

Design, Deployment and Assessment of a Movie Archive System in a Film Studies Context

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*This thesis is based on the candidate's own work, and has not previously been submitted
for a degree at any academic institution.*

Declaration

I hereby certify that this material, which I now submit for assessment on the programme of study leading to the award of Doctor of Philosophy is entirely my own work, that I have exercised reasonable care to ensure that the work is original, and does not to the best of my knowledge breach any law of copyright, and has not been taken from the work of others save and to the extent that such work has been cited and acknowledged within the text of my work.

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Abstract

This thesis describe our work in developing a movie archive system for students of Film Studies in Dublin City University. In particular, our system uses several recent multimedia technologies to automatically process digital video content but at the same time we use the usability engineering process to relate to the real tasks of real users in their real environments. We investigate how real users take advantage of technologies in a movie browsing system. By designing, building, deploying and assessing the usage of a technology in a user-focused way, the overall impact of a movie browsing system can be determined holistically. The application domain we work in is film studies where students need to study movie contents and analyse movie sequences. Our work began by identification of user needs through observations, focus groups and usability testing, followed by sketching and prototyping a web-based system. We then deployed the system to film study classes over a semester, monitored usage and gathered quantitative as well as qualitative data. Focused experiments were carried out to assess students' performance and satisfaction levels. Our findings show expected patterns of usage of a real-user setting outside the lab, but at the same time highlighted issues that need to be further investigated. In general, students found most of the provided features were beneficial for their studies. Findings from the experiment shows better performance in the essay assessments and higher satisfaction levels. An interesting finding shows students are more engaged with the newly-introduced software application and take longer time to complete the same task than without the advanced features of the application. This phenomenon was rationalized from established learning theory from the psychology domain. In a technologically-oriented multimedia field today, we attempted to bring in a user-centred approach of end-user interactions throughout a 3-year development process, and we identified benefits and challenges in trying to align the technical perspectives of novel multimedia features to real-world setting.

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Chapter 1

Introduction

1.1 Research Area and Motivation

There are growing needs for tools which manage digital video in applications like digital libraries, medical records management, entertainment and education. As a result of the rapid development in multimedia technologies both in hardware and in software, the use of media like video data directly by end-users is increasing, especially in applications such as entertainment and education. By this we mean that people are now creating, editing, storing, indexing, searching, browsing and then playing video themselves, directly and independently of other users and we are doing this more easily than before. Video is a very rich information source that contains visual, audio and textual elements woven together on a temporal basis, and providing a rich multimedia experience suitable for a variety of tasks spanning work and play [88].

In the work described in this thesis we try to identify and to get an in-depth understanding of the issues arising in developing a novel multimedia application based on video, by bringing together different disciplinary concepts, methods and framing of problems. These include the following :

- Multimedia concepts and software tools which provide novel scenarios and functionalities for processing and interacting with video;

- Information Seeking perspectives in matching the technical specifications of a software system to the end user needs as s/he performs some task;
- Usability Engineering techniques in designing and refining a software application in a user-centred manner, and finally
- Learning theories from a Psychology perspective in interpreting the usage and adoption of the software application within the users' work context.

In the thesis we want to highlight issues in order to understand better the nature of the software applications we create and how the features provided in such software applications could result in overall usefulness and benefit to the end-users when adopting the application. We demonstrate this by going through the full usability engineering process in designing, deploying and then assessing an entirely software-based movie archive system within a context of undergraduate and graduate students completing a Film Studies course.

Our approach tries to balance a technology-driven contribution to the development of a software system, with the user-centred and context-driven contribution, and we set out to achieve this balance right from the beginning, in making the system useful and usable. The work involves a technical setting within the domain of computing and an implementation and evaluation of this within a humanities setting. Thus the work will bridge both disciplines. Taking advantage of automatic content-based software techniques for analysis of digital video, numerous possible application scenarios can be imagined and built. In our work, we use the software analysis techniques in the development of technology for video content analysis as the main back-end of our software application. The scenario for our work is described as a diagram shown in Figure 1.1. The initial starting points for our work are the technology components (left side in the diagram), software techniques for automatic analysis of digital video developed over time within our research centre. The diagram illustrates our overall approach in putting the two perspectives together — both perspectives are at opposing ends and we are trying to develop each side in the context of the other side and eventually the two philosophies — the technical and the user-based — will meet some-

where in the middle. While the technological possibilities were the original basis on which the video management software application was developed, user perspectives (on the right side of the diagram) have now become the framework for progressing the development of the software application in a way as to continuously base our handling of the technological elements in as realistic and usable manner as possible.

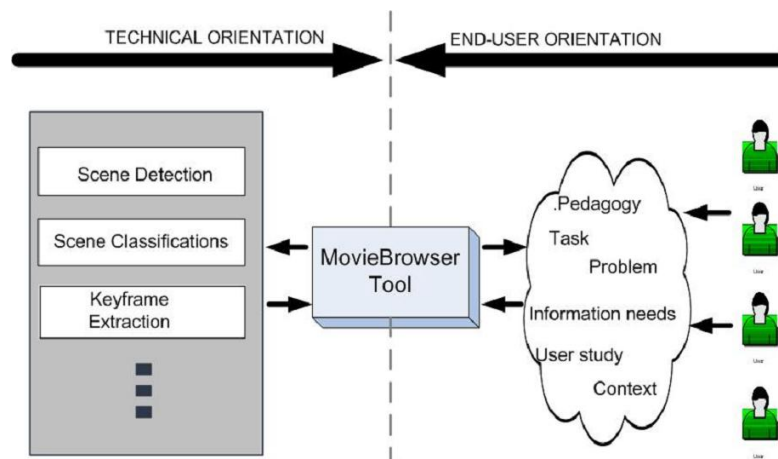


Figure 1.1: Research framework

There has been much work carried out regarding the technical possibilities for video content analysis. This work processes video elements with various automatic outcomes and analyses such as shot boundary detection, image segmentation, automatic detection of semantic concepts, etc. [88, 62, 90]. Much of this work has as its goal, a focus on the evaluation and measurement of precision and recall, of the efficiency and accuracy of the techniques developed. User involvement, if any, will normally be involved only at the testing stage. Such evaluations are performed in pre-defined lab settings or sessions. Various system interfaces to the new technologies can be developed as a showcase in order to carry out the evaluation. However, not much work has been carried out beyond this boundary where new video analysis techniques are deployed and used by real end-users in real settings and with real tasks involved, and the user interactions with the new software applications that incorporate these kinds of technologies being assessed and monitored, such true user interactions are almost never captured or considered. We consider the users

in this work as real users as they are getting exam marks for it (i.e. part of their module assignment) and thus motivated in performing the tasks.

The background to the work reported in this thesis is work that was carried out previously by one of the researchers in the CDVP¹ as part of another PhD. Lehane's work [52] is a technically oriented approach to the area of automatic video content analysis. His work takes a full movie of 2 hours, say, as a main domain resource, and performs automatic event segmentation based on scene detection, and he automatically classifies each scene into one of three categories (i.e. dialogue, exciting and montage). His main aim in his work is to evaluate and measure the accuracy of the scene detection and to improve its efficiency. In order to do that, Lehane developed a standalone system called *MovieBrowser* and he performed a series of experiments with users at the final stage of his work. The system he developed was not developed with any users or any user tasks specifically in mind from its beginning. In our work, we take Lehane's previous work and we incorporate components of this into the system we developed which we call MOVIEBROWSER2 but our system is a new system which does not focus on the accuracy of the video analysis. Our work is not about the development of new video analysis technologies, but on assessing the usage impact and user experiences when using such new technologies. The diagram in Figure 1.2 shows the overview of background work and how it contributes to this thesis.

1.2 The Problem We Investigate

Limitations of previous research — Most previous research in video content analysis in particular emphasizes technical possibilities and aspects such as indexing and structuring video elements for better retrieval. The navigation and browsing processes can be performed through various means such as using searching, browsing and summarization tools [88]. A number of working system applications have been developed that used the underlying techniques of video content analysis, particularly related to movies such as *MovieBrowser* mentioned previously [52] and a project at the INRIA laboratory [82]. These

¹Centre for Digital Video Processing, DCU

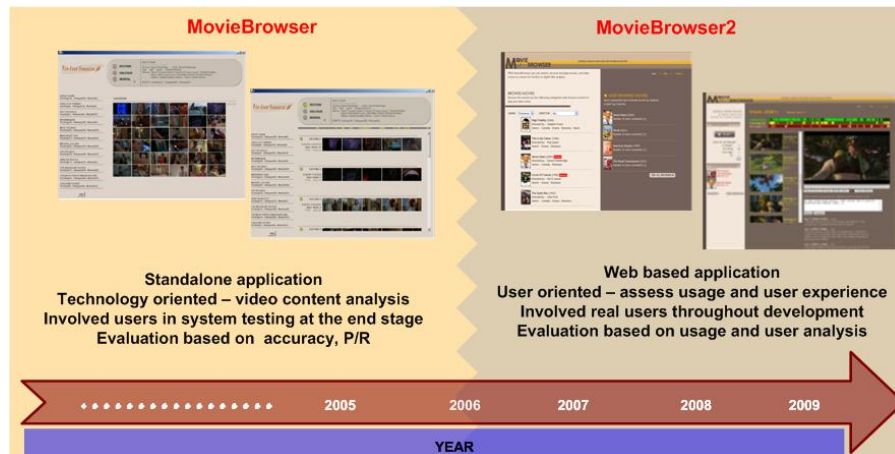


Figure 1.2: Background work timeline

works are explained in Chapter 2 (Background and Literature Review) and are among the many works that are novel and consider the technical perspective of the analysis (i.e. measuring Precision/Recall and accuracy). On the other perspective, they lack the assessment from the aspect of usage monitoring and the impact evaluation. The users' involvement in such previous work were left far behind when integrating user needs and backgrounds for example into the design of the system. Not much work has been performed which goes beyond the boundary of end-user orientation as Figure 1.1 illustrates, where the usage of these kinds of tools are actually monitored and assessed. In order to provide appealing user experiences in using the newly-introduced tools, user involvement needs to be incorporated.

In addition to pure technology-driven evaluations, there is also work reported that combines technological efforts into a deployment stage where it is subsequently used by users like Físchlár-News [50] or SportsAnno [46], both developed within our own research group. These research avenues show a growing awareness in terms of system evaluation in a realistic environment but they are still designed, built and deployed without consideration of user needs from the start — rather the systems are designed and built first and then tested with users. Studies that incorporate the end user perspective from the beginning of the design process are still rare and but becoming important in order to validate their true impact. We consider this to be a gap in previous research.

A gap in previous research — Given that there exist such research gaps, the work in this thesis was undertaken in order to explore the impact of implementing the technological component of the previous work of Lehane and others, and to evaluate it in terms of realistic contextual end-users who have real tasks to perform in a real environment. Even though there is work reported elsewhere which does involve deployment efforts, user involvement or interaction starts after the deployment and the expected outcomes are usually justifications of the technology as such work starts from the technical possibilities rather than the user needs. Why is this important? It is important because the benefits of usability engineering may not be gained if we only plug in the tools after the artefact is fully implemented and ready to be delivered. We are trying to investigate how application development can take advantage of available tools and methods from other disciplines.

Research Aims — Multimedia technologies have enabled production, storage and delivery of large quantities of audio and visual information. The amount of video available nowadays raises the challenge to us to develop applications that help us to organise, browse and find relevant information from this video. However efficiency is not the only aspect to be considered when building such applications. Usability and perceived user satisfaction also plays a major part in the successful adoption of any technology in a larger community. This research investigates how real users take advantage of technologies in a movie browsing system. By designing, building, deploying and assessing the usage of the overall value of a technology in a more user-focused (involving real users) way, the overall impact of a video movie browsing system can be determined holistically. This is the aim of the research reported here.

1.3 Brief description of methodology and rationale

In order to achieve our research aim, we follow the Usability Engineering procedure from the very beginning and throughout the process, including deployment and focused experiments. The application system we developed incorporates automatic video content analysis techniques, namely shot boundary detection, keyframe extraction and classification of scenes into action, dialogue or montage, as the main analysis components. Our application domain is the area of Film Studies, where students need to study movie contents and to analyse certain movie sequences in order to generate textual essays describing their interpretations of those sequences. This forms part of the assessment for their course and represents a real user task. We began our work with the identification of user needs through observations, focus groups and usability testing, followed by sketching and prototyping a system that incorporates some functional features. The rationale for following this procedure is to make the development of the new system more user-driven. At the start of a new semester in the student calendar, an initial system evaluation was carried out where user feedback was collected and the interfaces underwent refinement.

