VIRAMI - Visual Information Retrieval for Archival Moving Imagery

Christine Sandom [*] *and Peter Enser* [*]

[*] School of Information Management, University of Brighton, U.K
E-mail: c.sandom@bton.ac.uk p.g.b.enser@bton.ac.uk

ABSTRACT
Moving imagery, both documentary and non-factual, is recognised to be an important example of cultural heritage artefact. In common with other representational artefacts, advances in storage and transmission capabilities attendant upon digitisation would seem to provide opportunities for widening access and adding value to collections of film and video material.

Whilst technological advances promise to increase the physical accessibility of heritage information in moving image format, it is not at all clear that they can contribute greatly to the more pressing problem of improving subject access to archival footage.

A research project will be described in which a study has been undertaken of the nature and expression of client demand for archival moving images. Funded by *re*:source, the UK Council for Museums, Archives and Libraries, the project also provides an informed view on current indexing and retrieval strategies for such visually-encoded knowledge, as exercised by a number of representative film archives. It seeks to discover what information seekers require from moving image archives; what role automatic techniques might play in satisfying user requirements; and whether use of specialised terminology necessitates degrees of expert knowledge or thesaural support. This paper focuses on the first of these objectives.

Early conclusions indicate the absence of any consistent approach to subject or content cataloguing, and little in the way of standards to provide guidance; and that, typically, archives face a large backlog of uncatalogued footage. Moreover, requests for footage of specific events, people and places predominate, thereby precluding the widespread adoption of automatic image retrieval techniques.

KEYWORDS: information retrieval, archive, film, moving image, indexing, cataloguing, Internet

INTRODUCTION

Since the beginning of the last century moving imagery, in the form of film, television and video, has become one of the most important repositories of information and entertainment in the developed world. From the events of the early twentieth century, such as Queen Victoria's funeral, to the millennium celebrations around the world, moving images have recorded much of our history and cultural heritage.

News cameras recorded the important events of the century as they happened; however, it is not only news footage that contains information and evidence of twentieth century events and life – documentaries, educational films, features and home movies all contribute

to the store of knowledge. Documentary footage, including magazine films, travelogues, films of exploration and expeditions, and propaganda films all provide illustrations of life and events in general, rather than specific news-worthy incidents. As a by-product of their main objective, feature films record contemporary culture and society: transport, fashion, domestic life and artefacts, attitudes, beliefs, behaviour, and language. Home movies, footage taken by amateurs not intended for public circulation, often reflect the domestic life of families, particularly showing women's roles – the men were generally behind the cameras.

Film collections exist in many archives, libraries and museums around the world, as well as in the stock of commercial footage companies; there are more than 300 such collections in the UK alone [14]. Use of archive and stock film footage is flourishing, for both commercial and non-commercial purposes, and will increase further as more collections become available on the Internet. Additionally, interest in the history of the twentieth century is growing, as can be seen by the number of modern history programmes on television, which may also have an impact on the number of individuals who seek archival footage relating to their local or family history. As purpose-shot film increases in cost, reuse of footage may be a more cost-effective option for film makers, particularly in view of improvements in digital enhancement techniques.

From the collection viewpoint, sales of footage may fund preservation activity, growth of the holding, and in some cases, be necessary to ensure survival.

CONTENT DESCRIPTION AND SUBJECT ACCESS

Film is a blind medium, it must be viewed sequentially using specialised equipment, before its content can be known. Unlike a book, it contains no integral indexes or content lists, and it cannot be accessed randomly. However, unless a film's content is known, its commercial and research potential cannot be realised.

There are two approaches to content description: the first and most commonly used is to describe what a moving image item is about in a synopsis, outline or abstract. This is the approach usually adopted for feature films, for example by the *Internet Movie Database* [12] and *Halliwell's Film and Video Guide* [10]. The second approach is to describe the content of every shot in a moving image item, including technical detail such as camera angles and shot types; this is very time consuming, but shot-listing may be the only way of making film content easily accessible and answering information seekers' needs.

