Search by image through the Internet: an additional method to find information

Published in

Transforming Libraries and Librarianship
Delhi : KBD Publication, 502 pp.
Edited by Sanjay Kataria, John Paul Anbu, Shri Ram, Nirmal Kumar Swain, Naresh Singh Bhandari,
2015, ISBN: 978-81-907999-6-6,
pp. 179-194.

Search by image through the Internet: an additional method to find information

Paul Nieuwenhuysen
University Library
Vrije Universiteit Brussel
Pleinlaan 2, B-1050 Brussels, Belgium
Paul.Nieuwenhuysen@vub.ac.be

***Abstract*— Offers an overview of an ongoing assessment of search by image through the Internet. This is a relatively new method for information retrieval, in which a query does not consist of text but of an image file. Various tests have been performed. The results show that search by image is evolving to a powerful, additional method to meet information needs that are difficult to handle with other, more classical methods. Various types of applications are presented.**

***Keywords*— search by image; WWW; duplicates; semantic image retrieval; semantic gap**

I. INTRODUCTION / CONTEXT / BACKGROUND

Two evolutions shape the context of this paper:

A. *Increasing number of images*

The number of images available is increasing rapidly, together with the decrease in costs and in technical difficulties, which are related to

- digitization of hard-copy images,
- digital cameras and photography,
- publication / distribution of images through the WWW and even social interaction associated with images.

B. *Image retrieval*

To satisfy various information needs, various search methods on the WWW become available and are steadily improved. Several methods are not limited to text, but involve images in some way; the umbrella word "image searching" is often used, even though the methods can be quite different in their features, aims, power and limitations.

The application of some image search method can be attractive, efficient, interesting and productive for several reasons:

- Image search allows you to find relevant images, if some specific image is needed.
- Images retrieved by the search service are shown as thumbnail images, so that evaluating each result in a list of results takes less time in comparison with the more classical/normal display of results that consist mainly of text fragments.
- When you find an image that is related to your query and that is relevant, then the search system offers also a link to the WWW page plus the site that contains that image; all this can be relevant in the context of our information need.

We can search for images by submitting a text query, like in classical searching for texts. To search in this way through the WWW, several systems are available and even free of charge; examples are Bing, Yahoo! and Google [see for instance 15]. These systems have become quite popular; for instance, to find images, users in a university rely heavily on Google Image Search [11] and in China on the Chinese search engine Baidu, as well as on Google [10]. These retrieval systems function mainly on the basis

- of the image file name and other metadata added to the image file,
- of the text surrounding the image,
- of the text in hyperlinks to the image, which are located in other documents on the WWW.

Such retrieval systems suffer from classical difficulties in information retrieval, such as synonymy and polysemy. Even worse, in most cases

- the association of describing words with an image is loose,
- image descriptions / metadata are lacking or scarce,
- these descriptions are not controlled during creation by some thesaurus or ontology.

A technique developed later than text-based retrieval is content-based image retrieval or "CBIR". In this approach, images are indexed by a computer system on the basis of their visual content, such as colours, textures and shapes, with the ambition of creating some useful possibilities for searching (see for instance [1, 4, 5, 12, 18, 20, 21, 22, 23, 28] and a brief review available free of charge for anyone from http: //en.wikipedia.org /wiki /Content-based_image_retrieval.). Some of these systems allow users to search starting with a query in which an image file is submitted to the search engine. Generic names for such systems are "search by example" or "reverse image searching" or "reverse visual search" or "search by image".

II. PURPOSE OF THIS RESEARCH

The framework of this contribution is an ongoing investigation and assessment of services that allow us to search for information through the WWW, which involve

images. Some systems are publicly available free of charge. More specifically, this contribution offers an overview of our assessment of systems that allow us to search, not by submitting a query in the form of text, but by the more recent and less well known method in which even the query consists of an image file. Search by image can yield various types of matching / found images in the search results; this is illustrated in the Figure and explained in more detail below.