Interactions with another batch of students were carried out for the second deployment stage. This second deployment stage was undertaken with the goal to study and validate the usage of the technology that is incorporated into the developed system. By collecting log data from throughout the whole semester and monitoring system usage, an assessment of usage can be carried out. Having a deployment also validates the usage of these kinds of application as well as the technologies that are within the application and most importantly we identified issues that arise in adopting the full Usability Engineering procedure as prescribed in HCI for a multimedia application, particularly when the application has no prior or existing equivalent. From the analysis of the deployment, we found an interesting mismatch between what our users said and indicated they thought would be beneficial and what they actually used in practice where one of the features that we incorporated (i.e. note-taking or commenting) as a result of initial requirements analysis was actually under-used and unappreciated in practice. In the thesis we further look into such matters to try

to find a solution or recommendation. We discovered a few aspects of usage monitoring ranging from user assessment, features assessment, usage patterns over time, user opinions and experiences. We discovered an interesting finding from this stage which was a part of the usage pattern which we explained as phenomena from another domain of psychology in a learning perspective. This phenomenon is known as the 'pleasure' of assessing a newly-introduced technology as compared to difficulties in the prior conventional way of performing the students' work tasks, and we found this interesting to look at. The observations were that students have a much more conducive and enjoyable experience in the context of their work task as compared to the conventional way of going to the library to borrow the video material and being under 'pressure'.

As the deployment stage of our work discovers usage patterns in assessing a usable movie browsing application with multimedia tools that could be potentially useful to the end-users, we want to also measure the specific 'benefit' of having these kinds of tools made available. We want to measure objectively what the students will gain by using a newly-introduced software application as compared to their traditional way of performing their work task (i.e. using a standard DVD player). Thus we carried out another experiment to measure this.

At this stage it is worthwhile stating the specific experimental questions that we set out to explore in this thesis, a research questions in which this thesis is based. The main research question is "Do students who use our newly-introduced technology (in the software tool) get more 'benefit' compared to their conventional way of performing their work task?".

In order to answer to this question, we divided it into several sub-questions as follows:

- Q1. Do students make use of the alternative access features afforded by MOVIE-BROWSER2 and spend less time in completing the essay-writing task ?
- Q2. Given the same amount of time, is the 'outcome' for those using MOVIE-BROWSER2 better or worse than those who use only a standard DVD media player interface for browsing movies ?

- Q3. Do the students who use MOVIEBROWSER2 have a higher level of satisfaction than those using only a standard DVD media player ?

The protocols that are used in our experiments were using a within-group design approach and participants were assigned some tasks in the context of essay writing which forms part of their Film Studies module. This series of experiments were included as part of the module by the lecturer (*CM524 Film Theory and History*). Findings from this experiment were as expected in terms of student performance in the essay outcomes and the satisfaction levels both from quantitative and qualitative data. We foresaw a new phenomenon after performing data analysis in answering one of the questions, namely that students are more engaged with the newly-introduced tool and they take a longer time to complete the same task but at the end produce a slightly better essay outcome. This unexpected occurring phenomenon will be explained from another work domain we know as Flow Theory [21] from the psychology discipline. From the psychology perspective, the finding shows very good evidence in showing the engagement level among students when the newly-introduced tool is being used. We rationalized this phenomenon, for why the time taken is longer in the experiments using the new software tool from other Computing background disciplines. From the learning theory perspective, the engagement factor is 'measurable' from the essay outcome remarks and the time taken to complete the task. More explanation and discussion of the outcome are elaborated and detailed in subsequent chapters in this thesis.

The application tool in this work was built from scratch over a period of 9-months. The design and development effort starts from the conceptual design (i.e. interface design layout and sketches, module structuring and etc.) and implemented in PHP programming using streaming technology with Microsoft SQL database. The system has been configured for Microsoft Windows-based (XP), Microsoft Internet Explorer V6+ and VLC player. A screen resolution at least 1024 x 768 is recommended. It is also recommended that the machine has 512 MB of RAM and a processor of 2.0 GHz or above. All the software engineering and the system building was actually done by the researcher.

1.4 Thesis Structure

The chapters in this thesis are broken down into the following. Chapter 2 provides an overview of fundamental areas related to our work and it includes some broad explanations on the inter-related fields of Human Computer Interaction, Information Seeking, Multimedia Systems and some related sub-areas in the Psychology discipline. Background work on the current state of the art of multimedia technologies are elaborated particularly covering automatic video content analysis with examples of developed applications and systems. A few examples of deployment trials are also described. This is followed by an elaboration of our work domain which is on film studies. The overview chapter is followed by Chapter 3 which details the methodology that we undertook in carrying out experiments to address our research aim. This chapter explains the user requirements stage that has been performed following the Usability Engineering process in developing a new system. It includes observation, focus groups and usability testing on our initial system. It also incorporates the system design process we used in developing the application. Chapter 4 describes the interface design features that are included in MOVIEBROWSER2 and draws some rationale for the design we made. Chapter 5 explains the experimental protocols that are considered in order to answer our experimental questions and research aims. This represents a methodology, particularly at the deployment stage, and a controlled lab experiment (i.e. participants, tasks given). Chapter 6 gives a detailed analysis of our findings from the deployment and experiments that were performed. A discussion on the findings draws a conclusion to our work. Finally, the last chapter, which is Chapter 7 summarizes our conclusions and achievements, reveals the research contributions and lessons that we have learned from this work. We end with suggestions on future research avenues.

Figure 1.3 presents a summary of our interactions with different class groups of students of film studies in DCU over a 2-year period and main activities involves throughout the whole work as described in this thesis.

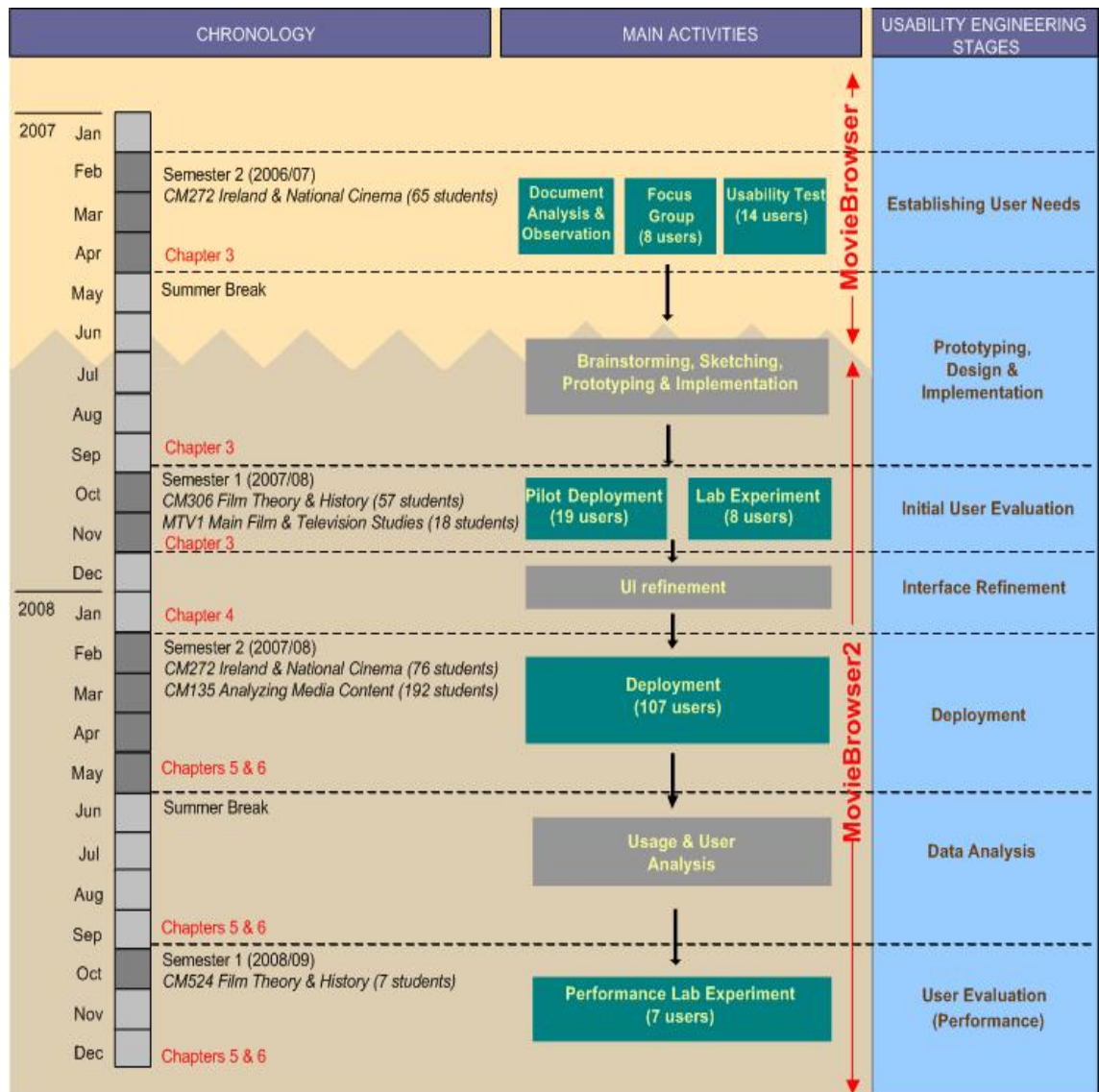


Figure 1.3: Summary of activities

Chapter 2

Background and Literature Review

This chapter introduces several areas of fundamental research related to our work. We start with a broad explanation of Human Computer Interaction (HCI), and then we go on to cover Information Seeking (IS), Multimedia Systems and then some established theories on organizational psychology. We then show how these different areas are inter-related in terms of our work. These fundamental areas are then followed by an explanation of Usability Engineering, some relevant Multimedia Technology and a description of some trial deployments of movie browsing systems which have been done elsewhere. The chapter ends with an overview of our domain of study, the area in which our users are based, which is Film Studies.

2.1 Introduction

2.1.1 Broad Areas of Related Research

Human Computer Interaction (HCI)

Human Computer Interaction (HCI) is a discipline that relates to the study, design, construction and implementation of human-centric interactive computer systems. It is a very broad discipline that takes account of different specialties with different concerns regarding

computer development. A definition of HCI by the Association for Computing Machinery as mentioned in Wikipedia is that it is:

A discipline concerned with the design, evaluation and implementation of interactive computing systems for human use and with the study of major phenomena surrounding them.

Dix et. al [28] stated that HCI is influenced by many other disciplines, however the central concern is computer science and system design. For example from the system design perspective, HCI involves the process of design, implementation and evaluation of interactive systems in the context of a user's particular task and work. The diagram in Figure 2.1 describes other fields which are somehow involved or related to HCI. This shows a wide range of areas which have influence on HCI and these vary from Psychology to Engineering and from Language to Computer Science. What we can infer from this is that HCI has a very broad scope.

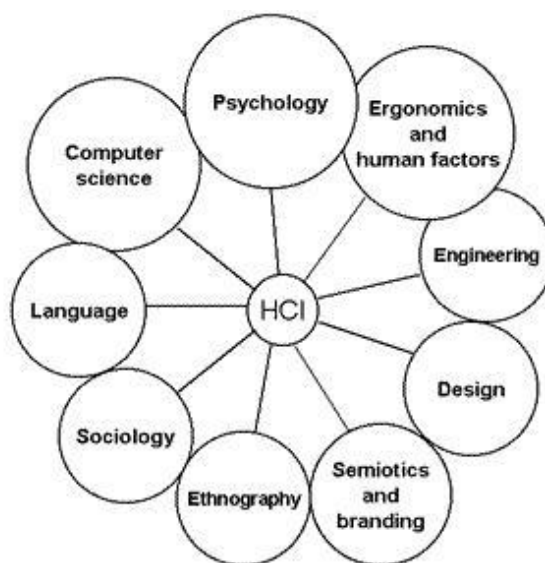


Figure 2.1: The field of HCI

Even though it is not a new area of research, there continues to be increasing growth in HCI research since the 1950s. Shackel in [84] breaks up the era of HCI into three groups of

years: firstly the beginning of HCI (1950-1970), secondly is the foundation of HCI (1970-1985) and lastly the development of HCI (1980-1995). Since 1995 we can say that HCI has continued to develop and to grow in importance and even as technology has given us new interaction possibilities and new devices, the principles of HCI, the theories which underpin the interaction between human and computer, these have remained solid. Among the indicators of this growth in importance of HCI are the increase of events like conferences, publications, journals and books related to HCI. The continued involvement of users in the design process also has been pointed out as one of the needs of future HCI work.

A user interface is the medium of interaction between the user and system. HCI is not only about designing interfaces that are easier to use but also involves studying the reasoning behind the building of specific functionality and the long-term effects that systems will have on humans. It is mainly about how to design systems that support interaction and human use between users and systems. It is about knowledge, context and the interaction between human and computer [37] and because it is so fundamental in nature, it is relevant and important to a huge volume of work. Because the work in this thesis is about humans interacting with video systems, HCI is also important here.