As has been widely discussed in the literature ([4], [5], [6], [7], [17], [18], [19]), describing the content of both images and moving images presents many problems, as images may convey different messages to different people, and it is not easy to pre-judge what aspects of an image or film footage will be useful in the future. This paper summarises a project which looks at the ways in which moving image archives describe the informational content of film footage, as well as researching the use of such archives by information seekers.

THE VIRAMI PROJECT

VIRAMI (Visual Information Retrieval for Archival Moving Imagery) is a two

year project being undertaken by the School of Information Management at the University of Brighton, which has been funded by the UK Council for Museums, Archives and Libraries – *re:*source. Its specific intention is to fill a gap in information retrieval research by conducting a formal analysis of content representation and retrieval in archival moving imagery, including the evaluation of current practice in a number of representative archives.

The project has four objectives:

- To establish whether systematic analysis of client information need reveals the same emphasis on expression of demand for uniquely defined and named visual features in moving imagery as has been found in the case of archival still imagery ([7], [2]).

- To reach a preliminary conclusion as to the role, if any, which Content Based Image Retrieval ([4], [17]) techniques might play, for example in a new breed of hybrid retrieval system, in alleviating some of the dependency on metadata content implied by the above areas of enquiry.
- To establish whether there is a significant pre-iconographic ([16], [19]) dimension to the demand for archival moving imagery which, in seeking to recover images which depict aspects of cultural heritage (e.g., fashion, domestic appliances, industrial processes) invokes layers of specialised terminology, the specificity of which demands expert knowledge and thesaural support.
- To analyse and evaluate current indexing and retrieval strategies in representative moving image archives.

The present paper focuses on the first two of these objectives.

The project has been approached in two parts, firstly from the information provider's perspective, and secondly from the information seeker's perspective. Following a pilot case study based on the South East Regional Film and Video Archive based at the University of Brighton, ten further case studies were selected to represent the major types of film archive: commercial footage companies, national and regional public archives, collections associated with museums, corporate archives, news and television libraries. In addition, extensive searching carried out on the Internet located 75 archives and footage companies with some form of catalogue database on-line. These were reviewed in terms of their search and retrieval facilities and the types of information provided.

The case studies involved interviews to ascertain the size and scope of their collections, the type of information seekers they served, how access is provided to their catalogues, what cataloguing and classification methods are used, and the types of information requests received. A sample of information requests was collected from each; in total 1,270 individual requests from the eleven case studies. The analysis of this data is discussed below.

STANDARDS AND METADATA - THE CASE STUDIES

Of the eleven case study collections only three, all from the public sector, based their cataloguing on Fédération Internationale des Archives du Film (FIAF) rules [11]. None of the other archives catalogued according to any of the published standards; instead, internally created rules and procedures were used.

Three of the case study collections provided subject access via a UDC (Universal Decimal Classification) based system. Other archives provided keyword access, based on a controlled vocabulary, and others used keywords, but did not control their use. Of those archives that did not use a classification system, the majority provided full text searches of their databases. One archive did not use a computerised catalogue system, and had no plans to do so.

The following observations are based on brief studies of the case study collections' databases. The majority of collections provided titles for most of their items; in some cases the items had no original titles and thus they had been provided by the cataloguer.

All of the case study collections provided content description of some kind: as an abstract, a summary, a synopsis or a shot list. The detail varied greatly both between and within collections; from single line summaries to multiple pages of shotlist. Different archives have different approaches to subject description. One of the regional archives, for example, has shot listed some of its collection, but does not keep these lists on their database, using instead short synopses together with controlled keywords; whereas one of the commercial footage companies had fully detailed shotlists for much of their collection. In many cases, the differences within a collection were due to cataloguing backlogs – on acquisition, a brief record may be added to a catalogue to record an item's presence in a collection and full descriptive cataloguing takes place at a later date. In many collections, because of the length of time needed to describe footage, only items considered to have good earning potential are fully shotlisted. Estimates for creating a catalogue entry for a one hour moving image item varied from 16 to 30 hours; it is understandable that potentially lucrative items are given priority.

In addition to subject descriptive information, the majority of the collections retained information relating to the people involved in the creation of the items, the physical format, the dates of creation, release or transmission and copyright restrictions. Other information varied between collections.

