Developing a MovieBrowser for Supporting Analysis and Browsing of Movie Content

Nazlena Mohamad Ali, Alan F. Smeaton, Hyowon Lee
Centre for Digital Video Processing
Dublin City University
Ireland
nmohamadali@computing.dcu.ie

Pat Brereton
School of Communications
Dublin City University
Ireland

ABSTRACT

There is a growing awareness of the importance of system evaluation directly with end-users in realistic environments, and as a result some novel applications have been deployed to the real world and evaluated in trial contexts. While this is certainly a desirable trend to relate a technical system to a real user-oriented perspective, most of these efforts do not involve end-user participation right from the start of the development, but only after deploying it. In this paper we describe our research in designing, deploying and assessing the impact of a web-based tool that incorporates multimedia techniques to support movie analysis and browsing for students of film studies. From the very start and throughout the development we utilize methodologies from usability engineering in order to feed in end-user needs and thus tailoring the underlying technical system to those needs. Starting by capturing real users' current practices and matching them to the available technical elements of the system, we deployed an initial version of our system to University classes for a semester during which we obtained an extensive amount of rich usage data. We describe the process and some of the findings from this trial.

INTRODUCTION

There is an increasing use of digital media in application areas such as medicine, digital libraries, entertainment, communications and education. As a result of developments in multimedia technologies, the prospect of wide and ubiquitous use of new media is promising in various domains. Video, which has tremendous potential in learning, is a very rich information source that contains visual, audio and textual elements woven together in a temporal basis, providing a rich multimedia experience suitable for a variety of tasks spanning work and play [9]. With the growth in management tools for digital video and its potential valuable usage as a learning tool, digital video can offer exciting ways for students to study better, especially in the context of film studies.

As in the education field, some of the main teaching benefits have been previously described regarding the use and assistance of DVD add-ons (e.g. director's commentaries) in providing a bonus features for teaching film [6]. The strategy of using add-on features often strengthens the overall appeal of the medium for the user, providing a bridge to established film studies and also have significant educational applications. Thus, this new strategy and 'tool' is also of great use to help students acquire the skills of reading film in future.

Our approach tries to balance a technology-driven contribution to the development of a system, with the user-centered and context-driven contribution from the beginning in making the system useful and usable as Figure 1 illustrates.
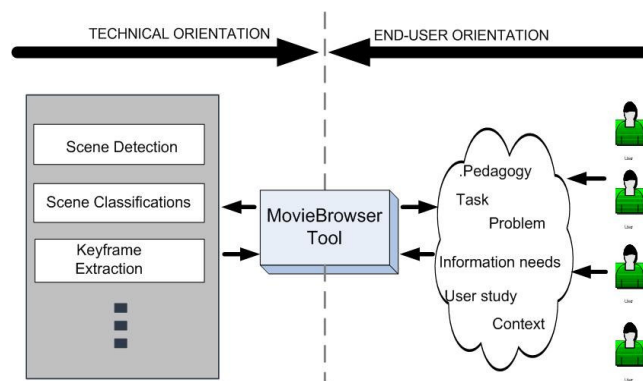

Figure 1: Context Framework

The initial starting point for our work are the technology components (left side of Figure 1), developed within our research centre, which automatically segment a movie into individual scenes then classifies them into action, dialogue and montage [2]. Representative keyframes from the segmented and classified scenes are automatically extracted to visually summarise the video.

As the goal of the application we have developed is to support learning (particularly movie content analysis and browsing), pedagogical consideration is an important user perspective we wanted to bring in. Our initial requirement analysis stage involved a number of interviews with lecturers on the Film Studies course in order to understand the aims, objectives and styles of their teaching, studying of teaching materials and assignments, as well as class

participation in order for us to understand the atmosphere and environment in the classes.

