.com [13]. On Like.com, its users can first search images by using keywords or categories, and then pick an interested image as the query image, and retrieve its similar looking images by clicking on the “VISUAL SEARCH” button under the query image. For example, Figure 1 shows an example of visual search interface/ button on each individual item. And the items in Figure 1 are generated by typing keyword “watch” in the search box on Like.com as depicted in Figure 2. The user can choose one watch image and click the “VISUAL SEARCH” button under that image to find similar looking watches on Like.com’s partner websites.
3.2 User Interfaces of Search-by-query-image

Friendly user interface not only means the interface should be as easy as possible to use, but also indicates it can satisfy users’ various searching needs.

There is always a tradeoff between the easiness of use and the complexity of the background technology. That is, the easier it is to use a system, the harder it is to implement it or the more complicated the background technology is. In CBIR area, many current content-based image search engines on the web adopted the most convenient way for image searching. This actually challenges the present CBIR technology to be more developed.

The easiest way to search similar images is different under different searching scenarios or users’ searching needs; therefore, the corresponding user interfaces should be designed to fit users’ various searching needs.

Upload image

Figure 3. An image uploading interface on Tineye.com

3.2.1 Uploading interface when query image is local

If the query image is local, i.e., on the user’s storage devices including hard drive, memory card, and flash drive, then an uploading interface should be provided for the user to upload the image file to the search engine. This uploading interface is standard and it usually contains a search box and a browse/upload button as shown in Figure 3, which was extracted from TinEye Reverse Image Search [19] website. Once the user clicks the browse/upload button, a navigation window will be popped up for the user to choose which file to upload. And the search engine will automatically search for similar images once the image file is uploaded.

Some traditional content-based image search engines like ASSERT [1] require users to circle a certain area in the uploaded image before clicking the search button. This way is expected to increase the precision ratio of the searching results, but sometimes, it is not the case, and it significantly increases the users’ burden and thus should be avoided as much as possible in user interface design.

3.2.2 What is the best interface for web images

If the query image is on a web page, a friendly image search engine should not ask the user to download the image and then upload it to the search engine for searching purpose. Instead, a more convenient way should be provided. Currently there are at least three ways for this purpose, i.e., copy and paste URL, make bookmarklet, and use plug-in.

Figure 4. Copy and paste URL interface on Tineye.com

Copy and paste URL interface. Figure 4 shows an example of copy and paste URL interface extracted from Tineye.com. The user needs to copy the URL of the web page containing the query image, paste it into the search box, and click the search button. The search engine will then automatically fetch all the images on the pasted URL and present them to the user. The user can then click the interested image to search for its similar images. The inconvenience of this method is that users have to copy and paste the URL and wait for the search engine to fetch all the images from that web page. To avoid copying and pasting URL, bookmarklet is introduced.

Bookmarklet does exactly the same as copying and pasting URL does, but without the need of copying and pasting URL. Bookmarklet is a little script that is run from the browser’s bookmark menu or toolbar. To add bookmarklet, users just need to right-click the link or linked button on the search engine website like “TinEye Images” button on TinEye.com as depicted in Figure 5, and select “Bookmark This Link” (on Mac) or “Add to Favorites” (on PC). Then the bookmarklet is added to the browser’s bookmark toolbar as shown in Figure 5. The bookmarklet “TinEye Images” looks like a regular bookmark, but when the user clicks it, it will fetch all the images on the current web page, and allow users to click on an interested image to search for similar images. Making bookmarklet saves the step of copying and pasting URL, but users need to add it to their browsers’ bookmark menu or toolbar.

Plug-in interface. Plug-in is a software that users can download and install on their browsers to add more functionalities to the browsers or achieve special presentation effects. Similar image search plug-in is designed for searching similar image purpose. There could be many ways to implement the plug-in user interface. One way is to use right-click menu. That is, once the similar image search plug-in is downloaded and installed, users can right click on any online image, and there will be a new item on the right-click menu like “Search Image on TinEye” in Safari as presented in Figure 6. Then the user can click it to search similar images on the web. Plug-in is direct and easy to use, and saves the time of fetching images compared to the previous two methods. The disadvantage is that some users may not want to install plug-in in their browsers.

Among the above three interfaces, plug-in is the most convenient to users’ behaviour and goals. When users intend to search for the similar images of an interested image they came across on the web, the natural way is to directly click/right-click on the image itself to launch the searching process. Copying and pasting URL puts a heavy load on the users. Even going to the Bookmark or
image search engines will be created on the web. In the future, more user-friendly, attractive, and powerful content-based interfaces are recommended, and it is expected that in the near future, these engines will analyze their advantages and disadvantages. Therefore, plug-in interface should be the targeted interface when the query image is on a web page.

Figure 7. Image search by sketch from Retrievr

3.2.3 Drawing interface for sketch images

Sometimes users want to find people images or artwork pictures similar to a sketch they draw [3, 5, 12], and then the search engine should provide a sketch panel for users to draft. Figure 7 is the search-by-sketch interface extracted from Retrievr [17]. As stated earlier, Retrievr searches images similar to the user’s sketch in Flickr image database. In Figure 7, users can pick a certain color and the size of the brush to draw a sketch in the blank panel. Once the user finishes drawing the sketch, Retrievr automatically searches for images similar to the user’s sketch and present them to the user. This technique can be used in many practical scenarios including police searching for suspects and people looking for artworks. The hardship of this method is that the sketch drawn on computers is usually rough, and the searching results are thus not quite accurate.

4. CONCLUSION

User interface is an important part of content-based image search engines on the web. Although different user interfaces should be designed for different searching purposes, they follow the same principle of interface design, i.e., the easier it is to use, the more popular it is going to be. The easy-to-use interfaces naturally challenge their background technologies to be more advanced and powerful. This paper conducts a survey on the user interfaces of current content-based image search engines on the Internet and analyzes their advantages and disadvantages. The easy-to-use interfaces are recommended, and it is expected that in the near future, more user-friendly, attractive, and powerful content-based image search engines will be created on the web.

5. REFERENCES