ANALYSIS OF ENQUIRIES

To answer the requirements of the first objective, the information requests gathered at the case study archives were analysed in a number of ways. Armitage and Enser [3] described research into user information needs in still image archives, using a method of image content analysis: the Panofsky-Shatford mode/facet matrix [16]. The art historian, Panofsky [16] defined three levels at which the themes of pictures can be analysed; these can equally be applied to moving imagery:

- the pre-iconographic level, which addresses the primary subject matter – what the image shows in generic terms, e.g. a woman, a baby;
- the iconographic level, which addresses the secondary subject matter – the interpretation of the image, with specific people or places identified, e.g. Madonna and child; and
- the iconological level, which addresses the intrinsic meaning of the image – its abstract or symbolic value, e.g. hope, salvation, motherhood.

	Specific (Iconographic)	Generic (Pre-Iconographic)	Abstract (Iconological)
Who	individually named person, group, thing	kind of person or thing	mythical or fictitious being,
What	individually named event, action	kind of event, action, condition	emotion or abstraction
Where	individually named geographical location	kind of place geographical architectural	place symbolized
When	linear time: date or period	cyclical time: season time of day	emotion, abstraction symbolized by time

Figure 1. Panofsky/Shatford mode/facet matrix

This analytical tool, which is illustrated in Figure 1, above, allows image request subjects – people or objects, events, places or times – to be classified in terms of their specific, generic or abstract nature. This method also allows multi-faceted enquiries to be recognised and used as an indication of complexity.

In addition, the requests were analyzed in terms of the type of catalogue information that would be needed in order to retrieve the requested footage successfully: technical information, such as format and type; participant information, such as directors or actors; and content descriptive information, such as synopsis and shotlist.

The enquiries were also considered in terms of the relationships between their levels of specificity and the type of collection, the type of enquirer and the method of contact used. Enquirers were classified as four types:

- commercial – all clients seeking footage for commercial projects, including film and video production and television companies, software developers and advertisers;
- education – all clients involved in teaching and academic research as well as students and schoolchildren;
- individual – generally people searching for visual information about specific people, events or places for personal reasons; and
- non-commercial – organisations that do not operate for profit, such as clubs, charities, libraries and record offices, film societies, military associations and organisations, councils and museums.

The majority of the data sample, 928 (73%), emanated from commercial enquirers. The remainder of the enquiries originated as follows: 73 (6%) from education clients, 109 (9%)from individuals, 99 (8%) from non-commercial organisations, and 61 (4%) from clients whose type could not be determined. The high number of

commercial enquiries resulted partly from the fact that a number of the case study archives dealt mainly with this type of enquirer, and partly because commercial enquirers often submitted multiple information requests, sometimes more than 50 individual enquiries in one contact.

Of the 1270 enquiries, 122 were for items that did not relate to the subject or content of footage; instead they were for known titles, films by particular directors, or starring particular actors. These requests were not included in the facet analysis.

The majority of the data sample, 928 (73%), emanated from commercial enquirers. The remainder of the enquiries originated as follows: 73 (6%) from education clients, 109 (9%)from individuals, 99 (8%) from non-commercial organisations, and 61 (4%) from clients whose type could not be determined. The high number of commercial enquiries resulted partly from the fact that a number of the case study archives dealt mainly with this type of enquirer, and partly because commercial enquirers often submitted multiple information requests, sometimes more than 50 individual enquiries in one contact.

Of the 1270 enquiries, 122 were for items that did not relate to the subject or content of footage; instead they were for known titles, films by particular directors, or starring particular actors. These requests were not included in the facet analysis.

Client type	Specific	Generic	Abstract	Total
Commercial	562 (64%)	547 (62%)	21 (2%)	876
Education	24 (49%)	30 (61%)	0	49
Individual	87 (92%)	21 (22%)	0	95
Non-commercial	74 (88%)	26 (31%)	0	84
Unknown users	33 (73%)	21 (47%)	1 (2%)	44
Total	780 (68%)	645 (56%)	22 (2%)	1148

Table 1. Enquiries by mode and client type

Table 1 shows that individual clients submitted the most specific requests; they also made the most detailed requests, as is demonstrated by Table 2, below. Education enquirers, in contrast, submitted the fewest specific requests as well as the least detailed.

