

Image storage and retrieval as an important development in services to library users.

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1. Introduction

The function of libraries is to store the knowledge and cultural heritage of mankind. Some libraries, for example national libraries and major archives, have as their main function the storage of that knowledge and cultural heritage for future generations. However we can accept that in general the function of university libraries is not so much to store material for posterity but to store it and make it available to support the processes of learning and research which take place in the parent institution. Furthermore it has been the case that librarians have moved well beyond the custodial function and it has become an accepted part of their job to promote the use of the material in their care through user education programmes, current awareness services etcetera. Increasingly, as the so called Information Superhighway develops, it will be the case that the knowledge and information stored in any one library will be accessible to researchers in numerous institutions.

To date the knowledge which has been published and so stored by libraries in journals, books, research reports, theses and the various forms of publication which we are used to handling. The essential thing about these sources is that they are paper based and text based. Though of course I accept that whilst they are text based they include information in other forms, graphs of experimental results and photographs of biological samples or archaeological finds are but a small number of examples.

Two years ago at your conference at the University of Thrace, I spoke about the ways in which academic librarians in the United Kingdom were and are collaborating with academics, computer services, publishers and others in the information chain to influence the development of future information delivery in an increasingly electronic environment. It is in that spirit of the academic librarian looking ahead and seeking to influence the ways in which information is packaged and delivered that I wish to use this paper to talk about images and to argue the case that as librarians we should be giving images much more importance and seeking to influence the development of image storage and retrieval systems.

Before I proceed further with this paper, I need to make it clear what I am not talking about. There is considerable development in Britain and I imagine other countries of digitisation of documents. I am NOT talking about images in the sense of creating an image of a document whether this is being done for purposes of the preservation of a

rare original manuscript or for the purpose of making textbooks available to students in electronic form though I recognise the importance of both of these developments. Nor do I intend to discuss commercially available image storage and retrieval software packages such as INMAGIC-Image or Zylimage which provide a means of storing a traditional text based record, such as bibliographic record and link those to surrogate images. Though again I recognise the importance of such packages and should you be interested in them I would direct you to the work of the Dutch Online Group VOGIN as reported by Sieverts and de Zwart(1994).

What I do wish to talk about is pictorial or visual information. To do so I want to say things about the importance of images as a part of the knowledge and cultural heritage of mankind, to consider why it is only now that we have begun to think about images and to outline briefly some of the problems and challenges which face us.

2. The importance of images

In English we have the saying "A picture is worth a thousand words". This is a useful way to remember that there are many areas of scholarship where words are inadequate. Some disciplines where images are important are: archaeology, art, art history, biology, chemistry, design, history, meteorology, medicine and doubtless there are many more that I could and should have added to that list. On some occasions the visual information acts as an adjunct to the text and on others it is important in its own right. For example chemical structure diagrams such as the one in Figure One convey information to a chemist far more unambiguously than does the use of chemical names or even chemical formulae. What sort of buildings would be built if architects had only words not images with which to describe their ideas to the builders? To take a completely different subject area, and using examples from Thessaloniki, how can anyone fail to be moved by the beauty of the golden oak wreath found inside the larnax in the tomb of Philip at Vergina which is shown in Figure 2? I look at it nearly every time I return here. I know what I am going to see as I approach the Vergina room in the museum yet I am always stunned by the beauty of it. I doubt very much that anyone can capture that beauty in words. How much more effective must it be for students of Greek history to see that image or indeed to see the image in Figure Three rather than just have words to explain the importance of the Vergina star: the symbol of dynasty of Macedonia.

Obviously I could use many more examples but I hope that I have made the point that images and indeed artefacts have an important role as part of the knowledge and history of mankind. And it should be said that the chemical and architectural examples were chosen deliberately to make the point that images play an important part in scientific and technical information communication as well as in the humanities.

In academia, to date the collection of images has been confined to a small number of universities and has principally been confined to their use for the teaching of art history and other humanities subjects. One exception to this is their use in medical education and some universities have collections of medical images. Once again the advantage of an image over text should be obvious both for teaching purposes and

indeed probably for medical diagnosis too. So there are some collections of images, usually slides in some universities in the UK. Quite often they might well be kept in a small slide library which is run by the academic department and which has no formal relationship with the university library system which organises the main text-based collections. Usually these collections of slides will be available to the academic staff only and not to the students. Thus it would be fair to say that they are not yet fully exploited. Often they will be poorly catalogued or not catalogued at all. To take one example, we have a collection of approximately 100,000 slides in a slide library within the Department of Historical and Critical Studies at the University of Northumbria. The organisation, and as librarians you might say that I was misusing the word organisation, is simply by having approximately 10 categories such as fashion, art and architecture. Within each category the slides are simply arranged alphabetically e.g. by name of painter.