Information Seeking

Information Seeking according to [37] is a dynamic process driven by an individual's need for information. Marchionini [60] describes information seeking as a process in which humans engage to change their state of knowledge. Information Seeking is problem oriented and the solution to the user's information need may or may not be found.

Information Seeking and Information Retrieval research as described in [41] consists of two separate areas. The former is more related to a Social Science background and the latter is based on Computer Science approaches that are narrowly bounded to technology and the two do not communicate with each other enough. The authors believed that these respective camps could and should be integrated and extended in context and throughout

the development and history of both areas, this has not happened enough.

According to Ingwersen and Järvelin [41], an integration of the two research areas' (IS & IR) goals are classified into a few perspectives:

- Theoretically understanding the phenomena of information access
- Empirically describing and explaining (predicting) these phenomena
- Supporting the development of technology in the broad sense covering both tools, systems and social practices in the domain of interest

Different goals and characteristics of a user's task may influence how a user approaches the IS&R activity, and these will be factors affecting the task performance and information seeking process. A nested diagram shows the inter-relations between the context and the evaluation criteria in IS&R. As can be seen in Figure 2.2, possible evaluation measurements in the IR context are such as system efficiency, recall and precision, while usability measurements and quality of the information process are the evaluation criteria in the context of information seeking.

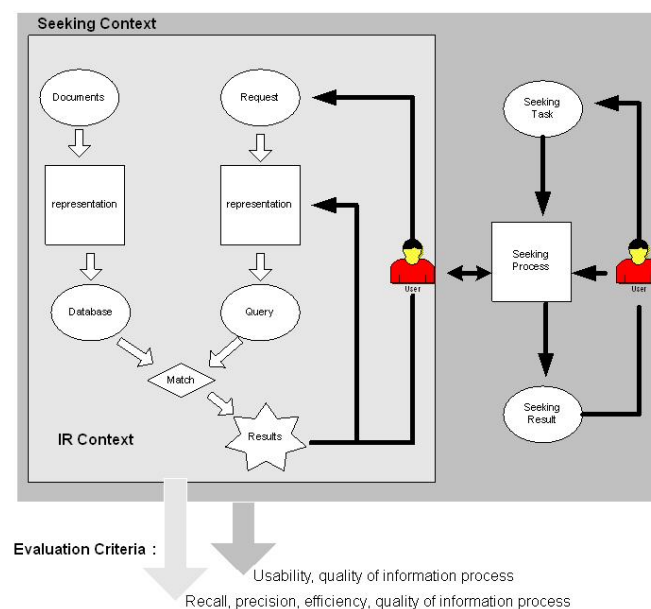


Figure 2.2: IS&R (Partially adapted from [41])

An effective application and usable interface design to any system needs to address a number of aspects such as learning methods and the use of different types of interaction, which will ultimately require less cognitive effort on the part of the user, making it easier to use. According to Marchionini and Komlodi [61], an interface serves as the communication channel through which information seeking can proceed. Defining and building interfaces that can support effective information seeking is thus a fundamental problem.

Information seeking is relevant to the work in this thesis because what we do later on is to support information seeking in the domain of Film Studies, so an understanding of what influence information seeking has on our work is important.

Multimedia Systems and their Evaluation

A multimedia system usually integrates one or more related technologies to automatically index multimedia contents (text, images, audio, video, etc.), so that consequent access to the multimedia information is enabled. Specifically looking at video which is the subject of this thesis, the automatic processing techniques used can be put into several categorical types of work including:

- Shot boundary detection
- Scene classification
- Face labelling and recognition
- Novel browsing, searching and visualization of image/video

For a long time, multimedia systems have been a hot topic with huge potential [31] and also an active research area [89].

One of the main challenges in multimedia systems is in managing the information, and in particular searching. The traditional information retrieval approach (system-based) when it is applied to multimedia systems, is mainly concerned with improving the effectiveness

of search techniques, and not incorporating issues of cognition and interaction [37]. The quality of the system, a high degree of efficiency and yet no user involvement in its design, are among the characteristics in a system perspective evaluation process. From the user's perspective, the system and the interface quality will be the main focus of interest. It would clearly be advantageous to the development of this area if there was work that could combine both the user and the system perspectives together which would allow for a more holistic approach to evaluation. The diagram in Figure 2.3 describes a typical model in information retrieval with boundaries and the scope of the evaluation commonly carried out from the system and user perspectives, independently of each other.

For the work reported in this thesis, the way in which multimedia systems are evaluated, from either a system or user perspective, is important because we set out to evaluate our work from **both** perspectives and we will see later on whether we succeed in this goal.

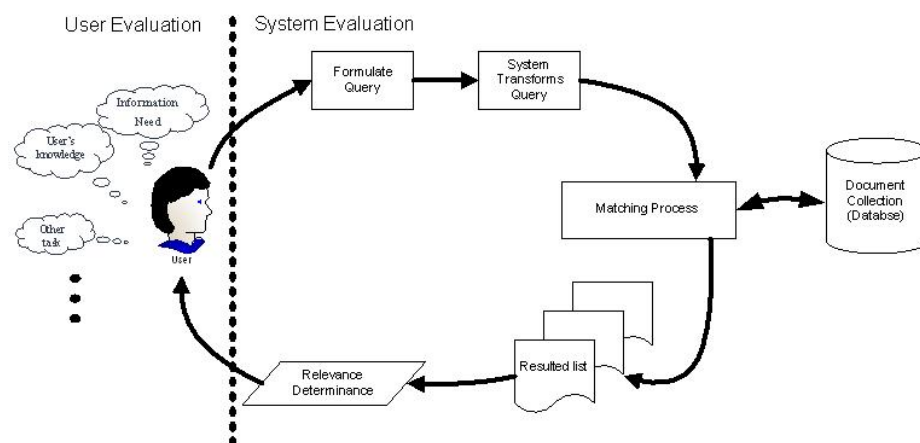


Figure 2.3: A typical model of IR

Work and Organizational Psychology

It would be strange not to include this discussion on work organizational psychology that have a place as part of the support areas for a thesis on the deployment of a technical innovation as we have found that there are areas from the work experience perspective that could explain the phenomena which we have observed in relation to users' engagement

and satisfaction levels in doing work tasks. As we set out to bridge the system and user perspectives we find theories from this area to be relevant to forming our conclusions.

Flow Theory — Flow experience is a concept defined by Csikszentmihalyi [21, 22] to describe the moments or states when someone is completely absorbed in an activity or task being carried out. This activity can be a work task or a leisure pursuit and indeed the user can become so absorbed that s/he is not aware whether it is work or play ! The involvement in the activity makes it seem that nothing else seems to matter and the user does not notice that the time already flies because s/he is so immersed in the activity that is being engaged in.

The complete immersion in an experience can occur in activities as diverse as singing in a choir, dancing or reading a good book, so there is no correlation with the activity being solo or group-based. People describe the sense of effortless action they feel in moments that stand out as the best in their lives [23].

The characteristics or components of flow as define by Csikszentmihalyi [21] are as follows:

- Clear goals — a clear defined goal for the task or activity
- Feedback — be able to provide feedback while engaging in the performed task or activity
- Challenges Match Skills — a challenge that is too hard for the user will cause anxiety while too easy a challenge will make someone feel bored
- The merging of action and awareness — when people’s attention is absorbed by an activity, she or he will be unaware of any irrelevant external stimuli
- Concentration — total attention onto one task
- The sense of personal control and self reward — feeling in control of the actions and experience

- Loss of Self-Consciousness — when people perform at their peak while in flow, they are not concerned with how they are doing
- Transformation of Time — lose track of time (“time flies”)

All of these broad characteristics of flow have an element of scale associated with them, so goals can be clear or confused, feedback can be provided easily or not at all, and so on. A combination of some values of these key characteristics in carrying out a task can represent flow experience but it is not necessary that flow consists of all these components. Among the feelings in flow according to Csikszentmihalyi are being completely involved in the task, focused on the goal, concentrating, a sense of timelessness, having intrinsic motivation and knowing that the activity or task is doable. These experience can be obtained from the conditions or characteristics of flow as mentioned above.

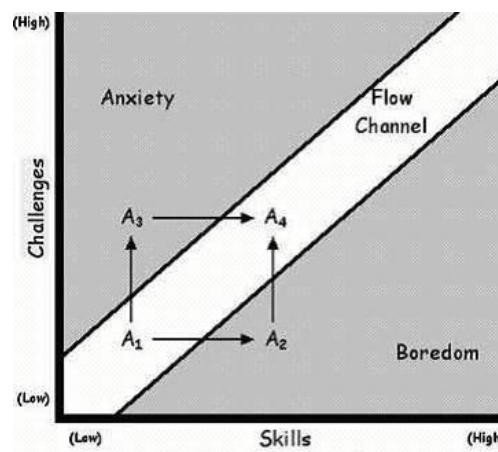


Figure 2.4: Flow, adapted from [21]

Figure 2.4 illustrates that if a task is not challenging enough, one will become bored, while a challenge which is too great will result in anxiety. To stay in flow, one must increase the skill level. The activities that can produce the sense of flow are varied, and can include creative art, athletic competition, engaging in hobbies and engaging in work for example reading a novel, gardening or even cooking.

From a system design perspective, flow can be considered in the design of applications in relation to users' experience by integrating features that can closely model real-world

usage patterns or the environment as a whole. Preece, Sharp and Roger [85], mention the consideration in designing a system from the perspective of goals of usability or user experiences. Examples of subjective qualities concerned with the added features in providing a system's 'feel' to users are of being satisfying, enjoyable, engaging, helpful, motivating, stimulating, entertaining, surprising and supportive of creativity. Flow, play and attention are among the elements that can contribute to pleasurable, exciting and a fun user experience. The flow concept is also becoming popular in interaction design for user experiences of websites, video games and interactive products [85](page 27), for example, building web interface designs to encourage the state of flow so that it will lead users to becoming completely absorbed. Makelberge [58], provides an overview from the psychological perspective in relation to interaction design and flow experienced with the use of technology. His idea of incorporating 'flow thinking' into the design of a system has the aim to provide people with a better and positive experience of activities, thus providing greater impact on people's lives and behaviour, even though the technological solution for enhancement was not an easy way to convince potential users. A strong focus in interaction design is on technology that helps the user to receive flow or positive experiences from the system artefacts.

Play — Another important concept in work and organizational psychology is the concept of play, which has received much attention over the years in research. Other research in relation to play has attracted attention from many fields, including child development, education, psychology and so on. This concept also can be applied to work or to Information Technology and the human process or motivation when using IT. Some research has been carried out regarding play by Codone [19]. Codone studies the phenomenon of play and how play can be effectively combined with learning. The enjoyment scale used was obtained from Csikszentmihayli's characteristics of flow, which measure students' perceptions of their enjoyment of an interactive multimedia course. She produced a play W-I-R-E model which indicates ways to use play, indicators of play, results of using play and other necessary elements for play to occur, as summarized in Table 2.1.

Way to Use Play (W)	Indicator of Play (I)	Result of Using Play (R)	Element of Play (E)
Edu-tainment	Self-Generated	Focused Attention	Relaxed
Constructive-Illusion, Individual	Intrinsic Motivation		Lack of Boredom
Constructive-Illusion, Group	Stimulating	Empowerment	Lack of anger/stress
Play Instruments	Pleasurable	Helps Knowledge Acquisition	Location-Dependent
Fidelity/Simulation	Sense of Humor /Fun	Timelessness/ Flow	Socially-Dependent
Imitation	Joy/Enjoyment	Performance	Balance
	Exuberance	Time on task/ focus	
	Silliness	Expense	
	Entertainment		
	Competitive		
	Non-literal what ifs		
	Spontaneous		
	Non-work/ Goal-free		

Table 2.1: W-I-R-E Model adapted from [19]

Other researchers added that play should be process-oriented, spontaneous, exploratory, undertaken for processes rather than expected outcomes and active. Play research gives impact on a variety of psychological compositions, which includes creativity, cognition, attention, motivation, perspective-taking, and language development [19]. The concept of ‘direct manipulation’ by Shneiderman [87], with its properties such as reversible actions, immediate and continuous feedback, and a style of system interface that encourages a more playful factor in interaction is largely applied to computer games. A more recent concept of ‘suppleness’ [42] also tries to capture the playful, easy and fluent aspect of interaction and could be considered an influencing element for play.

Intrinsic Motivation — A definition of intrinsic motivation from the Psychology Dictionary¹ is:

The motivation or desire to do something based on the enjoyment of the be-

¹<http://allpsych.com/dictionary/dictionary2.html>

haviour itself rather than relying on or requiring external reinforcement.

Intrinsic motivation occurs when people are engaged in an activity, such as a hobby, without obvious external incentives and it has been studied by social and educational psychologists since the early 1970s. It is usually associated with higher educational achievement and student enjoyment and has been carried out by some researchers for example on the work on self-efficacy and cognitive evaluation theory.