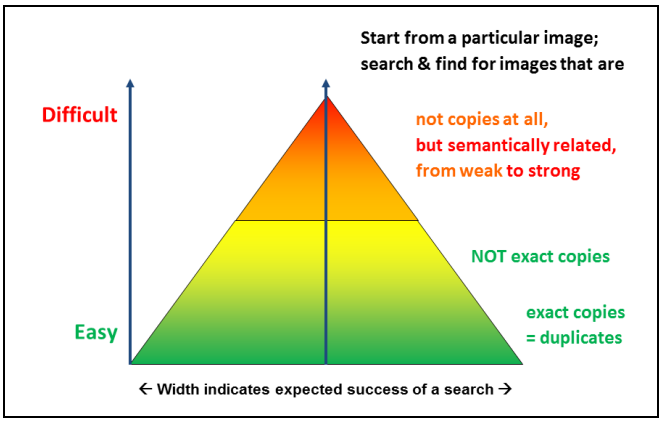

Figure: Search by image can yield various types of search results.

1. Images that contain at least some elements of the source image. Here we can distinguish various types as follows:
   - exact copies or duplicates of a source image;
   - almost exact duplicates, but different from the source image in size and/or colours and/or resolution and/or degree of compression of the data in the file, which causes some loss of details from the image;
   - other images based on the source image, in the sense that they include the source image, but also other images and/or texts, all composed or blended into one resulting image file;
   - other images that include only a part of the source image;
   - edited / changed / modified versions of the source image;
   - and of course also combinations of these types of images.

   The boundaries between the types listed above are not sharp and well-defined, but they overlap. Therefore we consider these together, here and also in the figure, as one category.
2. Images that do not contain elements of the source image, but which are related to the content / meaning / subject / topic / significance / semantics of the source image, or -- in other words-- which are semantically related to the source image. This relation can vary in strength:
   - The semantic relation can be weak or superficial or broad; for instance all plants are related to a particular tree species, or for instance all masks are related to a particular, specific, individual mask that belongs to the type created and used by a particular people in Africa in the 20th century.
   - The relation can be very strong or specific, right on target.

The spectrum of similarities sketched above prepares us for the following problem statements / research questions:

A. Which systems / services are available free of charge for searching by image through the WWW?
B. Which differences / variations among these services are noteworthy for a user in practice?
C. Which service performs best?
D. To which extent can a service to search by image find one or several exact duplicates that are present on the WWW?
E. We find that an image can exist on the WWW already for some time, but even when an exact copy is submitted as a query, search by image cannot locate it. Is this correlated with the success or failure of more classical searches by text for such an image?
F. How effectively can the search system find images on the WWW, which are not exact copies of a particular image, but which have elements in common?
G. Is search by image evolving / improving?
H. We can search by image to find images that are superficially, visually similar in the sense that they show similar colours or shapes, but can this method also reveal images that are 'semantically' related to the image submitted?
I. Can a more classical search for images by a text query be refined by adding a search by image, together in a single search action?

III. Methods Used in the Investigation

In each search by image on the WWW, one source image from the computer disk is submitted as query to the search service. The images used in the tests are mainly photos made by the author of this paper, which have been made publicly available

- in jpeg/jpg file format, because this is now a classical, popular, well known, standard format,
- on the central WWW server of a university,
- already for several years,
- as images included in a WWW page that consists simply of HTML-formatted text in the classical, normal way, using hyperlinks to the image files that appear in the page and that reside on the same WWW server; the images are NOT present in a way that would make retrieval less easy, for instance only as a part of a larger container document file.

To concentrate on a subject area that is familiar to the author and to investigate a type of information retrieval that may be useful in digital humanities, we use as source images mainly simple, documentary photos of static, sculptural, traditional, ethnic, art objects.

We found that Google search by image does not function with large images. Therefore, in some cases we used a smaller version for the search by image.