3. Why is there a sudden interest in images?

The answer to this question is, as you will realise, very simple. It is the ever increasing ease with which images can be stored in digital form and the prospect of accessing those images across the Information Superhighway.

The fact that images can now be digitised then stored, transmitted and displayed to a high quality leads to the vision of a future situation in which large collections of images are digitised and are then made accessible in many locations via the Information Superhighway. In the recent JISC strategy document (JISC, 1996), those charged with overseeing the development of information technology and information services to the UK higher education community have recognised that images have an important place in both teaching and research. In teaching JISC envisages that multimedia CD-ROMs can enhance students learning given their flexibility as learning tools. The same report recognises the importance on digital images for historic medical and artistic research.

So if images are an important resource and there is the technological possibility of storing and transmitting them much more readily than has been the case at present, what are the obstacles to a future in which pictorial information is much more widely used? It is that to which I now wish to turn my attention.

4. Towards accessible image collections

There are a number of small scale institutional developments of image systems. One example is the project to make art images accessible at the Davis campus of the University of California as described by Holt and Hartwick (1994). This project in its experimental phase took a pilot sample of approximately 1,000 images and the images can be retrieved by criteria of shape, texture and colour as well as by the more normal keyword approach. This is achieved by using IBM's QBIC system.

Another experimental system which operates in another part of the University of California is the Image database project at the Berkeley campus and described by Besser (1990). This utilises a text based description of the images from the various

collections at Berkeley which is linked to a collection of image surrogates. A query is constructed using a series of pull-down menus which include access to the vocabulary present in the system for that field. A search term can then be chosen from the vocabulary. This has the advantage of removing the possibility of spelling errors and of indicating to the searcher what is present in the database. When an initial query has been formulated the searcher can view a series of surrogate images which match the search criteria and then choose from that subset. Whilst this is an impressive achievement it is perhaps unfortunate that Besser points out that the starting point in the search is to indicate which of the various image collections at Berkeley the searcher wishes to search. Earlier in the paper, Besser had provided a persuasive case for the fact that images have multiple uses and the same image could be useful to many people from different disciplines for different purposes. It follows then that in all probability it will be difficult to predict which of the collections may contain useful images.

Developments such as these are very laudable but even at their most successful they can only provide access to a single collection of images and across a single campus. As Enser(1995) has pointed out there are image collections stored in many locations other than academic campuses. He notes public libraries, national archives, commercial collections such as press agencies and stock photo libraries, publicity departments of major companies and numerous specialist bodies such as professional societies. Thus there are a lot of images of potential value to the higher education community which are not a part of that community. Additionally those image collections which are available in higher education could be better exploited by the whole community rather than simply people in a single institution.

In my presentation in Thrace, I reported on the way in which the academic sector had worked together to make available to large numbers of academics, researchers and even undergraduates considerable amounts of bibliographic and other data through the collaborative purchase of that data. In addition, I commented upon the way in which the public sector through, librarians, computer service managers and academics had formed alliances with the private sector to undertake research into the new development of information products and services which met the requirements of the academic sector. This same process is now underway with digital image data.

In the United Kingdom, JISC has investigated the need for an image data service for the higher education community. There is a general recognition of the importance of image data within Higher Education. It seems that the recently announced Knowledge Gallery is the major initiative which seeks to bring together both the commercial sector, through companies such as Kodak and Sun and the higher education community with the intention of offering a high quality image data service to the higher education community to the benefit of both the public and private sectors. This initiative has only been in existence for a few months and so there are as yet no products and remarkably little information beyond short press statements, press releases and the occasional internal, unpublished document. The intention is to supplement text based information with sound, still and moving images to stimulate the learning experience....and yes that wonderful statement, as you have probably guessed is taken from the Knowledge Gallery's Press release earlier this year. The

interesting features of the Knowledge Gallery are that once again there is a recognition of the benefits of collaboration between partners in the public and the private sector to the benefit of both. Also there seems to be recognition that the provision of image data is not simply a matter of digitising images and creating large image banks. There is recognition that there is a considerable information retrieval problem. There is also recognition of problems related to copyright/intellectual property rights and of ensuring some method of payment for use which actually preserves the notion of free access. In addition to the Knowledge Gallery initiative, a centre has been set up at the University of Hertfordshire which is a mixture of public and private sector funding and ownership, with the remit of increasing the volume of digital image data available to the academic sector.