Research carried out in this area has established that intrinsically motivated students are eager and able to become totally absorbed in a wide range of effortful cognitive activities. It includes studies that show students with higher levels of intrinsic motivation are more curious, more creative, more persistent and earn higher grades than those who have lower levels of intrinsic motivation [20].

2.1.2 Summary

In summary, of all the broad areas that have been explained in this section, we can say that Multimedia IR is technology-centric, and results in myriads of systems and potentially useful user interface tools but is missing an important point: end-users and their tasks. HCI connects technology to users, and has a strong practical approach in front-end interface design. IS&R has a strong approach to turning empirical evidence through observation into theoretical models. A related area from work and organizational psychology (i.e. flow, play and motivation) can be used in explaining any natural phenomenon outcomes that occur (predicted or otherwise) while these disciplines are integrated or evaluated. There is room for these emerging fields to be integrated, and if this happens then this could provide a great outcome. Figure 2.5 illustrates the inter-relation among the fields in this work.

2.2 Usability Engineering

2.2.1 An Overview

Usability Engineering as describes by Mayhew in [63] is,

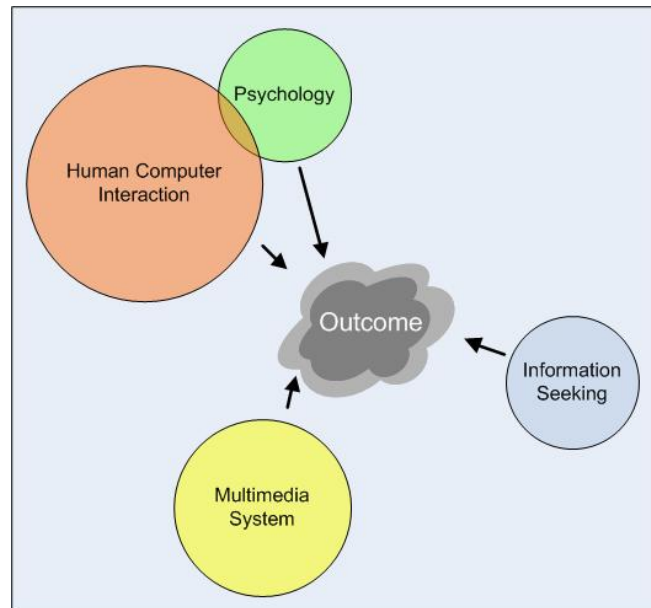


Figure 2.5: Inter-relationships among fields

A discipline that provides structured methods for achieving usability in user interface design during product development. It is a discipline with roots in several other basic disciplines, including cognitive psychology, experimental psychology, ethnography and software engineering.

Nielsen, in his book [72], mentioned usability engineering as,

A set of activities that ideally take place throughout the lifecycle of the product, with significant activities happening at the early stages before the user interface has even been designed.

Usability, according to Nielsen [72] is associated with attributes which are listed below:

- Learnability — system’s ease of learning
- Efficiency — system’s efficiency and possibility of obtaining a certain level of productivity once user has learned the system
- Memorability — system’s functionality which is easy to remember even though a user may not be using the system for a certain time periods.

- Errors — system’s ability to handle errors made by users
- Satisfaction — system’s measurement of how users like or are satisfied with the system

These attributes (learnability, efficiency, memorability, low error rates and satisfaction) formed a definition of usability by Nielsen which can be measured objectively and evaluated through different methods. Another definition of usability as mentioned in [43], from the ISO 9241-11 (Guidance on usability) is as follows:

Usability: The extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use.

The ISO 9241-11 standard is part of the ISO 9241 series that explains the necessary information related to specifying and evaluating usability. It also explains the general guideline specification and measurement for user performance and satisfaction. More information on the ISO standards series can be found in the official website ².

Unlike a Waterfall Model, a Usability Engineering approach to system development is an iterative design process. The Waterfall Model is a model of a software lifecycle that represents a development process in a linear flow. Figure 2.6 shows an example of a typical Waterfall Model. In this model, system development will follow a linear progression stage from one set of specifications to the next stage.

Nielsen recommended a Usability Engineering lifecycle as compared to a Waterfall model in building a system [74]. His point of view is that linear progression in a development process from one set of specifications to another set will not succeed because most users cannot read specifications. In his article, Nielsen suggested development should be divided into three main stages namely: Pre-design (i.e. field studies, usability test); Design (i.e. iterative design, prototyping); and Post-design stages (i.e. real-use data collections and feedback).

²<http://www.iso.org/iso/home.htm>

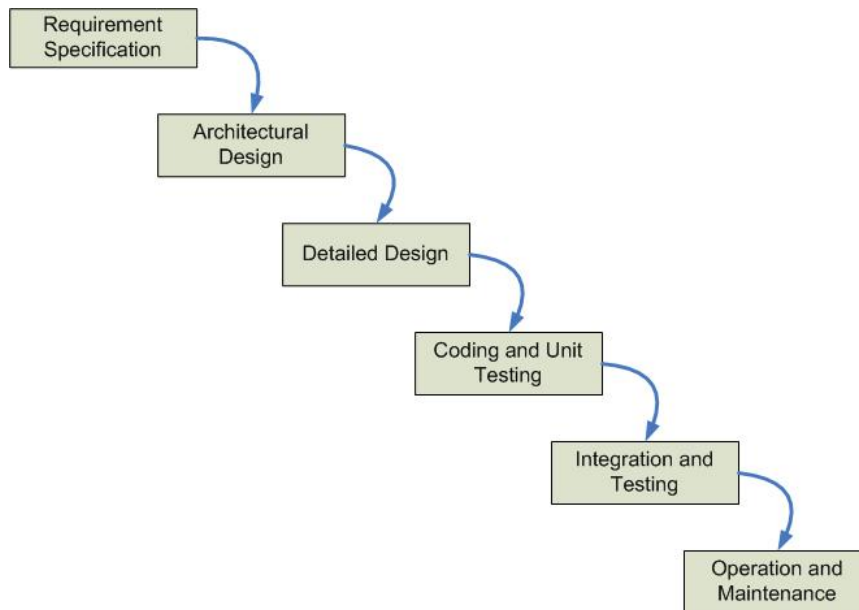


Figure 2.6: Waterfall Model activities in the software lifecycle. Adapted from [28].

2.2.2 The Usability Engineering Life cycle

There is an argument made in Goransson et.al [34] that it is important to bring closer together the field of software engineering and HCI in contributing for a better impact on the developed system or product and they also suggested that the software development needs to move towards a user-centred approach. The usability roles are important as well as software engineer to involve directly in the software-development life cycles. Usability engineering [72] are among the effort made within the HCI fields from the perspective of the development process life cycle.

Early work by Gould and Lewis in 1985 [35], recommended a very general approach to usability engineering design principles. These principles were already suggested in the 1970s. The authors divide the design principles into three global strategies:

1. Early focus on users and tasks — designers must understand users by studying their cognitive, behavioural, anthropometric, attitudinal characteristics and the nature of the work to be performed.
2. Usage empirical measurement — users should use simulations or/and prototypes to

perform real work in the early development process. Their performance, thoughts, and reactions need to be observed, recorded and analysed.

3. Iterative design — the process of design should be iterative. One should design, test, measure and redesign as often as necessary.

From the point of view of Mayhew in [63], the Usability Engineering Lifecycle was divided into three main phases which consist of several tasks in each such as:

1. Phase One — Requirements analysis
2. Phase Two — Design/Testing/Development
3. Phase Three — Installation

The usability task incorporated in phase one includes user profiling, contextual task analysis, goal setting and platform capabilities and constraints. In the second phase, each component will have levels such as a conceptual design model, screen design prototyping and iterative user interface design. Finally, the last phase includes feedback gathering after the installation process. The approach followed in this book describes more of the context of the application development and re-design of the whole development process around usability engineering expertise, methods and techniques.

Nielsen in his book [72], elaborates the stages of the usability engineering lifecycle model as in Figure 2.7. The summary of the steps consists of different levels of activities before it enters the design phase. This is to ensure the design will result in a better product.

However, according to Nielsen also [72], usability engineering efforts will still be successful even though it does not incorporate all the steps listed in the model. The usability engineering lifecycle can be adapted and tailored according to the project requirements, scope and specifications [63]. This is one of the approaches in user-centred design. A high need for usability and complex products, will need a thorough full-cycle of usability engineering [63] as for instance:

- Applying rigorous techniques to the User Profile and Contextual Analysis tasks

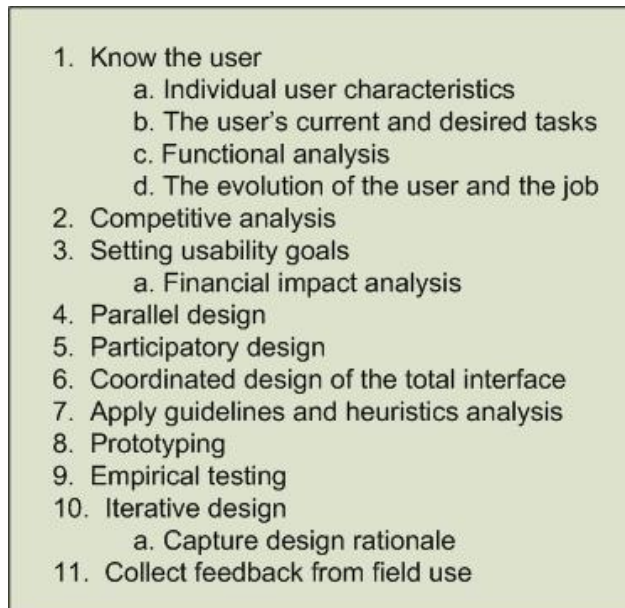


Figure 2.7: Usability engineering lifecycle stages. Adapted from [72] p.7.

- Conducting the Design, Testing and Development phases at all levels, with iterative evaluation of each
- Taking full product functionality through the whole life cycle for all layers

Meanwhile, for an application like a web based one which is comparatively simple with minimal resources, the customized life cycle can be adapted such as relying on general design principles or guidelines and the single iterative design process.

2.2.3 Summary

Usability Engineering provides a set of tools and methods that can be readily used and applied in developing a usable product, and this has been refined, tested and proven useful in both research and practice. Usability Engineering focuses on direct/indirect end-user input throughout the development process and iteratively refining and correcting according to this input so that the final product would more accurately reflect the end-user needs, thus taking a strong User-Centred Design philosophy at its core.

As will be seen in the remainder of this thesis, our work strongly follows the User-

Centred Design approach in investigating our questions and especially in developing our experimental system, the MOVIEBROWSER2. In doing so, a number of methods as suggested in Usability Engineering and as reviewed in this section have been adopted in our work and applied in order to establish our end-user (Film Studies students') needs, to design a prototype interface and iteratively refine it, to deploy it in a real environment (in some modules of Film Studies in DCU, for a semester), to ascertain usage data and feedback and finally to evaluate it with real tasks and with real users.

2.3 Multimedia Technologies

This section introduces the video content analysis techniques relevant to our work. We also provide, practical examples of the use of these technologies in research prototype systems highlighting the functionality, development cycle, evaluation and user interaction aspects of each system (or of each technology).

2.3.1 Video Content Analysis

As a result of developments in multimedia technologies, the prospect of wide and ubiquitous use of new media is promising in various domains. In particular there is an increasing use of digital media in application areas such as medicine, digital libraries, entertainment, communications and education.

Video, which has tremendous potential in learning [82], is a very rich source of information that contains visual, audio and textual elements woven together in a temporal basis [88].

The medium of video is characterized by its multiple information forms (visual + audio + textual) and its temporal basis [49]. It is difficult to process or index and present to users because of these multiple streams of information. As mentioned in [32], sophisticated multimedia system such as video search systems require sophisticated interface elements for searching and displaying results.

Due to the huge amount of digital video resources available [54] and the massive growth of data used [89, 92, 68] digital video needs advanced content management so that it can be accessed easily for many purposes. Managing digital video information involves analyzing, indexing, summarizing, aggregating, browsing and searching the video data.

A video element describes sequences of moving pictures. At a logical level, a video document can be divided into a set of basic components such as:

- episode — is a group of related scenes
- scene — is a set of consecutive shots that has meaningful semantic value
- shots — is a set of consecutive frames
- frame — is a single picture of a movie film and no temporal analysis at this level

Smeaton in [89] points out that video data can be retrieved using a number of approaches such as by using metadata and browsing by keyframe, text transcripts search, keyframe matching, semantic feature filtering, object matching and combinations of these techniques.

There is a complexity in video elements which need proper organization as compared to when dealing with only text elements. In a huge video database, necessary indicators on the audio, visual and textual elements will help the video material to be more searchable and browsable [38].

