# Archival Moving Imagery in the Digital Environment

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**Abstract**

Moving image media record much of the history of the twentieth century, and as such form an important aspect of our cultural heritage. Although potentially of great importance to both the education and commercial sectors, much of this store of knowledge is not accessible, because its content is not documented.

Digitisation is being considered as a means of making historic footage more accessible by allowing moving imagery to be displayed via the Internet. Further, digitisation of still and moving imagery opens the possibility of relieving the time-consuming and expensive process of descriptive cataloguing, by using automated indexing and retrieval techniques, based on the physical attributes present in the imagery, such as colour, texture, shapes, spatial and spatio-temporal distribution. These techniques, developed by the computer science community, are generically known as Content Based Image Retrieval (CBIR).

But will this type of image retrieval answer moving image archive users' information requirements? A project is being undertaken which researches the information needs of users of such archives; one of the objectives of this project is determine whether CBIR techniques can be used to answer these requirements

An analysis of requests for moving image footage received by eleven representative film collections determined that nearly 70% of the requests were for footage of a uniquely named person, group, place, event or time, and in many cases a combination of several of these facets. These are data that require to be documented in words.

From this and other analyses, it may be determined that digitisation and automatic indexing and retrieval techniques do not at present offer an alternative to the textual subject descriptive process necessary for access to information stored in the form of moving imagery.

## Introduction

In the visually stimulated society of the early twenty first century, the major vehicles for the dissemination of information are visual, particularly in the form of moving imagery: television, film, video. For example, according to recent statistics, watching television is the most common home-based activity of adults; some 99% of adults watch television [1], and the average weekly viewing time is more than 26 hours [2]. In comparison, only 54% of adults read a daily newspaper [3].

Moving imagery also comprises one of the largest stores of information about the twentieth century -from the funeral of Queen Victoria, through two world wars, to the millennium celebrations, the camera was present at the important events. However it is not only news footage that has value in informing our understanding of the recent past; documentaries, feature films and home movies all have a contribution to make to our store of knowledge. As such, all forms of moving imagery have great potential for use in education, historical and cultural research as well as for commercial use in the entertainment and advertising fields. There are more than 300 collections of film in the United Kingdom [4] - academic, commercial, private and public - many of which are available for research use.

Moving imagery, however, it not easy to access. Film is not a medium that can be simply viewed with the naked eye; some kind of specialised equipment is necessary. Further, it has to be watched sequentially and cannot be accessed randomly. Unlike a book, its content is not described or analysed in ari integral index or contents list. Unless some kind of content or subject description is provided, it is difficult to discover what a film contains without watching it.

Unfortunately, the task of describing the content of moving imagery is time consuming and expensive, and often requires a high level of specialised knowledge. Although there are published cataloguing standards for moving imagery [5, 6, 7], these provide little in the way of advice on subject description. Many archives have developed their own standards for content description, but there is little consistency in the approaches adopted by different archives. Moreover, many film archives have large and growing backlogs of items for which there are no content descriptions. There is little potential for unmediated access to such collections and seekers for information held in moving image form may find that their search efforts are hampered both by the absence and the inconsistency of descriptive catalogues.

## Digitisation

Digitisation is being looked at as a powerful technique for increasing access to information held in

all formats. Using the Internet, facsimiles of the world's great cultural artefacts can be brought to our homes, schools, libraries and offices. There is no need to travel to Rome to view the Sistine Chapel ceiling [8] or to visit art galleries throughout Europe and the United States to see the entire works of Vermeer [9], when they all can be viewed, in close up, on our computer screens. The Internet not only bridges geographical distances, but allows us to view facsimiles of artefacts of either such great historical significance or such fragility that they would normally be inaccessible: for example, the British Library website displays both a facsimile of the Magna Carta - the information-bearing artefact - and a translation thereof [10]; the American Duke University Papyrus Archive allows access to facsimiles of their papyrus collection as well as the catalogue records describing the artefacts and the information they contain [11]. Access to archival moving imagery is also beginning to be available via the Internet, with short sample clips being presented on a number of sites [12, 13, 14]

## Content Based Image Retrieval (CBIR)

In the field of image and moving image retrieval, digitisation also offers the possibility of using automated indexing and retrieval techniques that use non-textual search strategies; generically termed Content Based Image Retrieval. CBIR has been proposed as an approach that will free the visual image archivist from the problems of describing the concepts portrayed within an image or moving image, and provide visual information seekers with new methods of finding the images that they seek.

These new means of retrieving visually-encoded information are based on the attributes of an image, rather than what it represents. The image attributes that are used are colour, texture, shape, spatial distribution and, in the case of moving imagery, spacio-temporal distribution. For example, a digitised image can be analysed in terms of its colours, and a colour histogram used for its index. Searches for 'like' images would seek similar histograms, and retrieve pictures with similar colour distributions. [15,16, 17]

The computer science community has been undertaking research into CBIR techniques for some years and, as well as the colour-based applications, a number of systems have been successful. The Internet is a rich source of information about CBIR, describing new research as well as demonstrating successful past projects. Websites, often university computer science department sites, can be found offering demonstrations of techniques such as matching images effaces, cars and trains [18], colours, textures and colour composition [19], and sketched pictures [20]. CBIR image similarity search techniques can also be found in use in image search engines [21], and in at least one commercial site [22].