We believe that in order to develop a sound, practical and useful new media application, the perspective from multimedia technology should not stand alone in its almost relentless technical progress but should be balanced with conventional practices and the way human users carry out their tasks. In this paper, we describe our on-going development of a movie browser application for students of Film Studies at our University. In particular, our development brings in a number of recent multimedia technologies to automatically process digital video content but at the same time uses the usability engineering process to relate to the real tasks of real users in their real environments. By balancing a technological approach and a user-centered approach, we believe the final artifact we design and deploy will be in a far better position to satisfy users when providing novel multimedia tools. A part of the existing practices we bring into our development process is the pedagogical aspect as the application we are deploying and monitoring is for use by students of Film Studies where students learn while using the application.

RELATED WORK

Some researchers developing novel media systems work to deploy their systems to real users in an attempt to obtain realistic usage data. For example, Newsblaster at Columbia University [1] is an experimental system incorporating natural language processing techniques to automatically crawl news websites and summarise and present them to its web users. The system has been deployed since 2001 and a number of user studies have been conducted. Austrian interactive TV trial [7] deployed a novel TV application to a local cable TV provider in Salzburg, Austria, and ran for 4 months in 2004-5. Físchlár-News [3] incorporates a number of multimedia and recommendation techniques and was deployed within a University campus for 3 years, during which interaction logging and diary methods were used to capture its usage. While these trial efforts show a growing awareness of the importance of user evaluation in realistic environments, studies that incorporate the end-user perspective from the conception of the project, are very rare: most of the technology trials start purely from a technical point of view and only after deployment does it get any form of feedback from real usage and users.

Our work is similar to other trial studies as above, but from the very beginning of our project we incorporated techniques from usability engineering in order to firmly base system development and feature design on the end-users' goals and perspectives.

Work that is related to movie video browser includes work at INRIA [8], and the Virtual Screening Room [4]. These tools provide a novel movie content browsing and searching feature. A project at the INRIA laboratory is related to the development of an integrated tool for watching, browsing and searching a movie that are synchronized with its scripts. It was demonstrated with the movie "The Wizard of Oz". The "The Virtual Screening Room" project which is an informative browser for playing a movie with many useful features such as clip searching and various in-depth information representations. These projects are very useful and effective in understanding, appreciating and teaching movies especially for students in Film Studies. While focusing on these new and developing multimedia technologies is understandable in developing new media technology applications, what is almost always neglected is the knowledge, experience, and existing practices that could and should be ascertained and incorporated in such applications.

DESIGN AND DEVELOPMENT

One of the key aims of the multimedia research community is to automatically index media repositories by analysing the video contents.

The key multimedia techniques used in our application are:

- Scene detection – to automatically segment a movie into a number of scenes. Camera shot boundary detection is used first and segmented shots are clustered back together by considering their visual similarity and temporal distance;
- Scene classification – to automatically classify the nature of a scene into Action, Dialogue and Montage. Within-scene shots are analysed in terms of the amount of motion (in the case of Action), in terms of alternating shots (in the case of Dialogue), and in terms of motion speed and existence of music spanning multiple shots (in the case of Montage). Movie shooting and editing conventions are also used as heuristics for the classification.
- Keyframe extraction – to automatically select a most representative still image from a sequence of video. For each scene and shot, visually most average (common) frame is determined and selected as keyframe.

These are all active research areas in the field of multimedia at the moment and steadily improving their accuracy and robustness. More information about the above techniques is described in [2]. Taking advantage of these automatic content-based techniques, numerous possible application scenarios can be imagined and a large number of novel demonstration systems are currently built. In our work, we use the above techniques as the main novel back-end of our application.
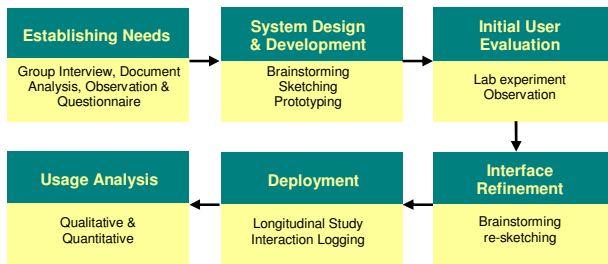
Figure 2: Design Process