Indexing and Structuring

In content analysis systems, video data is typically structured automatically into temporal shots which represent basic access and retrieval units. This processing step is called shot boundary detection (SBD). In most approaches, SBD is based on a measure of similarity between two or more adjacent frames. Usually a shot change is indicated by large changes in the similarity value [88]. Colour histograms [62, 13, 90], edge detection [13, 90] and using macroblocks [90] are among the many features that can be used for similarity comparisons.

Most authors distinguish between two types of shot boundaries as depicted in Figure 2.8.

- Sharp shot transition — i.e. cut (sharp boundary between shots).
- Gradual shot transition — i.e. dissolve (the content of last images of the first shots continuously mixed with the first images of the second shot) and wipe (the images of the second shot continuously cover or push out of the display of the first shot).

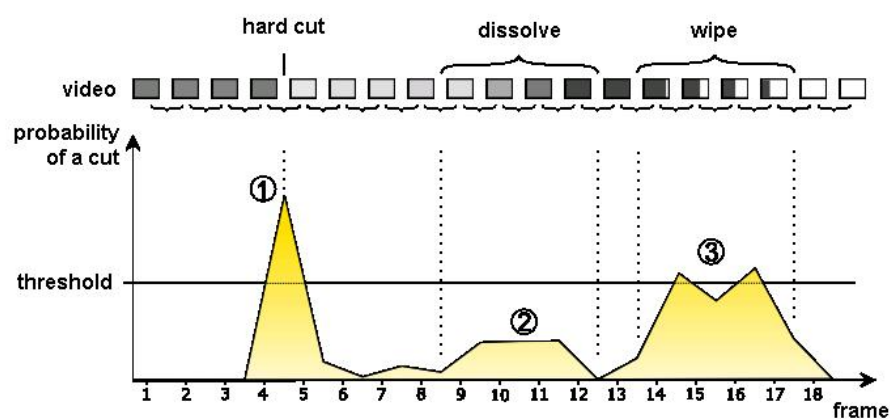


Figure 2.8: Shot boundary detection. Adapted from Wikipedia.

For video browsing and retrieval systems, the content of each shot is represented or summarised via representative keyframe.

Searching and Browsing

Navigation and access within large video collections can be performed through various means such as searching, browsing and summarisation [88, 25]. However, video navigation and browsing rely on shot segmentation and selection of representative keyframe for shots.

Video browsing is usually employed in scenarios where the user's informational need is broad. Browsing is typically performed via keyframe representations. Keyframe browsing is used in many research systems, an example being the Open Video Project³ at University

³<http://www.open-video.org>

of North Carolina.

Video search can be performed not only based on shot retrieval but also on text search on spoken transcripts of audio. Combinations of visual and audio transcript features have been successfully used for example in the CueVideo System [80]. In TRECVID⁴, search can also be performed using a sample image as initial query. Most groups involved for example [30, 2, 99], do search by image and also text in the TRECVID search task.

2.3.2 Working Systems for Video Browsing

We elaborate on some of the examples of existing systems that used the underlying techniques of video content analysis. We will review each system's functionality offered and how they were developed and evaluated with a real user group. Among the work that will be discussed is work carried out in Dublin City University [54], INRIA [82] and Virtual Screening Room [67].

1. *MovieBrowser*

Research by Bart Lehane [54, 52] at Dublin City University, used an approach to detect events in a movie and classified them into three classes based on film grammar as below:

- Dialogue — contains a conversation among characters (one or more people)
- Exciting — contains something exciting for the audience (car chase, fighting etc)
- Montage — contains strong musical background as in montage, emotional and musical events

In making a movie, a director will follow a certain universal film grammar. As for example, they will use a static camera to give an audience low distraction, relaxed

⁴<http://www-nlpir.nist.gov/projects/trecvid/>

viewing-mode and to give more focus. On the other hand, in creating an exciting feeling for viewers, faster pace editing and high camera movement is used to give high impact and increased stimulation levels. These will create a feeling of excitement to viewers indirectly, while music is used a lot as a medium for creating an emotional response among the viewers. Based on these criteria, a summary of certain measurements are used as the basis in the scene detections work carried out in Lehane's work in the CDVP⁵ as shown in Table 2.2.

Event Detection	Measurement
Dialogue	measure of camera movement, amount of speech, shot repetition
Exciting	measure of motion in video, shot repetition (low), editing pace (high)
Montage	measure of amount non-speech audio, camera movement (low), editing pace (slow)

Table 2.2: Summary of scene detection measurement [52].

Events are detected based on a number of audiovisual features from film creation principles. These features were used in the event class detections such as a description of the audio content, where the audio (speech or music) are placed into a specific class; measurement of the amount of camera movement; measurement of the amount of motion in the frame; measurement of the editing pace; and measurement of the amount of shot repetition. Two stages are involved in the overall system. The first stage will extract the audiovisual features set, while the second stage will use these features in the detection of events [53]. Figure 2.9 illustrates the scene detection, classification and keyframe extraction from this work. The system architecture is as shown in Figure 2.10 adapted from [54].

The above explanations describes the techniques used in the *MovieBrowser* in seg-

⁵Centre for Digital Video Processing

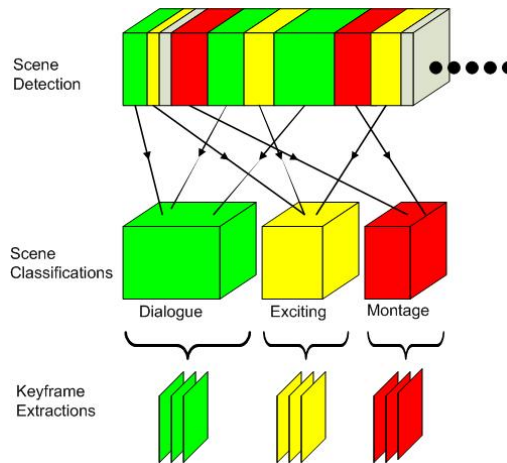


Figure 2.9: Overview of event detection and classification

menting, indexing and classifying events in brief. The author also developed a system that integrates the technologies into the *MovieBrowser* system [52]. This project was mainly carried out to facilitate ease of browsing and efficient retrieval by providing an approach that indexed a movie. *MovieBrowser* consists of three main methods for browsing movie content. Figure 2.11(a) shows the main page of the system that displayed information regarding the movie such as film director, year and genre. Listed below are the functionality that *MovieBrowser* supported.

MovieBrowser provides the facility for browsing movies using an event-based index or by searching.

- Browsing

Browsing the system can be done in two ways which is by keyframe and by event types. A keyframe is a representative images from a shot. Figure 2.11(b) shows a screen shot when this option is chosen. It will list a related keyframe in a row of 5 shots for a particular movie.

Three event types are detected in the system as a basis for browsing: Exciting, Dialogue and Montage. Exciting events constitute any part of a movie where the aim is to excite viewers. For example a car chasing, a fight, etc. These events usually have an increased editing pace and high amount of activity. A

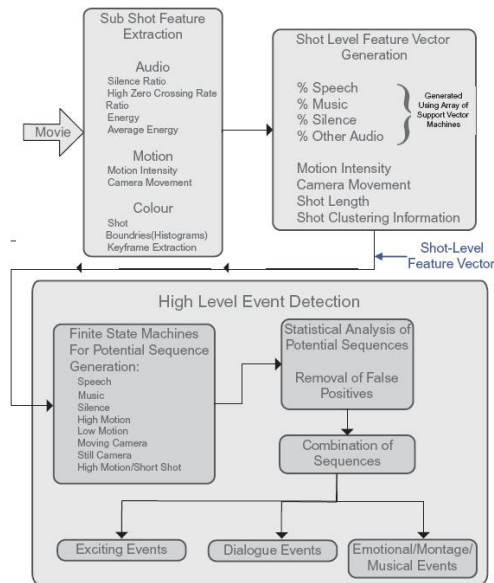
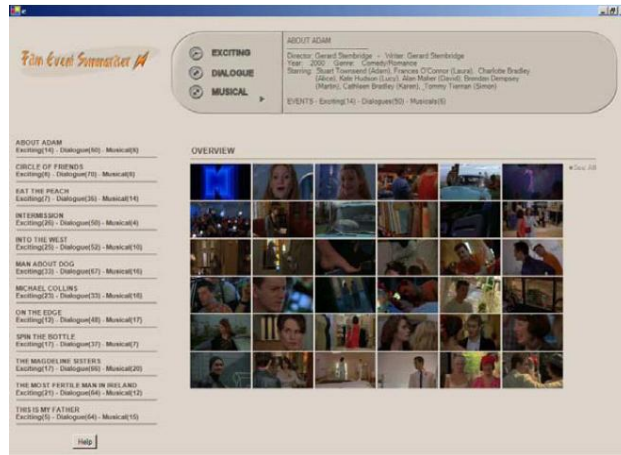


Figure 2.10: *MovieBrowser* system architecture

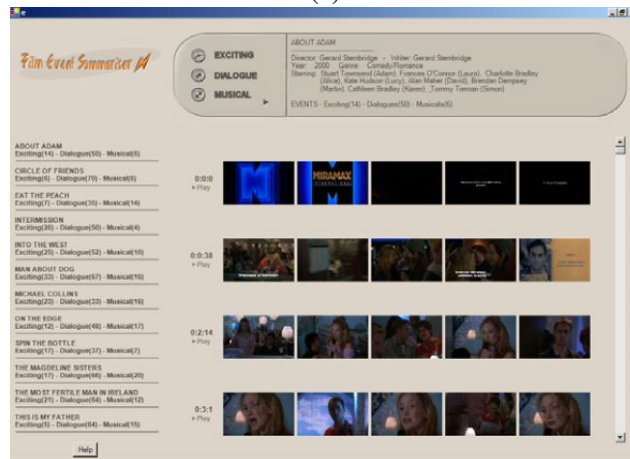
scene that involves a 2-person conversation or an argument was considered a dialogue event. A montage events is an event that constitutes a strong music or non-speech. Examples include emotional, romantic and musical. A screen shot in Figure 2.12(a) displays the event list when the “exciting” event function was chosen. The bar on the top area indicates the locations of the event type in the movie.

- Searching

The other option provided in the *MovieBrowser* system was searching for particular event detected. A screen shot in Figure 2.12(b) provides a filtering option for the viewer to choose any combination of features. For example, if the viewer wanted to find a car chase, the best methods would be to select the ‘High Motion/Short Shot’ primary feature without any filtering. This will return all areas where there is a lot of movement on screen. Another example is if viewer wants to find a conversation between three persons, one method is to select ‘Speech’ as the primary feature and then set the repetition slider bar to be say 45% and check the box to the right of the bar. However, using more than one filter was



(a)



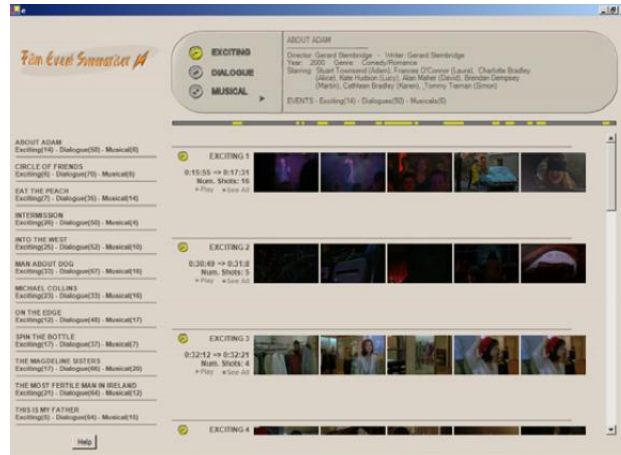
(b)

Figure 2.11: *MovieBrowser* screen shots (a) Welcome Screen, (b) Keyframe browse page not recommended as it would produce poor filtering results.

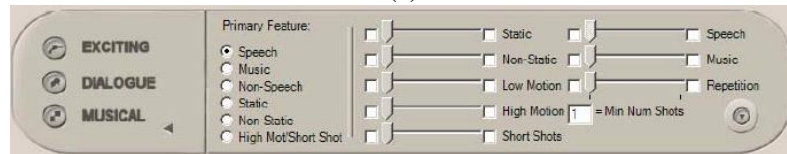
The performance of the proposed event detection in *MovieBrowser* has been evaluated in order to assess its effectiveness [53]. The evaluation was a controlled lab experiment that mainly investigated the browsing methods (event-based and search-based).

2. INRIA

Work that is related to movie video browsing includes work at INRIA [82] as depicted



(a)



(b)

Figure 2.12: *MovieBrowser* screen shots (a) Event-based browsing, (b) Filtering options

in Figure 2.13. These tools provide a novel movie content browsing and searching system. A project at the INRIA laboratory is related to the development of an integrated tool for watching, browsing and searching a movie which is synchronized with its scripts. It was demonstrated with the movie *The Wizard of Oz*.