5. Research and development needs

Notwithstanding previous comments, it seems to me that the major problem at present as far as image storage and retrieval is concerned is that our ability to create, store and transmit visual images is not matched by a similar ability to provide intellectual access to those images. Too much attention is being paid to the task of digitising images and not enough importance is being given to the task of providing access to those images. Of course I recognise that it might be argued that as someone interested principally in information retrieval, I might be somewhat biased in this assessment. Nevertheless I wish to make a few comments about developments in this area and finish with some thoughts about future needs. The principle problems seem to me to be as follows:-

- the problem of understanding what an image is about
- the cost and feasibility of providing access based on human analysis of images and that analysis being represented as images
- lack of awareness of image users needs from image collections

A major problem in creating image retrieval systems is that of deciding what an image is about. Generally an image will be an image of a specific object but it might also be useful as an image in a more generic sense. Thus, for example, the bridge in figure 4 is a photograph of the Tyne Bridge in Newcastle. It might be used in some cases as an image of the specific bridge, in others as an image of bridges in Newcastle and finally more generally as an image of a bridge. In addition images in fine art have the added dimension that the image often represents an abstract concept or emotion such as love or sorrow.

Various indexing languages have been developed with which to index the content of slides. The most prominent of these are TELCLASS, ICONCLASS and Art and Architecture Thesaurus(AAT). ICONCLASS is the result of several decades of research in art history, in particular Western Art. The schedules of this classification system contain 24,000 concepts which are organised in to nine main classes which have emerged from that detailed study of Western Art: _

magic and religion
nature
human beings, man in general
society, civilisation and culture

abstract ideas and concepts
history
Bible
literature
classical mythology and ancient history

TELCLASS originated in the need to provide detailed intellectual access to the contents of the BBC-TV Film and Videotape library in the late 1970's. Over time it has developed by the incorporation of a general classification scheme. But is generally perceived as being difficult to use. Art and Architecture Thesaurus evolved out of dissatisfaction with LCSH for providing access to material in Art and Architecture. Obviously there are other indexing languages which may be applied to some images.

Nevertheless the problem of the inadequacy of the existing index languages remains. In a small scale investigation in Northumbria, Rania Siatri(1996), whom some of you will know investigated the ease with which AAT could be used to index a sample of images chosen to represent the images to be found on the Internet. Generally she found that AAT was acceptable for indexing objects, assuming that it was capable of being extended in those areas where it had not been fully developed but that it was not very effective for representing those abstract concepts which are so important in the study of art history. Enser (1993) noted that queries taken to the Hulton Picture Library could not adequately be represented in the language of the Gibbs-Smith classification system which had been devised specifically for use with that collection. Thus it could hardly be expected to be a successful tool for mediating between queries and images.

To the fact that there is no satisfactory language yet in existence for the indexing of images must be added the fact that there are very obvious economic constraints which have precluded providing the intellectual access to image collections. Arguably what is required is an ability either to index picture automatically or at least to query an image collection which has not been indexed using a text based system. In this context, an interesting piece of research being undertaken in my own university uses trademarks as its example. Figure 5 gives a trademark of a very well known British company which I know has at least 2 shops in Thessaloniki so you will probably recognise it. Companies must register trademarks with the Patent Office. Before the Patent Office can allow a company to use a trademark, it must check its records and determine that a proposed trademark is sufficiently different from any existing trademark for there to be no chance of the two trademarks being mistaken for each other. Manually checking these records is a time consuming process. The system, known as ARTISAN, has a database of trademark images and it is able to accept queries, not in words but by shape features. It then matches the requested combination of shape features against the database and ranks the database content so that it provides the trademarks most similar to the shapes of the query first (Eakins,1996). The system is operational and is currently being tested to see how well it performs in comparison to the human searchers at the Patent Office. What is hoped for is a system which will significantly reduce the search time for these people by drawing to their attention those shapes most likely to be similar to a proposed trademark so that the Patent Office staff can then make a decision about the acceptability of a proposed