In order to develop an application that supports users' tasks, we extensively used usability engineering techniques from the Human-Computer Interaction field in the design process as illustrated in Figure 2. We conducted a number of user studies with students taking the Film Studies course from the School of Communications, Dublin City University, in order to capture their needs and requirements, as well as their feedback and wishes about their current practice. We iteratively sketched and re-sketched a user-interface based on student feedback.

DEPLOYMENT EFFORT

An interaction with the module lecturers was carried out before the semester began. The lecturers provided the student name list and the module descriptions. MovieBrowser was deployed during Semester 2 until the end of semester, which ended in May 2008. The system was deployed and used by undergraduate students from two groups of film studies module: *CM135 Analyzing Media Content* and *CM272 National and Irish Cinema*. The number of students attending these two modules was 268. In both modules, students were required to read and analyze very closely, a sequence (movie clips) from any chosen film. "Reading" a movie in their context refers to the process of understanding and analyzing movie content closely, looking for different levels of meaning and critique for example from elements like framing, depth of field, plot, shots, camera angle, lighting and so on. On a broader level it also involves an understanding of the generic conventions and narrative structure of individual movies [5].

At the time of deployment, there were 30 movies of various genres (comedy, drama, romance, action, etc.), ranging from contemporary Hollywood movies to old Irish movies, with production years from 1952 to 2004, all accessible via a web interface. We provide a set of Irish movies used for teaching one of the courses. Examples of Irish movies were *About Adam* (2000), The *Quiet Man* (1952), *The Snapper* (1993), *The Butcher Boy* (1997), *Korea* (1995), *Nora* (2000), *Poitin* (1979) and *Goldfish Memory* (2003), all directed and/or produced by Irish filmmakers. Hollywood movies included *Shrek* (2001), *American Beauty* (1999), *Oceans 11* (2001) and *Lilo and Stitch* (2002).

MovieBrowser is a web-based system and we use VLC streaming technology for movie playback, accessible only by students enrolled in the Film Studies course within the university. The process of trancoding and digitizing a movie is carried out either from the VHS tape or a DVD. A number of steps are taken, including the digitizing process from analogue to digital signal, using specific software and devices. The playback format used in the system is in MPEG4 file format. Both the video streaming server and the movie database are at the same server located in the School of Computing, DCU.

At the start of deployment, emails were sent around to the students in the modules informing them of the availability of the movie browser tool. A demo and a short presentation were conducted in each class to show how to use the system. Each student was given a username and password to access the system, and the subsequent usage monitoring was based on the activities of each user given his/her username.

During the semester, we monitored system usage via actual interaction logging captured as individual users click buttons, play movies and use other forms of interactivity with the system's features on the interface. An online questionnaire was also administered to collect students' feedback, satisfaction and opinion on the system. Further analysis and findings are under way and will inform to what extent our tool helps or assists students in carrying out their studies.

Figure 3: Main interface screenshot panel - (a) Timeline for browsing and navigating events, (b) keyframe list, (c) playing the movie/clips and (d) note taking features

An interface screenshot of MovieBrowser is shown in Figure 3. It consists of panels for browsing and navigating events, playing the movie/clips and note-taking features.

FINDINGS AND DISCUSSIONS

From the total of 268 students in both classrooms, only 107 students (40%) accessed the system. From those who accessed the system, 60 students (56%) responded to the questionnaires we had administered. From the actual log data collections, we found that almost all of them accessed MovieBrowser at least 2 times (per user).