From these sites and use of the demonstrations, it can be determined that for images whose content, in terms of colour, shape or texture, has intrinsic information value, CBIR can play an important part in increasing their accessibility. However, where the desired image is of a specifically named person, place, thing or event, CBIR techniques cannot take the place of the more traditional text-based methods.

For example, a similarity search using an image of the Eiffel Tower as the picture example retrieved five hundred images, three of which were, indeed, of this edifice, together with images of space rockets on launch pads, a pagoda, the Washington monument, the statue of Liberty and a grain silo. Similarity searches on images of specific people had a very low precision rate - a search using a portrait of Michael Portillo produced many portraits of people, both men and women, wearing ties, none of them being the requested person.

Searches using art works as picture examples again retrieved numbers of inappropriate images. The Duke of Urbino, by Piero della Francesca, used as a picture example, retrieved a number of full face photographic portraits, as well as a Barbie doll, a tallboy dresser and an ethnic urn. Similarity was apparent in terms of the colours in the images and the placements of the central objects; but these were not images that might satisfy a searcher looking for similar mediaeval Italian portraits.

## VIRAMI

VIRAMI (Visual Information Retrieval for Archival Moving Imagery) is a two year project, funded by resource, which researches inter alia the information needs and retrieval strategies of users of moving image archives. One of the four objectives of this project is to evaluate the role, if any, which CBIR techniques might play in answering user requirements, and thus alleviating some of the moving image archives' dependency on subject and content descriptive cataloguing.

The research initially concentrated on the South East Regional Film and Video Archive based at the University of Brighton, and was then expanded to cover a further ten case studies, selected to represent the major types of film archive: commercial footage companies, national and regional public archives, collections associated with museums, corporate collections, news archives and television libraries. A sample of users' requests for film footage was collected from each resulting in a total of 1,270 individual requests from the eleven case study archives.

As figure 1 indicates, the footage requests ranged from the very simple, single-term items, to highly complex - specifying unique events, and often including technical shot or film type requests.

Simple single term queries

- Transport
- Meercats
- Portillo
- The supernatural

Multi-faceted requests

- Ferries departing at night
- Animal rights protestors outside Hillgrove cat farm, wearing masks
- side pov of German countryside from train window and pov through stations
- Delegation of Australians arrive to discuss new constitution - Alfred Deakin, Edmund Baston, Robert Dickson in London with Joseph Chamberlain (Secretary of State for the Colonies 1900)
- "Famous" b & w shot circa 40-50 of a couple embracing in silhouette in an alleyway at night

Highly specific and complex requests

- John Lcnnon/Yoko Ono sleep-in, Amsterdam, March 21 in 1969
- The 2nd Battalion as Guard of Honour in Palestine, General Allenby and Duke of Connaught inspecting troops in 1918
- Newsreel of the Britannia Shield (Boxing) which took place at the Empire Pool, Wembley, on Wednesday 5th October 1955.
- Mother [of the enquirer] achieving world athletics record for 880 yards at the White City, on 17 September 1952 of 2 minutes 14.5 seconds.

**Figure 1. Examples of the different levels of complexity in requests**

Figure 2a gives examples of requests which required some subjective judgement on the part of the researcher or cataloguer, whilst Figure 2b illustrates some requests which demonstrated a lack of understanding of moving imagery within the historical context, and which thus could not be resolved with documentary footage; only feature or recreative footage could apply.

- women at work and at play - must look 'British'
- Quirky - light hearted view of transport - cars - 20s to 70s

**Figure 2a**

- First phonograph (cylinder) Edison 1877
- British settlers arriving in Cape Harbour, South Africa, in the early 1800s
- Ancient Britain - Queen Bodicea with chariot and blades
- Livingstone and bearer

**Figure 2b**

The information requests were analysed in a number of ways, including their levels of use of specific terminology and their complexity. In a previous research project, relating to user

information needs in still image archives, Armitage and Enser [23] described the analysis of image content using the Panofsky-Shatford mode/facet matrix. Irwin Panofsky [24], the art historian, defined three levels at which the subjects or concepts of pictures can be analysed; these are equally relevant to the subjects of moving imagery. These levels are: pre-iconographic, which addresses what the image shows in generic terms, e.g. a woman, a baby; iconographic, which addresses the specific subject matter, with people or places named or identified, e.g. Madonna and child; and iconological, which addresses the symbolism of the image - its abstract concepts, e.g. hope, salvation, maternity.