Client type	Average number of specific facets	Average number of generic facets	Average number of abstract facets	Average number of all facets
Commercial	0.87	0.84	0.02	1.73
Education	0.65	0.67	0	1.33
Individual	1.82	0.26	0	2.08
Non commercial	1.57	0.36	0	1.93
Unknown users	1.07	0.57	0.02	1.66
All types	0.99	0.74	0.02	1.76

Table 2. Enquiries by client type and number of facets

The measure of complexity of the enquiries is indicated by the number of facets: more than half of the enquiries had two or more facets, and the most complex subject enquiries numbered four or five, in some cases further refined with technical information; for example: 'famous black and white shot circa 1940/50 of a couple embracing in silhouette in an alleyway at night'.

The levels of specificity and complexity in enquiries by commercial users were lower than individual and non-commercial clients; their requirements were generally less stringent and more loosely defined. Phrases like 'anything about...', or 'something that says...', indicative of a less precise requirement, appeared more frequently for commercial clients; for example: 'Poland or something that says Poland', or 'anything to do with Jewish immigration to South Africa'.

The metadata level analysis noted that from the total of 1270 enquiries, 1178 were considered answerable by metadata alone; thus in order to answer 92 (7%) of the enquiries some kind of mediation, in the form of a subjective judgement or expert knowledge, would have been needed. Although complete shot listing was not a common practice, 384 (30%) of the queries could only have been successfully answered from shot list level description. These included requests that specified a particular shot type, format or camera position, some 90% of which originated from commercial clients, who tend to have a more informed view of the type of images they are seeking.

Eleven of the enquiries could only have been answered from non-documentary or feature footage, as they requested events that predate the invention of moving image cameras; for example, 'Livingstone with bearers' or 'Ancient Britain - Queen Boudicca with chariot and blades'; another possible reason for providing a greater level of subject description than brief synopses for non-documentary films.

It can also be clearly seen from the results of these analyses that CBIR techniques in the form of automatic indexing and retrieval based on image

attributes, offer very little potential for answering the needs of the researcher for archival moving image resources.

MOVING IMAGE ARCHIVES AND THE INTERNET

Increases in processing and telecommunication line speeds, together with advances in compression and communication software and Internet movie players, as well as decreasing costs, have meant that archival moving imagery can be made accessible to both home users and professional researchers.

Since 1982, when the first 80286 processor was introduced, processing speeds have increased from 900,000 instructions per second to the Pentium 4's 1,500 million instructions per second [1]. One hour of colour video is estimated to take up between one and two Gigabytes of disk space, depending on resolution and compression. The low resolution, small dimension moving image clips which are presented on some archive sites are short in duration, generally of about two minutes run time, and the file sizes average 1.1 Megabytes per minute of run time.

Although these advances are opening up access to archival moving imagery to many people, communication speed is still a problem, with the faster Modems operating at 56 Kilobits per second and ISDN at 128 Kilobits per second. Even with streaming technology and the small clips that are available on archive sites, downloading can be prohibitively slow; therefore browsing through numerous short clips to find required footage may not be an acceptable option for many researchers.

Many archives and footage companies have sought to increase their visibility by using the Internet. The majority do this to maximise their commercial potential, although some archives, particularly those that are publicly funded, are interested in increasing access to their collections of moving images for less commercial reasons – education and academic research, family and local history, or individual research for personal interests.

The Internet film collections considered in this study, some 75 in all, represented both commercial and not-for-profit organisations, and included stock footage companies, news archives, film and television libraries, museum film collections and national archives. The main purpose was to establish the type of metadata used by each collection, particularly relating to subject description, the level of use of digitised moving imagery as a supplement to, or in place of, subject description, the types of search facilities available and whether there was any consensus on what information should be provided to seekers of moving image information.

The study noted that there was no consistent approach to presenting collections of moving images on the Internet. A number of the web sites contained only information about their collections and how to physically locate them, others provide fully searchable text databases of their entire collections. Some collections provided sample footage as browsable clips, and only one appeared to make extensive use of available technology, by providing a searchable text database in combination with digitised footage, key frames, keywords and synopses.