The majority of the students stay off-campus and they have no access to the system when trying it from home, and only able to access when they come to the University during the daytime. 56% of the students accessed MovieBrowser from PCs in the laboratories, while the rest use their own laptops (37%) and PCs in the library (7%). Most of the students were in an age group between 18-20 years, with 23 male and 37 female. They were composed of varies faculty programmes ranging from Journalism, Multimedia and Communication students, all from the School of Communications.

The convenience factor in accessing movies was the major motivation from the majority of students in using the system. According to the questionnaire responses, the main benefits of the system the students perceived were as in Figure 4. From the diagram in Figure 4, the biggest contribution is through the online web access, which is about 39% of the motivation. The second's factor (24%), which influences usage, is from the technology provided in the video segmentations and classifications. Other types of factors are Irish and Hollywood movies selections and DVD resources difficulties.
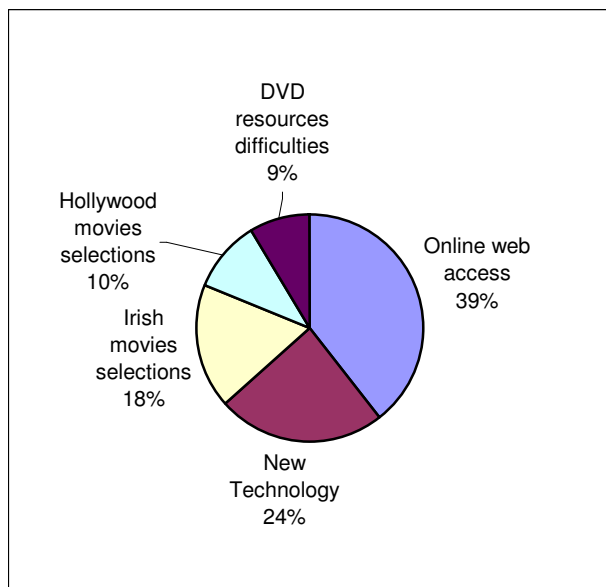

Figure 4: Access Motivation Factors

This shows that students found difficulty in getting some movies on a DVD either from the library or rental shops. They also found that by having such tools like MovieBorwser can helps reduce their efforts in certain circumstances as can be seen from the comments below.

"It saves a lot of time when doing the assignment"

"It was very easy to access the movie required and very beneficial. It is far easier than renting a DVD as sometimes people might have taken it out or you can only have it for a few days or sometimes its not even there, so in that respect it is very good."

"It was useful for jumping to scenes and allowed me to browse faster than if I was using a DVD"

Convenience factors are not only related to what the system can provide, like web access and free-of-charge in using the system but also from the end-user's perspective such as reduced effort in their learning.

"I benefited from MovieBrowser as I was able to watch the film when I had missed a class and not be behind in the module"

"Discovered interesting films I had previously not heard of e.g. The Quiet Man"

"Easy and unlimited access to movies on the course, which has infinite benefits and reduces lots of stress"

We also found from the students' feedback, detailed usability issues related to specific features provided in the MovieBrowser such as multi-timeline bar, keyframe list navigation and event categorization. We noticed that the most important value of the system was simply the fact that it allowed easy access to movies in a non-linear fashion. The timeline (Figure 3(a)) and keyframe list (Figure 3(b)) which highlight where the action, dialogue and montage scenes overlap in a movie were praised as very useful, indicating that a strong temporal orientation with additional cues on the movie contents is useful.

"The timeline feature was probably the most useful feature on the browser as I can view the structure of movie as a whole"

"I found the combination of timeline and event categorization very useful since I can selected fast those parts of the movie that contains the events of interest"

"Timeline. Much easier to navigate through a film."

The actual interaction logging supports these comments, as the use of the timelines feature was the highest of the frequently used features (21%) from the total actual interactions logs, followed by keyframes list (18%). An event categorization or segmentation into several movie chunks (exciting, montage, dialogue) that underlies in the timeline and keyframe list representation show positive

feedback. Figure 3 shows when a student filtered out the movie to see only "exciting" events from the movie Shrek.