This analytical device, which is illustrated in Figure 3, below, allows footage request subjects - people or objects, events, places or times - to be stratified in terms of their specific, generic or abstract nature. It also allows enquiries comprising a number of different facets to be recognised and used as an measure of complexity.

| | 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 symbolised |
| When | linear time: date or period | cyclical time: season time of day | emotion, abstraction symbolised by time |

**Figure 3. Panofsky/Shatford mode/facet matrix**

Of the sample of 1270 footage requests, 1,148 requests were subject requests: the remainder were requests for particular titles, directors, actors, shot types and the like. The results of the mode/facet analysis of these subject requests were:

| | Specific (Iconographic) | Generic (Pre-Iconographic) | Abstract (Iconological) |
|---|---|---|---|
| Who | 373 | 409 | 4 |
| What | 100 | 310 | 16 |
| Where | 360 | 120 | 1 |
| When | 310 | 13 | 1 |
| Total | 1143 | 852 | 22 |

**Table 1. Summary stratification of subject requests**

It can be seen from the table that there was a large number of requests for footage of specific subjects; for example, 373 requests included a named person, group or object, 100 a specific action or event, and 360 a specific place. In all the footage requests included 1,143 named people, events, places or times. It should be noted that the total number of facets is more than the total number of

requests, because many of the requests comprised more than one facet. Requests for specific subjects were more evident than for generic subjects, and requests for abstract subjects were unusual.

The table below gives an indication of the complexity of the requests, as it stratifies the number of requests by the number of facets of each category and in total.

| Number of facets in request, (n) | Requests with (n) Specific facets | Requests with (n) Generic facets | Requests with (n) Abstract facets | Total number of requests with (n) facets |
|---|---|---|---|---|
| 0 | 368 | 503 | 1126 | 0 |
| 1 | 519 | 456 | 22 | 542 |
| 2 | 171 | 172 | 0 | 390 |
| 3 | 79 | 16 | 0 | 173 |
| 4 | 11 | 1 | 0 | 40 |
| 5 | - | - | - | 3 |
| Total no of requests n > 1 | 780 | 645 | 22 | 1148 |

**Table 2. Analysis of request complexity**

This shows that 780 of the 1148 subject requests (68%) contained one or more specific facets; i.e. requests for footage of a named person, group, event, place or time, and that 645 (56%) included one or more generic facet. More than half of the subject requests comprised two or more facets, and the maximum number of facets in one request was five, which occurred in 3 requests.

As has already been discussed, CBIR techniques at their current stage of development are not appropriate for image retrieval when the information request is for a specific, named item. The high proportion of requests for moving imagery of such items, noted in this study, effectively precludes the use of CBIR for image retrieval within moving image archives. A small number of the footage requests, .however, was noted,, which potentially might be answered using a hybrid technique - these included requests for footage of clouds, mountains, skyscapes, desert, and sunrise. In an informal test using an initial keyword search and one of the retrieved images as a picture example, additional similar images were retrieved based on shape and colour, although even these simple requests retrieved many irrelevant images.

Although the basic image retrieval by image attribute techniques may not have much relevance for archival footage, various advances in the CBIR field have the potential to make the process of subject description and cataloguing considerably simpler. Descriptions of several experimental systems can be found via the Internet. These include: shot level video segmentation and key frame detection, which can be used to provide a story board which can then be used by a cataloguer to describe what's going on in the shot [25, 26, 27]; speech recognition to provide automatic transcription of video soundtracks, which can be used with time codes as a textual index for the footage [28, 29]; video skimming, which creates a video abstract that can be viewed in

considerably less time than the original [29]

It must be remembered that CBIR techniques are only applicable to digitised media and there are issues that need to be considered before any moving image archive embarks on wholesale digitisation. Digitisation is just not a practical option for many archives, and only one of the project's case study collections was actively undertaking a large-scale digitisation programme. The creation of digital copies is in itself a time consuming activity and although storage costs are decreasing year by year, it would not be practical in view of the size of some moving image collections to consider anything but a very limited digitisation programme. Moreover, developments in computer hardware, especially digital storage technologies and software mean that the current digital media may swiftly become obsolete - consider the 5 V4 inch floppy disk? There are, as well, questions over the unproven longevity of digital media.

Transmission speeds also present a problem if access to digitised archival moving imagery is to be made available via the Internet. Film clips that are currently available are generally poor quality, low resolution, and with a small display area. Even so, they create large files: a typical Quicklime movie clip has a file size of approximately 116KBytes per second playing time, which equates to nearly 420MBytes per hour. One hour of compressed colour video is estimated to require up to 2Gbytes, dependant upon image quality [30]. To download even a low resolution, poor quality, movie clip is slow: with modem speeds of56Kbits per second, a typical 20 second clip would currently take a minimum of five and a half minutes to download.

## Summary

The VIRAMI project has determined that, because of the predominance of information requests which are for specifically named items, automatic indexing and content based retrieval is not, at present, of great use for archival moving imagery. However, advances in techniques such as video skimming and shot segmentation will provide an invaluable tool for cataloguers to use. Speech recognition techniques will further assist by their capability for creating automatic indexes - potentially providing connotation to the denotation provided by the images themselves.

But there is much in the way of digitising that needs to be done before these advanced techniques can fully meet their potential. There is still no alternative for the skills and expert knowledge that the experienced cataloguer and archivist can bring to their task.

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