There was also no consensus on how best to describe individual items within a collection, that is, what type of catalogue information should be

provided. A great variety of different types of information was noted, suggesting that cataloguing standards or rules were not in general use. In total, the 75 web sites used 101 different data elements to describe items within their catalogues. Many elements were unique to a single collection, and were as diverse as anthropologist, weather conditions and predominant colour. The most commonly provided information were titles; summaries, synopses, or abstracts; and runtimes.

Half of the 101 data elements used by these collections were not prescribed within any of the moving image cataloguing standards or guidelines. These included both descriptive and technical data, such as: surroundings, scenics, viewed by censor, origin, processing lab and film stock.

The two sets of standards specifically designed to catalogue moving images, *Archival moving image materials - a cataloging manual* [15] and the *FIAF cataloguing rules for film archives* [11] both specify more than 80 separate data elements to provide a complete catalogue record for a moving image item. The eleven case studies of the project averaged 30 data elements, whereas the Internet-based collections averaged ten. There may be many reasons for this apparent paucity of information – that the less detailed catalogue may be necessary for reasons of space and time optimisation, or that the amount of detail contained within the Internet catalogues has been confined to what is relevant to footage seekers, and other information, such as collection management data, may have been omitted. However, at this point, research has not been carried out into what information Internet searchers require about moving image items, and whether this differs from the requirements of searchers using other means of accessing catalogues.

A great variety was also evident in the levels of content description used. There is, as has been previously described, very little published guidance on the best way to describe the content of moving image footage; this was apparent from the wide variations in descriptive levels which were noted both within and between collections. Some catalogue databases, usually of news or documentary footage, gave very detailed, shot by shot description; for example, the description of a London Transport film, within Film Images (London) Ltd's database and accessed via their web site [8] included the following entries:

01:05:00:00-01:10:00:00
high < shot of people on ascending escalator
ms man in bowler hat getting ticket from machine
cu list of destinations on ticket machine
vs ticket machines being used
ms group of people on platform as train pulls in
cu train doors closing
dark shot of interior of underground train with men in bowler hats reading newspapers
mcu hand with stick pointing to underground map
vs tunnel entrance under excavation
mcu small group of workmen descending in lift into tunnel
vs workmen digging tunnel and trucks filled with earth moving past
ms workmen drinking tea etc in tunnel

Figure 2. Part of a shot list

The full shot list for this five minute period of time of footage ran to more than thirty lines.

In contrast, other catalogues, particularly for feature films, gave very short synopses of their content. As such

films are generally viewed sequentially and in their entirety, it may be argued that there is no requirement to describe their content in detail; however, this ignores the increasingly recognised view that feature films contain a wealth of information about contemporary life, attitudes and culture, quite apart from their story lines and entertainment value. The following example describes an 80 minute feature film made in 1996, from the archive of Irish Film at the Irish Film and Television Net website [13].

This film is a tragi-comic story of deceit, lust and incest between two middle class couples over a weekend in Dublin

Figure 3. Example of a film synopsis

This synopsis does not recognise the film's potential use to cultural historians seeking information relating to late twentieth century Dublin.

Although there is little commonality of catalogue detail across the collections, many of them can be accessed using a common footage search portal, Footage.net [9], which provides full-text searching and browsing capabilities.

The majority of collections provided text search capabilities. Sites which showed moving image clips or stills generally provided them as examples or demonstrations of the type of collection, rather than for information searching. Some, indeed, provide rather pithy short descriptions to accompany the images, rather than serious subject description, and it might be assumed that their presence is more for Internet browsers rather than footage research.

Evidence of any use of formal classification systems was rare, only some examples of use of subject keywords were noted, perhaps demonstrating the prevalence of full text searching within these collections, and within the Internet itself.

It is clear that growing numbers of moving image collections are looking to the Internet as a vehicle for increasing their visibility and maximising their commercial potential, and that the Internet provides visual information seekers with low cost access to footage collections around the world. However, the variable quality and quantity of information, particularly content description, may suggest that effective searching may be difficult to achieve.

CONCLUSION

Advances in computing and communications technologies offer the potential for increasing access to cultural heritage in the form of moving imagery – probably the most comprehensive storehouse of information about the twentieth century. Improving hardware technology has meant that the enormous files that digitised moving imagery creates can be stored and accessed via the Internet, and software developments have given us effective compression and online movie players, as well as new automatic image indexing and retrieval techniques.