Image retrieval is relatively new and there is no standard image collection and method to measure and compare the performance of particular systems [see for instance 12, 25]. For each query, we inspect the search results offered by each

search service and we note our observations in a table. The performance of the retrieval system is mainly measured / evaluated by considering the highest ranked results and by counting the number of relevant results. This is equivalent to measuring the precision, which is a method that is widely accepted as practical and useful [see for instance 12] and which is now the most popular choice, according to a recent survey of interactive search in image retrieval [25]. Keeping in mind that the concept of "relevance" is complicated [see for instance 27], this seems like a practical/realistic and reasonable approach.

IV. Findings / Results

A. *Services available to search by image*

Several services are available free of charge to search by image through the WWW [16]. The system available at http://tineye.com has been available since 2008 and has been mentioned relatively often. "Unfortunately, very little is known about the actual systems" [24]. More recently, since 2011, search by image is also offered by the big and popular company Google and has been described briefly in a user manual [8]; this system is integrated with the huge database of WWW documents and algorithms that have already been developed for its more classical search engines.
A few add-ons/extensions for the Internet browser software Firefox are available free of charge, which allow the user to indicate an image on a web page in the browser and to send this image as a query fast and easily to a few services that offer search by image. Such an add-on for Google Search by Image is also made available Google.

B. *Variations among services to search by image*

After the roll-out of Google search by image, a few quick tests with very limited samples have been reported online:

- A very brief report mentions a test with 10 searches, which showed in all cases that the older TinEye did not perform as well as the more recent Google service [2].
- A few test queries showed that TinEye and Google performed both in a similar way; in one case, when the source image was a photo of a cityscape, Tineye failed while Google yielded other, similar images [13].

We have compared more matured versions of both services, in more detail and in a more systematic way [16]. We submitted 10 images that have a duplicate, exact copy present on the WWW as a query to both TinEye and Google search by image. Of those 10 corresponding duplicate images on the WWW, TinEye revealed only 3, while Google revealed 7. Furthermore, we have investigated how well the services find images that have been derived from those 10 original images and that have been published on some other WWW site: TinEye found not a single derived image, while Google found at least one in the case of 7 images. So the differences among the services are substantial.

C. *Performance of the search services*

The tests mentioned above indicate that Google performed better than TinEye. Therefore, subsequent tests of search by image are carried out mainly using Google. Various ways are available to search by image with Google: "To search using an image, go to images.google.com and just put your picture in the search box. There are many ways to do this. You can click the camera icon in the search box and upload a photo from your computer or paste the URL of an image from the web. You can also drag and drop pictures from webpages or your computer into the search box. To search images on the web even faster with just one click, you can download the Chrome or Firefox extensions." [8].

D. *Finding copies of an image*

In each test we used a source image of which we know that a copy is also present on a static, stable, public WWW site, already for many months or years. 25 queries with Google search by image revealed 15 of the image duplicates on the WWW site. So this application is successful, effective, efficient, but not in a perfect, complete way.

E. *Correlation between various image search methods*

We know that the image files that we submit as query in search by image do exist on our own public WWW site, but nevertheless some of the queries did NOT reveal their duplicate existing on our WWW site. As users we expect that a search by image fails indeed in some cases, simply because Google is not aware of the image file on the WWW. More concretely, an image file has perhaps not been included in the search system database index or has not even been crawled / harvested or has even not been identified / noted by Google. There can be other reasons / causes / explanations for these observations, which we can catch with the phrase 'erratic behaviour' of the search engine. In general, search failures are understandable and acceptable in the sense that search systems for the WWW do not offer a complete coverage. With this in mind, we may expect a strong correlation between this search by image and the more classical search for images, because they are not separated but on the contrary integrated, in the sense that their database is based on the same WWW reality and crawling / harvesting and indexing systems of the same company. To investigate the correlation between various image search facilities, we started with some of our images and searched for duplicates on our WWW site, not only using search by image, but also using the more classical image search with a text query that consists of the known URL or file name or of words that occur in that URL or file name of the duplicates on our WWW site. We found the following. If a search by image revealed the known duplicate image file on the WWW, then the normal image search also found that duplicate. Four tests of search by image did not reveal the known duplicate; for these cases, we searched also for their duplicate on our WWW site, by using the normal image search with a text query. In only one of these searches, the existing duplicate was again not found, as we may perhaps expect; however, the normal classical image search did find the three other images on our WWW site and in two cases those images were even ranked on top as number 1 in the collection of thumbnail images that form the results of the search. [16]
A second series of tests was performed later. In total, 25 images were submitted as a query. 15 of these were found