- Search and retrieval

Search of movie shots can be performed by using full-text as the system used natural language in the script descriptions. Among search modes that are supported are:

- Shot size
- Scene location
- Camera movements
- Actor
- Places

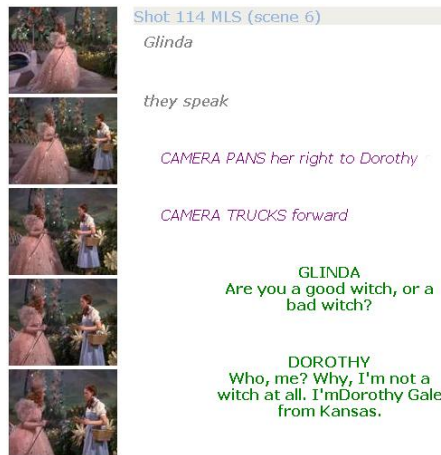


Figure 2.13: A movie browser with script indexing

- Objects
- Actions

A Boolean query interface allows a combination of all the above modes of searching.

- Browsing

From the above search query, the result was a list of shots. Thus a few types of browsing features are available. The tools provides navigation on:

- Current shot in the movie
- Current shot in the result list
- Current shot with similar actors, locations or sizes

Not only that, viewer can use the DVD player to browse with the updated synchronized metadata and scripts.

This work was concerned with browsing and watching movies in synchronization with the scripts and some metadata. Browsing and navigation links were dynamically generated by the server as the user watched, browsed or queried the movie. Users would need a browser with a plug-in DVD player. Browsing and navigation could be done from a DVD or by using the movie keyframe/thumbnails. To our knowledge,

no interactions or evaluation has been made during system development and also no evaluation with real users. Theoretically the system would be beneficial to film studies students for movie analysis but in practice, no user experiment was performed so far.

3. Virtual Screening Room

The Virtual Screening Room (VSR) [67] project is an informative browser for playing a movie with features such as clip searching and various in-depth information representations. The development of VSR was meant to be a 'textbook' that can be used in teaching film which specifically focused on the Editing chapter/topic. The database stores 500 movie clips related to the Editing Chapter for instance techniques used in film editing. System functionality provided is as below:

- Browsing

Text on certain topic is displayed with some add-ons on the interface layout such as a film reel icon and a text hyperlink to redirect to relevant movie clips. Thumbnails are also presented in the interface for the same reason. An interface screen shot in Figure 2.14 presents the features. Browsing for more in-depth information on a specific movie was available through movie metadata such as movie resources, director, film editor.

- Searching

Searching for particular movie clips also can be performed in VSR. Users can search from 500 movie clips that are stored in the database in two forms of view: clip list view and single clip view (for more detailed information). Specific search can be performed by using a button provided at the top area of the screen. Both Figures 2.15(a) and 2.15(b) illustrate these functions.

The tool was meant to be used by MIT or other institutions that are interested. To our knowledge also, there is no information on the interactions made with real users



Figure 2.14: VSR Main page.

during the development and evaluation.

4. Video Audio Structure Text MultiMedia Browser

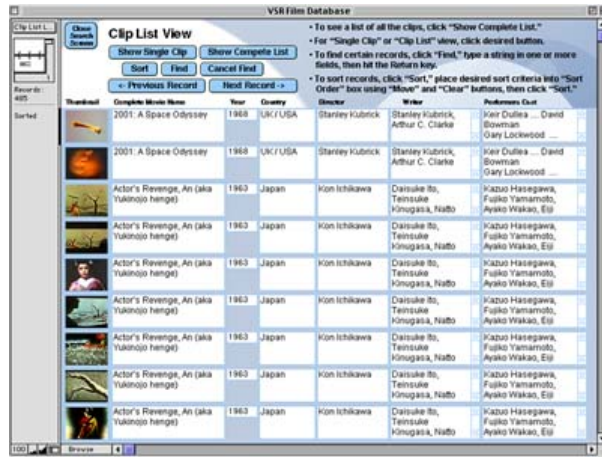
Video Audio Structure Text MultiMedia Browser (VAST MM) supports an approach for segmentation and indexing of video presentation. An extensive user study has been carried out over a long period of time (3 years) to get user feedback and to improve the system indexing methods and the tools [39, 38]. They conducted one to two user studies each semester in order to iterate the design process of the system's improvement and evaluation.

Figure 2.16(a) illustrates a very rich graphical user interface (GUI) design, to support activities such as browsing and searching of video content [45].

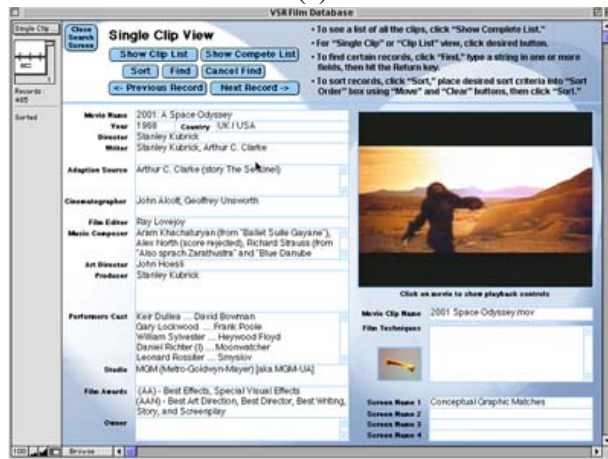
- Browsing

Browse classifications in VAST MM include:

- Thumbnail snapshots
- Tracked audio
- Timeline of timestamp visual change
- Video presentation content of keyword and phrase from the transcript



(a)



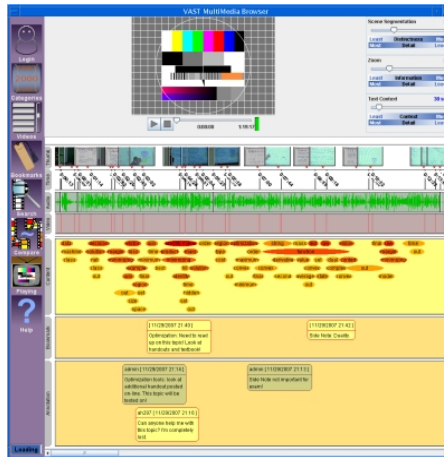
(b)

Figure 2.15: VSR screen shots (a) Clip list view, (b) Single clip view

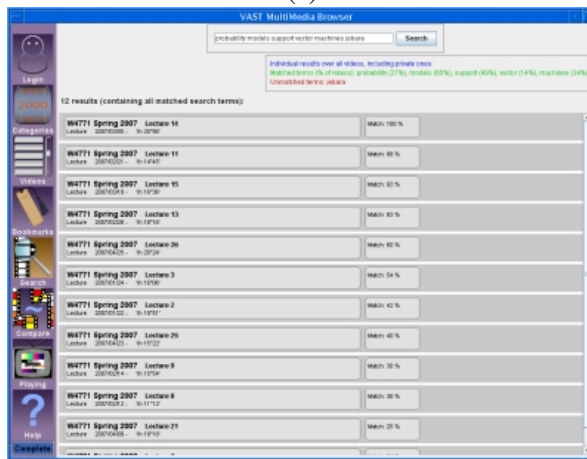
- Personal annotation bookmark
- Public text annotation
- Text-based search

The Search interface can be used to query the video database using text terms. A text term is used for searching for particular video in the database, based on Automatic Speech Recognition and Optical Character Recognition and ordered by match score. This is illustrated in Figure 2.16(b).

Interactions with users have been made via a long series of user experiments, getting



(a)



(b)

Figure 2.16: VAST MM screen shots (a) Main page, (b) Search interface

feedback on system improvement especially on the searching of video content with engineering students at Columbia University. They also conducted another user study after 3 years improvement with computer science students to measure the potential impact of the tool.

2.3.3 Summary

We presented a brief explanation of the techniques used in managing digital video which include indexing, browsing and summarising. Video needs to be segmented into appropriate

ways so that its content can be accessed. A movie is a type of video element that is rich with information. The main aim in indexing a movie is to provide easy access to the movie content.

We also introduced some examples of applications that exploit video technologies in their development. Segmenting a movie into several chunks or scripts is among the technologies that have been researched and evaluated in terms of performance efficiency. Each example of research carried out, exploited different aspects like in the work of Lehane [54, 52] that proposed techniques to maximize movie content access from the perspective of event detections. INRIA focused on scripts associated with movies while VSR tried to provide a facility for students with an electronic textbook. 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 into the development of such applications.

Most application systems mentioned above provide similar features for browsing and searching in a video system. These systems were mainly initiated from a technical perspective of video content analysis, designed and developed as intermediary interfaces to evaluate the proposed techniques or methods. As far as we are concerned, no interactions with *real* users has taken place in designing and evaluating these systems as their main aim has been on research on the technical possibilities.

2.4 System Deployment

2.4.1 Deployment Trial Efforts

In this section, we explain some of the other related work carried out by other researchers on deployment efforts and ethnographic studies. Some of the similar trials carried out are from Dublin City University — Físchlár and SportsAnno and others are from Columbia Univer-

sity (Newsblaster), and Austrian interactive TV. We describe each of these trial evaluations as follows:

1. Físchlár Digital Video Library System

The Físchlár Digital Video Library System was developed at Dublin City University to support capture, indexing, browsing, searching and summarising of digital video and has been deployed into four separate video content collections for a variety of users and application scenarios [92]. The four versions of the Físchlár system include TV programs [48], TV news [91], TRECVID video track participation [12] and nursing educational videos [36]. Information provided to users in the system interface are based on finding and selecting a video program either using text or metadata. Supported interface elements included a keyframe slideshow, a hierarchical keyframe browser, and a timeline browser.

Físchlár-News was one of the collections designed to support an archive to the main evening TV news broadcast. It incorporates a number of multimedia and recommendation techniques and was deployed within a University campus for several years, in which the large scale testing and evaluation (performance and usability) has been carried out [91]. Methods used from video content analysis include such as shot boundary detection, keyframe extraction, capture of closed captions, and the system allows for text searching, browsing and playback. An example of an interface screen shot is depicted in Figure 2.17 adapted from CDVP⁶.

An extended live usage study has been performed on Físchlár-News for a month with 16 users using a highly qualitative and ethnographic diary [50]. This study mainly emphasized the understanding of real use, the development of use over time and the use of new technologies in new contexts.

⁶www.cdvp.dcu.ie

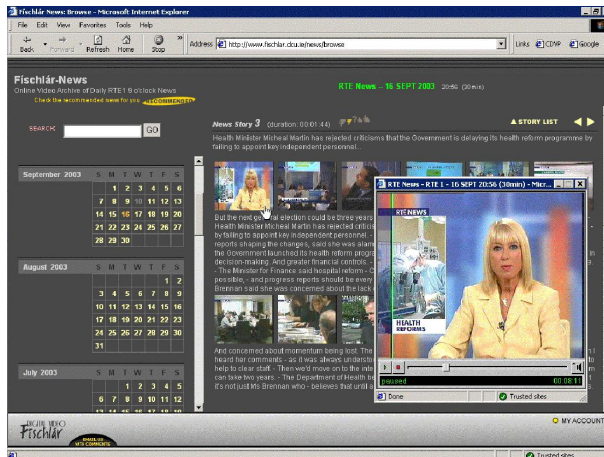


Figure 2.17: Físchlár News System interface screen shot

2. Newsblaster

Newsblaster at Columbia University [65] is an experimental system incorporating natural language processing techniques to automatically crawl news websites on a daily basis and summarize and present them to web users. The system has been deployed since 2001 and was developed mainly to demonstrate its summarization robustness and the use of TDT technology. An example of the interface is shown in Figure 2.18 adapted from [65] that shows the Newsblaster front page with six news categories namely US, International (World), Financial, Entertainment, Science and Technology, or Sports.

Researchers on the Newsblaster system had started conducting a large online evaluation to measure the usage and preferences. The system that is available online⁷ has also undergone a number of experiments mainly on summarization efficiency (Precision and Recall) such as reported in [66].

3. Austrian Interactive TV

⁷<http://newsblaster.cs.columbia.edu/>

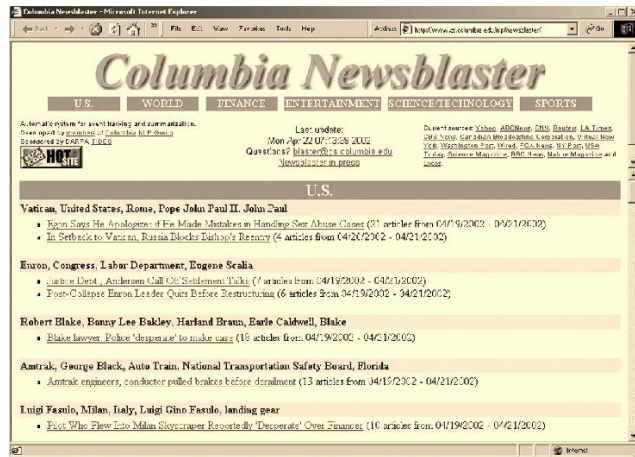


Figure 2.18: Newsblaster frontpage

An Austrian interactive TV (*iTV*) trial [6] deployed a novel TV application to a local cable TV provider in Salzburg, Austria, and ran for 4 months in 2004-5. In this paper, the authors tried to overcome the lack of research in the area that can provide actual usage data; the researchers carried out evaluation and generated results from a usability test and the findings on the use of the *iTV* services. In order to assess actual usage data, the system was deployed into more than 300 households. Apart from that, the design of the system also followed a user-centred design approach in order to collect more usable data.