But our research shows that, in the great majority of cases, the moving image information seeker is looking for film that illustrates specific events, showing named individuals or groups of people, in particular places or on unique dates. CBIR offers no solutions to the problem that without effective cataloguing, in particular, the provision of subject and content descriptions, the researchers' needs could not be met.

It might be further argued that, if a

film's content is not textually described, researchers must remain heavily dependent on the collection and domain knowledge of the archivist or librarian; if no one knows what information is contained on the artefact, it cannot be considered as a resource for serious information seekers.

REFERENCES

1. Archivebuilders.com. *Site summary, http://www.archivebuilders.com/whitepapers/27006v003p.pdf*

2. Armitage, L.H. & Enser, P.G.B. *Information need in the visual document domain,* British Library, London, 1996 (British Library Research and Innovation Report 27).

3. Armitage, L.H. & Enser, P.G.B. Analysis of user need in image archives. In *Journal of information science,* 23(4), 1997, 287-299

4. Eakins, J.P & Graham, M.E. *Content-based image retrieval: a report to the JISC Technology Applications Programme*, Institute for Image Data Research, University of Northumbria at Newcastle, 1999, *http://www.unn.ac.uk/iidr/report.html*

5. Enser, P.G.B. Pictorial information retrieval. (Progress in Documentation). In *Journal of Documentation* 51(2), 1995, 126-170.

6. Enser, P. Visual image retrieval: seeking the alliance of concept-based and content-based paradigms. In *Journal of Information Science,* 26(4), 2000, 199-210.

7. Enser, P.G.B. & McGregor, C.G. *Analysis of visual information retrieval queries,* British Library, London 1993 (British Library R&D Report 6104)

8. Film Images (London) plc. *Welcome to Film-Images.com., http://www.film-images.com/*

9. Footage.net. *FOOTAGE.net - The stock, archival and news footage network, http://www.footage.net*

10. Halliwell, L. *Halliwell's film & video guide,* Harper Collins, London, 1997

11. Harrison, H. W., Ed. *The FIAF cataloguing rules for film archives.* Saur, München, 1991

12. The Internet Movie Database Ltd. *The Internet movie database, http://us.imdb.com/*

13. Irish Film And Television Net, http://www.iftn.ie

14. Kirchner, D., Ed. *The researcher's guide to British film and television collections.* Fifth edition, British Universities Film and Video Council, London, 1997

15. Library of Congress, *Archival moving image materials - a cataloging manual,* 1999. *http://www.tlcdelivers.com/tlc/crs/arch0332.htm*

16. Panofsky, E. .*Studies in iconology: humanistic themes in the art of the Renaissance,* Harper & Rowe, New York, 1962

17. Rasmussen, E.M. Indexing images. In: Williams, M.E., Ed. *Annual review of information*

science and technology Volume 32. Information Today (ASIS), Medford, NJ, 1997, 169-196.

18. Sandore, B., Ed. Progress in visual information access and retrieval. In *Library Trends,* 48(2), 1999, 283-524.

19. Shatford, S. Analysing the subject of a picture; a theoretical approach. In *Cataloging & Classification Quarterly* 6(3), 1986, 39-62.

ABOUT THE AUTHORS

Christine Sandom is a Research Officer in the School of Information Management at the University of Brighton, UK. An early career in information technology, culminating in senior level responsibilities within a major international corporation, initiated an interest in database and information retrieval techniques. A desire for a change in career led to a degree in information and library studies from the University of Brighton which stimulated her present involvement with the indexing and retrieval of visually encoded information.
E-mail: *c.sandom@bton.ac.uk*

Peter Enser is Professor of Information Science and Head of the School of Information Management at the University of Brighton, U.K. He has extensive teaching and management experience in Higher Education, together with long standing research interests in visual image indexing and retrieval. Among his professional roles currently are those of President of the Institute of Information Scientists, and membership of the Library & Information Science Peer Review Panel of the U.K. Arts & Humanities Research Board.
E-mail: *p.g.b.enser@bton.ac.uk*