with search by text as well as with search by image. 10 were NOT found with search by text and also NOT with search by image. So not a single test gave an image found with one method, but not with the other method. In other words, the correlation between the two methods was complete.
In conclusion, the effectiveness of a search by image to find the duplicate of that particular image on the WWW is strongly correlated with the effectiveness of a more classical search by text to find a copy of that query/source image file on the WWW.
Furthermore we also observed that an image that is included in one and the same WWW page can either be retrievable or not; in other words, not all images that are included in a particular crawled WWW page are treated in the same way by the search engine and service. That is not easy to foresee, accept and understand. In other words, as outsiders, as users we experience this aspect of image search in practical reality as complicated and hard to grasp. [16]
At least we conclude that search by image for duplicate images functions with an efficiency that is highly variable from case to case.

F. Finding modified versions of the source image

We have also investigated how effectively the search system can find images on the WWW that are NOT duplicates / exact copies of a particular source image, but that have common elements.
Above, findings are mentioned that we should repeat briefly in this context: the TinEye search by image service did not reveal images derived from our original images, whereas Google search by image revealed numerous images that include some elements in common with the original images.
In a test series, 16 queries were executed with Google search by image, each one of course with one image. Here we do not consider the original duplicate image on the WWW site of the author. In 12 of these searches, at least one other copy was revealed on another WWW site. The following paragraphs deal with more specific questions.
How effectively can the search system even find images that have gone through some manipulation / modification / alteration that has resulted in a difference in resolution or in number of picture elements? In several tests, a search by image revealed that various WWW sites make a copy of that image available, even when that copy has a different size or modified colours or a combination of both.
How effectively can the system to search by image even reveal other images on the WWW, which contain the image that is submitted as a query as only one component, besides other added images and/or texts, which are not present in the submitted image? The search service even revealed images that contain the image submitted as a query, only as a part besides other images or added text. The search service even revealed images that contain among other elements a modified version of the image submitted as a query, for instance with original colours turned into grayscale.
The following gives some examples of remarkable findings of usage of images without informing the author/creator [16]:

- A photo of a mask from Africa is used as part of a calendar.
- A colour photo of another mask from Africa is used in a poster without colours.
- A photo of a sculpture from Africa is used on the cover of a published book.
- Two photos, each one of an African sculpture, have been combined on the cover of published contemporary music.
- A WWW page containing a few images has been translated and made available on another WWW site.
- A photo of the mountain Kilimanjaro made from an airplane has been copied and put on the popular, big Flickr photo WWW site; there it has already been inspected by thousands of users and it has received numerous comments.