trademark. A related project which only started last month is examining the requirements for interfaces to image databases: at present we have little understanding of how to tackle this problem. Trademarks may seem like a very specialised and esoteric area of image retrieval but the next stage of research is likely to be to try applying the approach used in ARTISAN to very different problems. One which is being considered is in the area of conservation. Could an ARTISAN like system identify problems in paintings by comparing a digitised version of the painting with digitised representations of known defects in paintings. Another problem might be the notion of investigating stylistic analysis of paintings by shape feature analysis. But these are simply possibilities under discussion and about which I understand little so I will not pursue them. Nevertheless I hope that they serve to illustrate the sort of problem which might be tackled.

I must not spend all the time talking about research project at Northumbria rather I need to move to the final area which needs investigation namely that of user information needs for image storage and retrieval systems.

Attempts at providing access to image collections are hampered by the fact that there is a very limited knowledge of how people might wish to access such collections. Thus there is an obvious need for investigations of how people might wish to access collections of images. This is all very well but in all probability peoples' ideas about how they might wish to access collections is hampered by their very limited experiences of available systems. In a recent evaluation of a new OPAC in the UK, I found it quite difficult to discuss with users what they would really like an OPAC to do because their thinking was conditioned by that with which they were familiar. Nevertheless there have been at least two important studies of users' information needs with regards to image retrieval systems.

Enser(1993) has undertaken an extensive analysis of more than 2,700 requests made to the Hulton Deutsch Picture Library. This is the largest picture library in Europe with approximately 10 million pictures in various collections. This analysis indicated that, at least for this collection, the vast majority of requests are for unique images rather than generic images. For example an image of a particular person rather than a person with particular attributes or for a specific boat rather than a particular type of boat. On many occasions where the generic type of query was made it was accompanied by qualifying information about the generic image required. Enser went on to note that the queries presented to this image collection were markedly different from the queries often posed of OPACs in that there was not a tendency for the searcher to ask to translate an information need into a more general statement. Finally he noted that the queries as presented did not translate well into the language of the classification scheme used to organise the images. Generalisations cannot be made about all image collections from the requirements which are placed on this single collection however large and important it may be. However there are some important ideas in this paper about the requirements of image retrieval systems and it will be interesting to see how transferable these findings are to other collections.

The only other reported study of which I am aware is that by Keister(1994) who has reported on the study of image queries which had been brought to the (American)

National Library of Medicine's Prints and Photographs collection. This analysis of queries brought to the library yielded the predictable requests which included a variety of subject/topical terms. Some examples might be the following:-

a picture of a nurse in emergency field service during the First World War.

that picture of Louis Pasteur with his grand-daughter

intestines

chromosomes

a warm picture of nurse, mother and baby

or requests for a famous picture of an eighteenth century psychotic patient tied in a chair

This is a much used picture in the collection and a picture that conveys a lot about attitudes to patients with mental disorders in that era...but of course crucially that implied information is in our interpretation. This data has not been subjected to a detailed analysis but I think that the few examples which I have quoted demonstrate that the notions of general instance and class type, possibly with the modifying attributes would probably apply to this data as well. Clearly there is more work to be done in the area of understanding information needs before successful access to image collections can be guaranteed.

I believe very strongly in the sort of collaborative efforts which we have developed in the UK in recent years. I think we have demonstrated with services like BIDS that there are benefits to all parties in working collaboratively. Thus I think it very likely that developments such as the Knowledge Gallery or something like it will offer the basis of an image data service to the UK higher education community. Of course the Knowledge Gallery may well not be the only service: there may be other similar services developed. Happily librarians are involved in the Knowledge Gallery existence. Clearly there are many problems to be solved. These relate not just to the technology of image digitisation, image storage and image transmission but also to the legal problems of pictorial information ownership and use. The crucial place for information professionals is to ensure that adequate effort is put into understanding the real information needs of users and that appropriate effort is put into developing workable information retrieval mechanisms. Assuming this to be the case then we can look forward to image data taking its proper place alongside textual information as an important part of information provision to our clientele in higher education.

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