"With event categorisation made things easier to find/understand scenes"

"I liked the way I could go directly to the exciting or montage parts"

Other than those features included, we also incorporated the notes features as shown in Figure 3(d) above. Being able to jot down comments or ideas at any point of a movie was identified as important and useful feature from the very beginning when initial student needs were being captured and thus incorporated in the system. However, the feature was underused and unappreciated during the deployment period according to the interaction log data (used by 3 students during the deployed period which is only 1% of the total interaction log). This shows an interesting mismatch between what our users said would be beneficial and what they actually used in practice. Interestingly, in the questionnaire we got very positive responses regarding the benefit of this feature even though they did not actually use it:

"Notes taking, it helps you keep track of information you are taking down on a particular part of the movie and helps you remember"

"Using MovieBrowser I can locate quickly relevant part in a movie and take notes while watching. This helps me in reducing the amount of work in reviewing a movie since I can anytime come back to my notes and also watch again preferred parts or parts that I need to focus more"

Some possible reasons for this were that maybe students did not want their notes to be shared or viewed by other students. Notes used for class essays are different from the notes they write in a product review on the Amazon website or funny comments they write on social network websites such as Facebook or Bebo. In the context of an online educational tool, students might feel reluctant to leave notes as they don't want their useful comments that they want to use for their essay to be copied by other students. We know students value the notes feature, and we know it was not used in our system. We are tracking our users in order to identify the reasons for this mismatch.

We gave a set of questions on various usability criteria on differential scales from 1 to 5 (1=Totally Disagree and 5=Totally Agree) as shown in Table 1. In terms of the overall system satisfaction, we get relatively all above average value with modes and median equal to 4 (Agree) for all differential questions. Table 1 shows the means and standard deviations on overall deployed system. We also asked our students whether they would use the MovieBrowser after the semester. Among 60 students who replied, 43 (72%) of them said they would use in the future.

Differential	Means (Standard Deviations)
Learnability	4.05 (0.81)
Easy to use	3.98 (0.91)
Simplicity	3.98 (0.85)
Usefulness	3.88 (0.99)
Effectiveness	3.88 (0.83)
Excellence	3.73 (0.88)
Stimulating	3.70 (0.81)
Novelty	3.62 (0.87)
Satisfaction	3.62 (0.83)

Table 1. Descriptive statistics on overall system

Pedagogical Perspective

We also believe that, even though the proposed tool still needs some enhancement, the current design of browsing movie content still can provide a positive impact and will aided in their learning. In the pedagogical perspective, the tool provides an indirect process of reading a film. For example, as a student attempts to grapple with the complex audio-visual signifiers which make up the film text, a tool like the MovieBrowser can be of great assistance in breaking down conventional patterns of viewing and helping the reader to appreciate the grammar and structures of film making. Such a tool might helps to break down the narrative and style of the film into its constituent parts. This process is necessary for the student to attempt to tease out how the film works for audiences and allow them to write about the film from the inside.

Enabling the film to be seen and navigated with a timeline outlining exactly where the sequence in relation to the whole film for example is very useful when students are trying to grapple with narrative construction and the different functions of any given scene in a film. Furthermore, by allowing the student to take notes directly on the screen underneath as they watch various scenes, enables the student to appreciate the process of engagement with the film, almost instantaneously as they cognitively experience the film. Such initial impressions are necessary to later help develop a more reflective as well as an intuitive engagement with the text. Film criticism is certainly not an exact science, nonetheless having such software tools to measure and compare a number of features of the text, including 'exciting', 'dialogue' and 'montage', while enabling the user to jump at will across the timeline of the film, is an excellent method in encourage them to appreciate structural similarities and differences within the text. Another important example of the research benefits of such a tool might give is with regards to Irish

cinema for instance, would be the ability to empirically compare Irish film and directors with their Hollywood counterparts to test and evaluate any differences between indigenous national cinemas as against more commercialised Hollywood cinema.