G. Search by image is improving

Finding images and texts related to objects that are semantically similar to the object displayed in a known image would be a useful application to obtain more information about that particular object. This is true in particular if the user knows simply the general nature of the object(s)/subject(s) in the image, but does not know their specific character or names, so that the user cannot express the specific need for information by formulating a specific/focused text query. We have performed practical tests by submitting image files to Google search by image. Here we should realize that the search system can and will consider and analyse the image contents of course, but that the system can also take into account the name of the image file. This file name can provide additional useful information, if it is related to the meaning, to the content of the image. Therefore we have submitted queries each consisting of an image file that avoided to provide Google with a clue on the meaning of its content / subject; these image files were obtained by renaming each file name that was significant / meaningful to a name that was NOT meaningful, such as x.jpg.
In a series of 20 test queries, the results were images showing similar colours, shapes and composition, but no images of other objects that are semantically related to the sculptures on the photos submitted [16]. Performance of semantic image retrieval was even poor in cases when many conceptually related images are present on the WWW, as we know from earlier, other, different ways of exploring the WWW [16]. These disappointing, unproductive results are not surprising, because developing an effective system for a general, generic, high-level semantic search by image through a large and diverse/ heterogeneous collection of images is quite challenging if not impossible. Indeed, it is difficult or impossible for a computer system to match on the one side some or several of the many possible high-level, semantic contents/concepts that can be seen in an image by the user of the retrieval system with on the other side in the computer system the more basic/low-level/essential visual features/primitives of each image, such as the quantifiable attributes/features of colour, texture, shape and the spatial distribution or regions, which can be automatically detected within the pixel domain of the digitized image and which can be automatically extracted/indexed. In general, links between the high-level concepts and the low-level features are weak or

even absent [see for instance 3, 5, 12]. This is reflected by poor performance of the systems, with a low recall and precision of the search results; this is particularly true in the case of big image collections with a broad content. In other words: on one hand, semantically similar images may have dissimilar low-level features, which causes low recall; on the other hand, semantically different images may contain similar low-level features, which causes low precision. This problem is one form of the more general problem in information retrieval, which is known as the "semantic gap" [see for instance 3, 5, 12, 26].

More recently, in 2014, we made more tests, including repetitions of the tests mentioned above. Unexpectedly, in this series of experiments, several test cases yielded search results that included a description of the source image that was correct and in some cases even quite specific, plus semantically related images [17]. This indicates improvement in the performance of search by image to find images that are semantically similar to the query/source image [17].

H. Finding semantically similar images

As mentioned above, searches with some particular source images yield not only visually similar images, but also relevant descriptions and semantically similar images. The cases that deliver such fruitful results are mainly those that start from a source image that is well present on the WWW in the form of several copies, with some of these even in a significant text context [17]. This agrees with

- the comments by the producer of the system, Google: "The feature works best for images of things that are quite well documented, such as often-photographed tourist attractions or images that are seen frequently online." [quoted by 19],
- the observation that a search with a source image of a few famous landmarks also yielded a correct description and other images of the same landmarks [13].

Al this is in accordance with the fact that the Google search system is not purely and simply a retrieval engine to find relevant images from a database that consists only of images, but that it also exploits the texts associated with the images on WWW pages.

"Search by Image returns the best results for images that have related content already on the web, so you're more likely to get relevant results for distinctive landmarks or paintings than you will for more unique photos like your toddler's latest finger painting… The technology behind Search by Image analyses your image to find its most distinctive points, lines and textures and creates a mathematical model. We match that model against billions of images in our index, and page analysis helps us derive a best guess text description of your image." [9].

"Search by image looks for similar content on the web, so unique or never-before-seen images won't work well" [13].

After the retrieval process, the service then offers ideally (i) a correct and specific description of the source image, (ii) semantically similar images and (iii) the WWW pages in which these occur.

This elaborated procedure for information retrieval is a recent and successful example of the general view that exploiting text as well as images in a single, hybrid search action can be more fruitful than exploiting only one kind of retrieval [see for instance 4, 5, 6, 7, 12, 14, 18, 28]. "…a text retrieval and an image retrieval system can simply complement each other." [18].