The researchers got low feedback from the trial due to some technical constraints. The system received some suggestions for improvement from the usability test findings and these will be tackled in subsequent projects. Data collections from the server logs, questionnaires and interviews were used to illustrate the findings. User acceptance of the new technology is considered low as this area is still immature. Figure 2.19 (a) and (b) give an example of the interface screen shots.

The developers followed a user-centred design in order to provide a usable system for the user to use but then due to time constraints the improvements could not be carried out for the deployment test. The research will proceed with the improved version and further re-deploy in their future work. When trying to improve the system



(a)



(b)

Figure 2.19: iTV Salzburg screen shots (a) Portal, (b) News application

they stick to a user-centred design approach to take into account user characteristics, experiences, expectations and preferences. From the user test it showed that users preferred a simple navigational design.

The research outputs also noted several issues from the trial such as technical, usability and user acceptance issues. For instance, during the field trial, users reported some technical problems and these become one of the reasons for low usage. From the deployment conclusion, they identified that usability should be taken seriously to ensure user acceptance.

4. SportsAnno

SportsAnno is a video browsing system that is designed and developed to allow users to make comments and share opinions and ideas on soccer events with other registered users. Users are drawn from members within the research group, and friends and outsiders [46]. SportsAnno was deployed during the soccer World Cup 2006 matches. Example of a screenshot is in Figure 2.20. Users can browse soccer video and at the same time make comments and annotate while reading texts of newspaper reports related to the matches. The system provided up to date information and context on the current match.



Figure 2.20: The SportsAnno interface

Usage data on sports event segmentation are gathered during the deployment stage. From the deployment, a number of usage monitoring and issues were pointed out such as low responses for some specific games comments. Among the solutions suggested are that the system should have an alert notification, informing or making aware that there are new comments. Some other lessons learned were to include direct linking and annotation that allow easier navigation and locating video events within the report. By viewing comments of other users, users will catch additional

information which are not available in the original newspaper report.

2.4.2 Summary and Discussion

This section summarized some related work of trial usage of video navigation systems i.e. Físchlár [51], Newsblaster [65], iTV [6] and SportsAnno [46]. These are examples of some of the work in deployment efforts that combine technology into practical system development. These trial efforts show a growing awareness of the importance of user evaluation in realistic environments. Studies that incorporate the end-user perspectives 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 do they 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 our system development and feature design on the end-users' goals and perspectives.

While focusing on these new and developing multimedia technologies is understandable in developing new media technology applications, there are still lacking of knowledge, experiences, and existing practices that could and should be ascertained and incorporated in such new applications.

We included this section in the thesis because deployment is important in getting real usage data on any developed system whether it is for evaluation, validation or user testing purposes. In our research perspectives, we want to consistently validate our developed system with real interactions from real users which we believe as far as we are concerned not enough work has been done related to trial deployment efforts with real users in our research domain. We hope to determine a more holistic view of the work by performing these activities. We provide some arguments in illustrating these which we believe are important as Figure 2.21 depicts below.

As can be seen in the diagram, there are different stages in technology development, where technical evaluations were the main concern. Research was mostly carried out to evaluate the effectiveness as for example the Precision and Recall of any proposed tech-

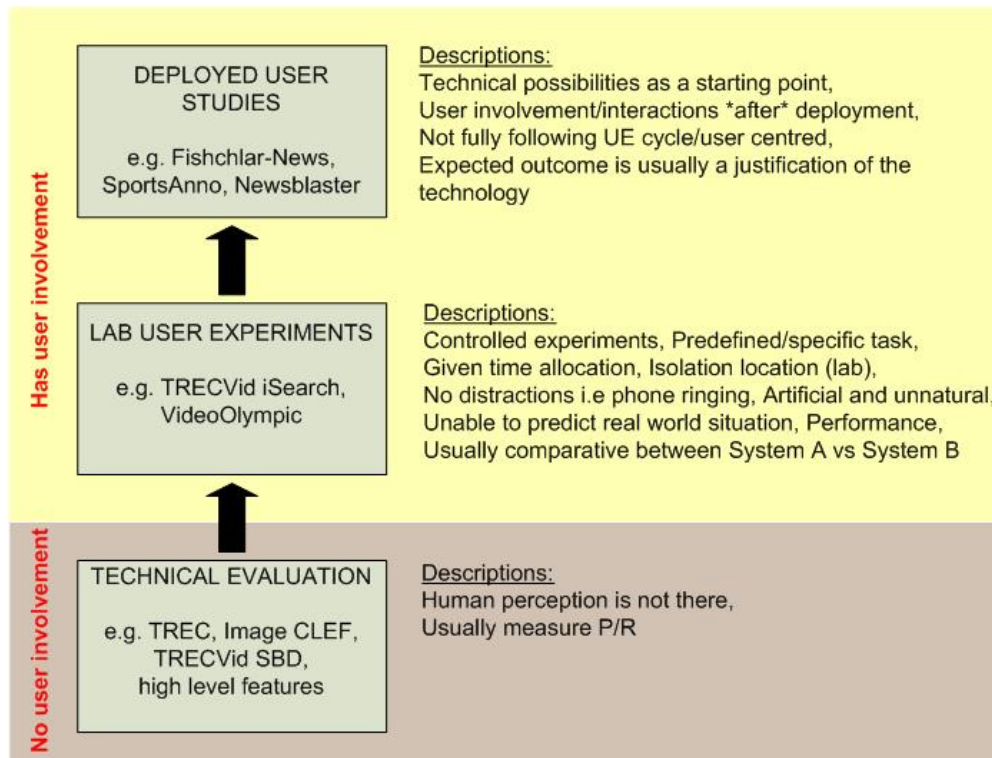


Figure 2.21: Research perspectives

niques (bottom part of diagram). Some of the work includes TREC [97], ImageCLEF [4] and TRECvid SBD [93, 77]. Without the involvement of real users, these overall technologies remain only as technical possibilities. By building an end-to-end system, we can bring in human users into the whole process of development and test the technology in a more natural way. Having users involved in the experiment is normally done by recruiting a number of sample users doing a predefined task in a specific lab or place. Usually the measurements are based on comparative versions of the system but still focusing on the effectiveness of any proposed techniques. In this way, user involvement starts. Examples of research experiments carried out such a way are include numerous interactive search task experiments in TRECvid [100] and VideoOlympics [101], and indeed majority of user experiments in the fields of Multimedia, Information Retrieval and other technologies which try to measure and compare the effectiveness of a proposed technique.

However, working in an artificial lab environment, having time constraints within which

to complete searches, working on pre-defined tasks, etc. makes a user experiment artificial and unnatural. With this acknowledgment, a small number of more ambitious studies have started an actual deployment of systems into the real world. All *messiness* now become part of the evaluation. A very good example as previously described in the deployment trials above. (e.g. Físchlár, SportsAnno, etc.).

From the other perspective, these work are not fully user-centred, because their involvement with users can be considered to start *AFTER* the system deployment happens. In other words, the technology itself was already conceived and developed, the application scenarios constructed, and the interface has been designed, without any end-user involvement.

In our research, a system deployment effort was conducted, but from the very beginning, target users were involved. We followed the full cycle of Usability Engineering, obtaining requirements, user interface sketching, system building and then this was followed by deployment and usage monitoring.

2.5 Film Studies

2.5.1 The Film Industry

The film industry includes any activities that are involved in filmmaking like producing and distributing movies. It also includes the film production companies, film studios, cinematography, film production, screenwriting, pre-production, post production and film festivals.

The major film distributors ('Big Six') [7, 98] are as listed below:

1. Warner Bros. Picture
2. Paramount Picture
3. Walt Disney/Buena Vista
4. Sony/Columbia Picture

5. Universal Studios

6. Twentieth Century Fox

These *Big Six* are the major film studios that contributes up to 95% of their revenues to the United States and Canada, and also form more than half of the international market from their released films [7]. This can also be seen from the breakdown chart in Figure 2.22 adapted as part of BoxOfficeMojo.com⁸ which listed the top 12 studios or distributors and their market share for the year 2008 that the top 6 were from the *Big Six*.

January 1–December 18, 2008
Overall Gross: \$9.091 billion

Rank	Distributor	Market Share	Total Gross*	Movies Tracked	2008 Movies**
1	Warner Bros.	18.5%	\$1,678.5	29	19
2	Paramount	16.7%	\$1,518.7	16	13
3	Sony / Columbia	13.3%	\$1,212.9	22	19
4	Universal	11.1%	\$1,012.6	19	17
5	Buena Vista	10.3%	\$938.7	17	12
6	20th Century Fox	10.0%	\$907.4	23	19
7	Lionsgate	4.6%	\$422.2	18	18
8	Summit Entertainment	2.3%	\$208.9	5	5
9	Fox Searchlight	2.2%	\$200.2	9	6
10	Focus Features	1.5%	\$133.0	7	5
11	MGM/UA	1.3%	\$119.5	17	11
12	Overture Films	1.1%	\$100.3	7	7

* In millions. ** # of total movies tracked that were released in 2008.

Figure 2.22: Top Studios — Market Share Breakdown

Distribution companies or the majors was depicted as a “three-tier society” by Wasko [98]. At the top were the big studios that dominate the tier, followed by the second tier which are the less influential smaller production studios, while the bottom tier were the smaller independent companies. Outlining these corporation was difficult because of ongoing restructuring, merging and unmerging from time to time.

The Internet Movie Database [1], is a movie information database that stores a massive amount of movie and video data such as plot summaries, movie ratings, year of release

⁸<http://www.boxofficemojo.com/studio/>

etc. According to imdb.com, the United States released 9999 titles in the year 2008 which was the highest in the world of titles released, followed by the United Kingdom with 1509 titles while records listed from Ireland shows the number of 94 titles. The figure shows that United States contributes as the major producer of movie videos. These titles included movies and television productions. Information on movies and videos on the internet were indeed growing from year to year. It can be seen from the graph in Figure 2.23, adapted from [57] that there is huge growth in the number of films produced which continued throughout the decades with the increase more than doubling from 1971 to 2001. This figure also included TV production data.

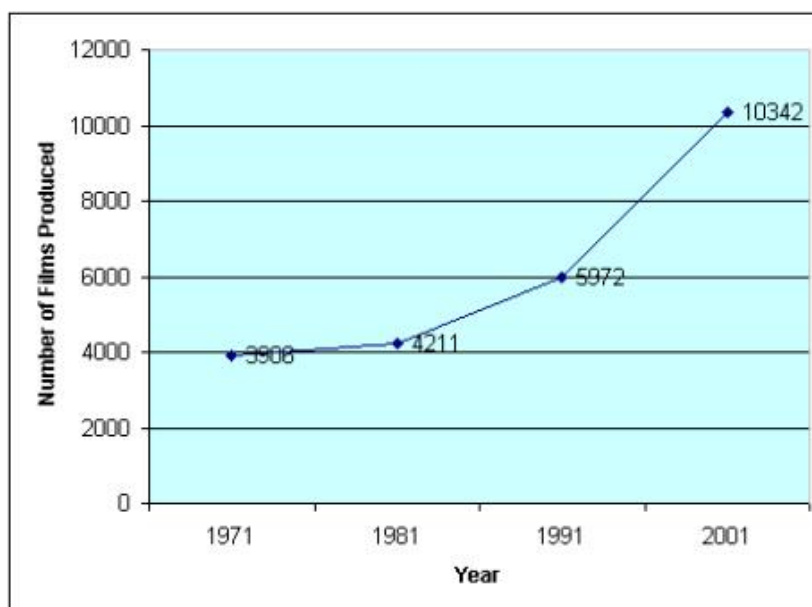


Figure 2.23: Worldwide Films Production

2.5.2 Film Studies

Film Studies is a study about film history, theory, and criticism. Some courses also include the study of TV and film productions. Dublin City University offers various modules related to Film Studies either at Undergraduates or Masters level. All the modules are under the School of Communications, Faculty of Humanities and Social Sciences, DCU. The school is the only university department in the state focusing on media and is known as one

of the largest of its kind in Europe with 600 undergraduate students, 130 taught Masters programmes students, and 25 research students ⁹.