While the system's value as learning supports will have to be evaluated by its educational impact (e.g. students' essay marks or movie reference quality compared to previous semester when the tool was not available), we are planning more focused follow-up experiment where the impact of some of the main features of the system will be more objectively compared.

Besides the positive and valuable feedback, MovieBrowser also had some negative feedback. Most of the feedback related to technical issues in assessing the system over the network such as sound and playback error and restricted access limitations within campus area only. Students also requested more movie selections to be included in the system in the future.

Overall students are satisfied with the deployed system in that it provides easy and convenient access to the movies they needed to watch in order to write their course essays. Some user comments on the system as in the qualitative feedback show very positive opinions:

"I think the concept is excellent and it has the potential to be a great aid in learning."

"The tool made my work much quicker. It was generally very helpful. Sort of like an upgrade. Metaphorically speaking, I am now driving, while I had just been cycling."

CONCLUSION
To conclude, the system design that will support and help end-users to acquire the skills of reading film is considered in this paper. We hope that the design of the system we have built will be a helpful tool for students developing the core skills of textual analysis, within the film studies domain. By integrating both the knowledge from technology which is on automatic movie content analysis and the practice of the information seeking process from end-users, it will provide a bridge to established film studies and helps in assisting new generations to 'think digitally'. Developing an end-to-end system that leverages currently researched technology and deploying it into a real usage situation is difficult because the immature technology elements can easily hinder the usage and perceived value of the system. In our work, we adopted a full cycle of usability engineering techniques throughout all processes of the system development, not only at the end of it, in order to make the new technology being developed more in tune with how it could and should be used in real life.

We believe our work can contribute to the HCI field with the actual user study carried out in a particular context (Film Studies) and in interface design development, refinement and deployment that focused on the real end-user's, real task and real environment.

REFERENCES
1. Kathleen McKeown, Regina Barzilay, David Evans, Vasileios Hatzivassiloglou, Judith Klavans, Ani Nenkovo, Carl Sable, Barry Schiffman and Sergey Sigelman. Tracking and summarazing news on a daily basis with Columbia's Newsblaster, *Proc. of the Human Language Technology Conference,* (2002).

2. Lehane B, O'Connor N, Smeaton A.F and Lee H. A System For Event-Based Film Browsing, *3rd International Conference on Technologies for Interactive Digital Storytelling and Entertainment (TIDSE)*, (2006), Vol. 4326, 334-345.

3. Lee H, Smeaton A.F, O'Connor N and Smyth B. User Evaluation of Físchlár-News: An Automatic Broadcast News Delivery System. *TOIS - ACM Transactions on Information Systems*, (2006), Vol. 24, No. 2, p145-189.

4. MIT Center for Educational Computing Initiatives, The Virtual Screening Room, [Last accessed] 12 August 2008, http://caes.mit.edu/projects/virtual_screening_room/index.htm.

5. Pat Brereton. How to write a textual analysis of a film, class notes for CM135 Analyzing Media Content, Dublin City University, (2008).

6. Pat Brereton. Teaching with DVD Add-ons. A Case Study of 'Smart' films, Donnie Darko (2002) and Run Lola Run (1998), To appear in *MLA Book Chapter Volume on Teaching Film*, (2008).

7. Regina Bernhaupt, Marianna Obrist and Manfred Tscheligi. Usability and usage of iTV services: lessons learned in an Austrian field trial, *ACM Computers in Entertainment*, (2007), 5(2).

8. Remi Ronfard. Reading Movies – An integrated DVD player for browsing movies and their scripts, *Proc. of the 12th ACM International Conference on Multimedia,* (2004).

9. Smeaton A.F. Techniques Used and Open Challenges to the Analysis, Indexing and Retrieval of Digital Video, *Information Systems Journal*, (2007), Vol. 32, No. 4, 545-559.