I. Combining search by image with search by text

The findings mentioned above indicate, show and illustrate that Google exploits also text information on the WWW, even in a search by image only, in other words with a query that includes no text. This can be called an IMPLICIT, somewhat hidden application of a hybrid retrieval action in which images and text are both exploited. Then we can say that Google also allows us to perform EXPLICIT applications of hybrid search by text and by image, combined in one single query. Some tests with this approach have also been made [16]. We can consider the cases in which the image file that is submitted as a query has a filename that does carry some significance in the sense that it is semantically related to the object on the image. For instance, an image shows simply a chair and its filename is simply chair.jpg. In our test cases, search by image did reveal semantically related images and documents. In these cases, we are not dealing with pure search by image only. Furthermore, if we know the type or name of an object or person on the image, then we can also apply more classical searching for images with a query that includes this word or name; therefore, in those cases, search by image is less appealing, as it is not the last resort to find semantically related images. We have considered this in a deeper way, as follows. Can a search by image combined in one and the same query with a search by text for images be more productive in some way than a simple normal search with a text query for images? If we apply a search by image --that is in fact always a search by image in combination with a text search by filename-- then the precision of the results of this kind of search will probably be higher than when only the text search is executed. With the following example we try to clarify this. If we search for images with the word "chiwara", then we find indeed images related to chiwara; these include images of the various subtypes of chiwara, such as male and female, vertical and horizontal. (It is not important in this context, but anyway: the chiwara is one of the generic names of a famous type of headdress created by the Bamana / Bambara people in Mali, Africa). More concretely, such a search in practice gave an image of some chiwara in 16 of the first 20 images showed by Google image search; 12 of these included a male, vertical chiwara. Such a high level of precision of the search results will be satisfactory for most users. But it can get even better as follows. If we search not only with the word "chiwara", but if we make a search by image with a photo of a male, vertical chiwara and when the filename includes the word "chiwara", then we also find images of chiwara, and furthermore all first 20 shown by Google belong to the type male and vertical, without exception. Results like this will probably be experienced as a welcome increase in the precision of the ranked list of results.

This finding agrees again with the view that information retrieval can be made productive in some systems by the combination/integration of content-based image retrieval with more classical text-based indexing and retrieval, as seen above in the more implicit combinations in Google search by image. In conclusion: search by text and image combined in a single search action can increase the precision of search results.

V. CONCLUSIONS / APPLICATIONS / RECOMMENDATIONS

From the findings described above, we conclude that searching by image is evolving to a powerful, additional method to meet information needs, exploiting the increasing number of images on the WWW plus the related texts.
A recommendation: "… libraries should consider providing additional information literacy courses in the areas of image information seeking and visual literacy." [10]. This recommendation was formulated after a survey of how students search for images, mainly with the classical method of searching for images by formulating a text query; clearly the more recent additional tool of search by image can or should also be demonstrated and explained to potential users. Possible applications of search by image are summarized in the following:

A. Finding copies of your image

Search by image allows you to investigate if a particular image that you have created is made available from another WWW site. Even modified versions can be traced. Probably the copy has been published without asking permission from the author or from the original publisher or even without informing the author or the original publisher. This can be interesting in several ways:

- Copyright infringements can be discovered.
- Curators or owners of a collection of objects can assess the impact and reuse of photos of the physical objects in their collection, on a worldwide scale.
- Photographers or artists can assess the impact and reuse on the WWW of images that they have created.

B. Finding other versions of an interesting image

You can start from an image that you know and that you consider as interesting, but that you did not create and that is perhaps not the original version. Then searching by that image may allow you to find

- a more suitable version of that image; for instance a version closer to the original image at a higher level of resolution or quality or integrity,
- the creator/author or the copyright owner of the image or the copyright status of the image,
- a copy or other version of the image plus also its location on some WWW page and WWW site, which can provide you with more information about the image.

C. Finding visually similar images

Search by image allows you to find visually similar images (colours, shapes, textures…). This may have some applications, even though these similar images are in most cases not at all semantically related to the source image.

D. Finding semantically similar images

The following is probably more important and interesting: when the source image is present on the WWW in the form of copies, then a search by image may even directly deliver a suitable and informative description in words of the image, as well as other images that are semantically related/similar, plus links to WWW pages that can provide more information.

E. Increase the precision of search by text for images

To find images that show a particular subject, we can use text queries in some of the available services to search for images on the WWW. Combining two search components in one query in Google image search can be fruitful: you can combine in one query (i) a text search with (ii) a search by image in which the image file subject is clearly and closely related to what you want to find; then this kind of image search can yield a precision that is higher than when only a text query is used.

References

[1] WM. Cao, N. Liu, QC. Kong, H. Feng, "Content-based image retrieval using high-dimensional information geometry," Science China Information Sciences, vol. 57, issue 7, pp. 1-11, July 2014

[2] S. Chapman, "Google rolls out reverse image search: RIP TinEye," 2011, Retrieved from http://www.zdnet.com/blog/seo/google-rolls-out-reverse-image-search-rip-tineye/3463

[3] R. Datta, D. Joshi, and J.Z. Wang, "Image retrieval: ideas, influences, and trends in the new age," ACM Computing Surveys, vol. 40, no. 2, Article 5, pp. 1-60, 2008.

[4] B. Dinakaran, J. Annapurna, and Ch. Aswani Kumar, "Interactive image retrieval using text and image content," Cybernetics and information technologies, Volume 10, No 3, pp. 20-30, 2010, available free of charge from: HTTP: //WWW.CIT.IIT.BAS.BG /CIT_2010 /V10-3 /20-30.PDF

[5] P.G.B. Enser, C.J., Sandom, J.S. Hare, and P. Lewis, "Facing the reality of semantic image retrieval," J. Doc., vol. 63, no. 4, pp. 465-481, 2007.

[6] Y. Gkoufas, A. Morou., and T. Kalamboukis, "Combining textual and visual information for image retrieval in the medical domain," The Open Medical Informatics Journal, 5, (Suppl 1-M6) pp. 50-57, 2011.

[7] N. Goel and P. Sehgal, "A refined hybrid image retrieval system using text and color" [online] Int. J. Comput. Sci., vol. 4, Issue 9, 2012.

[8] Google, "Inside Search: Search by image," [online] Retrieved in 2013 from: http: //www.google.com /insidesearch /features /images /searchbyimage.html

[9] J. Wright, "Search by text, voice, or image" [online] http: //insidesearch.blogspot.be /2011 /06 /search-by-text-voice-or-image.html

[10] K. Huang and D. Kelly, "The daily image information needs and seeking behavior of Chinese undergraduate students," College & Research Libraries, vol. 74 issue 3, pp. 243-261, May 2013.

[11] M. Kandiuk and A. Lupton, "Digital images in teaching and learning at York University: Are the libraries meeting the needs of faculty members in fine arts?" Evidence Based Library and Information Practice 7.2, pp. 20-48, 2012.

[12] Y. Liu, D. Zhang, G. Lu, and W.Y. Ma, "A survey of content-based image retrieval with high-level semantics," Pattern Recognition, vol. 40, issue 1, pp. 262–282, 2007.

[13] M. McGee, "Up close with Google's Search By Image: hits, misses & more" [online] http://searchengineland.com/up-close-with-google-search-by-image-82313, 2011.

[14] Y. Mistry and D.T. Ingole, "Survey on content based image retrieval systems" [online] International Journal of Innovative Research in Computer and Communication Engineering, vol. 1, issue 8, 2013, http: //www.ijircce.com /upload /2013 /october/ 34_Survey.pdf

[15] P. Nieuwenhuysen, "WWW image searching delivers high precision and no misinformation: reality or ideal?" Issues in Informing Science and Information Technology, vol. 7, pp. 109-131, 2010. ISSN: On-line 1547-

5867; CD 1547-5859; Print 1547-5840, peer reviewed journal, available online free of charge from http://iisit.org/Vol7/IISITv7p109-131Nieuwenhuysen770.pdf

[16] P. Nieuwenhuysen, "Search by Image through the WWW: an additional tool for information retrieval," full text published in proceedings of the international conference on Asia-Pacific Library and Information Education and Practices = A-LIEP 2013 "Issues and challenges of the information professions in the digital age" held at Pullman Khon Kaen Raja Orchid Hotel, in Khon Kaen City, Isan, Thailand, 10-12 July 2013 [online] http: //aliep2013.com /images /download /pdfs1 /PaperNo41.pdf & Abstract published in printed Abstract Book, 55 pp., on p. 38.

[17] P. Nieuwenhuysen, "Search by image through the Internet: applications and limitations," in Libraries in the Transition Era: New Space –New Services – New Experience. The Proceedings of the Seventh Shanghai International Library Forum, organized by the Shanghai Library, in Shanghai Library, China, 9-11 July 2014 http: //www.libnet.sh.cn /silf2014 /English /index.htm Shanghai : Shanghai Scientific and Technological Literature Press, http: //www.sstlp.com, 476 pp, ISBN 978-7-5439-6289-7. pp. 145-155. Full text also available free of charge from http: //www.vub.ac.be /BIBLIO /nieuwenhuysen /presentations/

[18] J.-F. Omhover and M. Detyniecki, "Combining text and image retrieval" [online] Proceedings of the EUROFUSE Workshop on Data and Knowledge Engineering, 388-398, 2004. Available free of charge from: http: //www-poleia.lip6.fr /~marcin /papers /Omhover_EUROFUSE_04.pdf

[19] P. Parker, "Google voice search & search by image comes to desktops" [online] http://searchengineland.com/google-voice-search-search-by-image-comes-to-desktops-81633, 2011.

[20] A.S. Patil, N.K. Patil, and V.P. Gejji, "Content based image retrieval – a review" [online] http: //www.irdindia.in /journal_ijeecs /pdf /vol1_iss1 /7%20ICICT-17thNOV-GOA-13_IRD-007.docirdindia, vol. 1, issue 1, pp. 38-43, 2013.

[21] R. Rahimzadeh, A. Farzan, and Y. Fanid Fathabad, "A survey on semantic content based image retrieval and CBIR systems," International Journal on "Technical and Physical Problems of Engineering" (IJTPE), ISSN 2077-3528, issue 18, vol. 6, number 1, pp. 64-69, 2014.

[22] I.F. Rajam and S. Valli, "A survey on content based image retrieval," Life Science Journal, www.lifesciencesite.com, vol. 10, no. 2, pp. 2475-2487, 2013.

[23] M. Rehman, M. Iqbal, M. Sharif, and M. Raza, "Content based image retrieval: survey," World Applied Sciences Journal, vol. 19, no. 3, pp. 404-412, 2012. Available from http: //www.researchgate.net /publication/256748785_Content_Based_Image_Retrieval_Survey /file /60b7d523b534f8e0f4.pdf

[24] H. Stewenius, S.H. Gunderson, and J. Pilet, "Size matters: exhaustive geometric verification for image retrieval," in ECCV 2012, part II, LNCS 7573, edited by Fitzgibbon et al., pp. 674-687, 2012.

[25] B. Thomee and M.S. Lew, "Interactive search in image retrieval: a survey," Int. J. Multimed. Info. Retr., 1, pp. 71-86, 2012.

[26] C.-F. Tsai and W.-C. Lin, "Scenery image retrieval by meta-feature representation," Online Information Review, vol. 36, no. 4, pp. 517-533, 2012.

[27] P. Wang, "Information behavior and seeking" In: Interactive information seeking, behavior and retrieval. Edited by I. Ruthven and D. Kelly, Facet Publishing, pp. 15-41, 2011.

[28] T. Weyand and T. Deselaers, "Combining content-based image retrieval with textual information retrieval," [online] 2005, http:/ /tobw.net /work /cbir/ weyand--research-project--05.pdf