In relation to this, Ireland provides many courses with practical and theoretical education in the fields of television and film studies. There are altogether 43 schools, colleges and agencies that offers a variety of academic and practical courses in film, media, communication and acting which includes Dublin City University as one of them [16] (page 15-16).

The typical tasks of Film Studies students is to read and analyse movies. 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 [9].

Nelmes in [70] explains in brief the technology changes in the mode of film distribution. Film distribution began in 1975 with Time Inc.'s Home Box Office cable pay-TV (HBO) and Sony's domestic Betamax videocassette recorder (VCR) and was followed by the introduction of VHS format for domestic VCRs by Matsushita in the following year that soon become an industry standard. The first commercial Digital Versatile Disc (DVD) players were introduced in Japan (i.e. Toshiba and Pioneer) in 1996 with them competing with VHS. The DVD market grew very fast as compared to VHS. This is as quoted in [70] as "... Blockbuster Video estimating that 30 percent of its US rental business was DVD¹⁰". Due to its features of higher quality of audio/video and higher capacity data storage (i.e. a minimum of 4.7GB of data), DVD became an important mode of distribution for film.

The growth of DVD usage has been addressed in [70](page 51) as quoted below:

The number of DVD players in the US grew from around 350,000 in 1997 to approximately 1.4 million in 1998, 5.5 million in 1999, 14 million in 2000

⁹<http://www.dcu.ie/communications/index.shtml>

¹⁰'DVD Rising', Chicago Tribune, 14 October 2001.

*and to an estimated 30 million by the by the end of 2001*¹¹. *This exponential growth mirrored the growth in numbers of TV sets in the late 1940s, with DVD replacing video as the home-based entertainment phenomenon. Thus by the turn of the new century DVDs' interactive features - multiple story-lines, games, instant search controls, different camera angle for the same action*¹² — *heralded the new digital home viewer, the viewer-cum-user or 'viewer'*. *But this viewer - most likely 12- to 24-year-old, frequent cinema-goer -, in the form of PC downloads. The industry got the message, and now the Majors, such as Universal, offer blockbuster movies as temporary or permanent downloads. Some industry pundits feel that the move to online distribution 'windows' signals the beginning of the end of DVDs.*

The industry predicted that online distribution will replace the DVD in the future [70]. A lot of video sharing websites generated by users are currently available for downloading and sharing video clips an/or the whole movie (i.e. ifilm¹³, veoh¹⁴, etc.) either as free services or with a certain charge. These facilities could provide more convenient spaces for the students of Film Studies to download film material easily from the Internet.

Conventionally, in preparing to write a textual analysis for a course, students of Film Studies will be given a list of topics to be chosen from prior to that. Once decided on the particular topic, students will start looking for related movies which they get either from the library or from their own DVD collections. They will play the whole movie a first time to get a rough idea what the movie is all about and will repeat the process many times either on the whole movie or on the specific sequences that interest them. Reading a movie could not be done in a day, as the skill will emerge over many times practicing and discussing with the lecturer or classmates.

In all the film studies modules that we have chosen in our study in DCU, students needs

¹¹ 'DVD Shipments Seen Reaching Lofty Heights', Reuters, 24 October 2001.

¹² 'DVD Shipments Seen Reaching Lofty Heights', Reuters, 24 October 2001.

¹³ www.ifilm.com

¹⁴ www.veoh.com

to read a film. Reading means understanding the language or grammar of the movie and the in-depth meaning, finding the uniqueness in a systematic way, capturing the essence in the movie and focusing on various aspects of arguments for example the use of colour, music, semiotic means (study about symbols, objects and etc), *mise-en-scene* (what is in the frame), lighting, and so on. The length of the textual analysis varies across modules from 1,000 to 3,000 words which depends on the level of the module. Film grammar is a unique language. There is no unique formula to decode a film. A rigorous textual analysis of a given film consists of how and why things happen. A textual analysis must engage with the grammar of the cinema and the most important thing is to concentrate on how the meaning is created [9]. In brief, the student's major task is to read material, see the film, and try to write about it as a practice.

2.5.3 Summary

The film industry is growing very fast with a lot of higher quality films produced each year. As for any applications that were developed related to movie content analysis, this industry indeed provides a potential market.

Film studies is a field that associates the exploration of films or videos as an art. It has a higher potential in the job market for various career paths related to film with a lot of courses being offered. DVDs are the most important material for the student of Film Studies for reading and analysing movies. Advanced technology is made available enabling movie content information to be accessed easily with the existence of the Internet providing resourceful information such as the IMDB page, the Internet Archive¹⁵, and so on. With the increase in work carried out in video content data, video material can be indexed and accessed easily. Students in Film Studies are able to access video information through various techniques proposed in the research in the area.

As explained in Chapter 4, some of the main teaching benefits have been described regarding the use of DVD add-ons (e.g. director's commentaries) in providing bonus features

¹⁵www.archive.org

for teaching film [10]. Using add-on features often strengthens the overall appeal of the medium for the user especially students of Film Studies.

2.6 Chapter Summary

This chapter elaborates some disciplines or areas that are inter-related in our study. The first sections broadly explained the inter-related main areas of Human Computer Interaction, Information Seeking, Multimedia Systems and some established theories in organizational psychology. The following sections elaborate on the Usability Engineering methodology that we employed in our research from the very beginning. Our back-end work was on the technology built into our system development, which is video content analysis techniques. Thus we included in the third section of the chapter divided into two parts, the technological and technical perspective on video content analysis, followed by some example of application systems that implement the technical possibilities as a usable tools. Our survey continued with other similar work on deployment trials particularly in assessing usage from real user groups with different trials implementing different issues or domains of study (i.e. news and interactive TV). Lastly, we explore the domain of research which is about Film Studies.

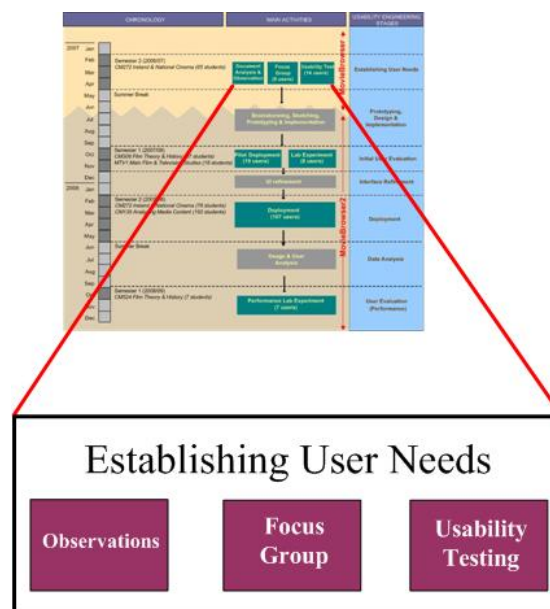
Marchionini mentioned in [60] that, information seeking is a fundamental human process that is related to learning and problem solving. The process of getting knowledge or information from the surrounding environment can be referred to as seeking activities. Digital video has been used and adopted in many applications. For example in the classroom when used as part of teaching, digital video could provide a potential learning benefit. In Film Studies for instance, applications that are developed related to movie content analysis such as MovieBrowser [52], INRIA [82], and the Virtual Screening Room [67] could be beneficial to students in generating, manipulating or representing movie information for student's analysis tasks. With the emergent use of technologies that are embedded into system development, the information seeking process of the individual could be enhanced.

We consider these sections as inter-related in our research as they are involved in the process of the thesis construction in designing, developing and assessing usage of our applications system. Studying films does indeed require creativity in analysing the texts that are associated in the films and there are no exact answers. With the emergence of technologies in video content analysis, some tools have been developed for use. Learning in the film studies application could be supported better.

Chapter 3

User Requirements and System Design

3.1 Understanding Users' Needs and Requirements in Analysis and Browsing of Movie Content



Our work started with the identification of users' needs followed by further system

development. In subsequent refinements of the system, the emphasis has been on new features to be included in order to support a real user group in carrying out their tasks. We took a user-centered approach, effectively tackling the development of the system from the user point of view and using user feedback to guide us. Users' points of view and their feedback will be used to enlighten our future system re-design. In order to assess the overall holistic impact of video analysis and browsing in a film studies context, we need to have a software tool that can effectively support end-user information seeking. An examination of the users' needs, their preferences and work contexts are important in order to provide any effective support system [102]. A user interface plays an important role as an intermediary between the system and the user. An interface serves as the communication channels through which information seeking can proceed [61]. Thus, defining and building interfaces that can support information seeking is a fundamental problem which we address for the context of users browsing movies in a film studies context, and will be the motivation of the work which we carry out.

The study which we carried out is based on an initial standalone movie browsing system, which is available in Dublin City University (DCU) [52], and our work will look at this system and the functions it offers from the user's perspective in a more holistic way than has been done previously. *MovieBrowser* was developed using a highly technical perspective in the approach taken to movie segmentation and detection and classification of events into dialogue, exciting and montage shots. The work by Lehane as part of his PhD thesis was not evaluated from a user's perspective, and the system itself was not designed, either the interface or the functionality, with users in mind. We use this as a starting point for our own work.

The main objective in the user requirements stage of our work is to understand how students analyze video content (movies) in their context of film studies. Our work tries to study and identify how film studies students seek and extract information from video segments. In the film studies module, each student needs to do in-depth or close analysis of scenes in films and to critically interpret and analyze this in the form of documentation

writing. As the conventional practice, students will borrow a DVD from a library or other sources like renting from a DVD shop. They will actively watch the DVD and try to identify and focus on interesting parts based on a topic given by the lecturer of the module. Students will read the video content and interpret the surrounding context of a specific movie and produce a written text essay. That is their task.

3.1.1 User Study Methodology

The main reason why the study we completed was conducted in the first place, was to get feedback from users and to learn what are the new features which should be included in any future system redesign. This study took about 3 months to complete. Historically, students analyzed movies using a DVD from a library or from their own personal video collections. Now however, we have the *MovieBrowser* system as a video management tool, which we made available to these students as a starting point for the development of a more tailored system. A current limitation to the system is that access is restricted to only 40 PCs as it is a standalone system which runs on a PC, and it was installed on the PCs in one of the students' laboratories.

The requirements gathering and specification stage was carried out using a few different and complimentary methods. In the early evaluation on the initial *MovieBrowser* interface design, an experiment using usability testing with users was carried out with the aim to find out any usability problems regarding the interface design and system functionality. As suggested in [76], there are four ways of evaluating an interface namely: formally, automatically, empirically and heuristically. Current practice is by doing empirical evaluation experiment with test users. Before the work can be developed and designed according to specific needs, two major activities were involved which are requirements gatherings and specification. Among the methods we use for data collection at this stage are focus groups, usability testing of the current existing system, designing with the user, questionnaires for data collection and direct observation.

Students from the *Ireland and National Cinema* (CM272) module were chosen as tar-

gets and make up a real user group because the course is one of the modules under the Film Studies Curriculum in the School of Communication, DCU. These first experiments were conducted during Semester 2 of the academic year 2006/07. The course was given by Dr. Pat Brereton with 65 undergraduates students at level 2, taking part.

Observations — The objective of this activity was to understand more of the objectives, learning outcomes, and overall evaluation of the course module. We carried out this observation to understand the way students were taught, lectured and assignments were completed. An observation towards students' learning scenarios was made through consistent observation for the whole semester by the researcher making an effort to attend lectures for the class module. We introduced ourselves to the students at the beginning of the semester so as not to become anonymous and to know and interact well with the students. We observed how the whole class was conducted and managed by the lecturer.

In the meantime, we also try to understand the whole structure of the module, by reading and understanding the course requirements and learning outcomes. The syllabus and learning outcomes of the modules were studied. A number of early discussions with the lecturer were carried out. Reading and analyzing were also carried out for previous years' written assignments. The course learning outcomes were to make the students learn to apply film theories to Irish cinema (*CM272 Ireland and National Cinema*) in a broad range of contexts and within other national cinemas.

Focus Groups — This activity had a general goal of discussing new features, of listening to opinions and other insights from the students. Focus group were performed in an interactive group setting to more actively elicit students' opinions as they discussed among themselves, agreed and disagreed during the sessions. The objective of the focus group was to extract as much direct information from the students on their requirements, needs and specifications in their film studies. Specific objectives were to identify typical tasks, typical workflows, problems, and features that would help in their studies and learning goals.

Participants for the focus groups were carefully chosen because we wanted to get good feedback as at this requirement stage, we want to extract as much information as we could. Among the procedures we used in selecting participants were through observations in class. Early involvement and interaction with the students by sitting in the class lecture helped us in choosing the right participants. This was important in order to familiarize us to students and vice-versa, and to get to know the students well. We chose students who are regular active participants in class in giving their arguments and opinions when the lecturer highlights certain issues or topics on certain movies that are screened in class. Once identified, we contacted them through direct communication after class ended.

8 participants were recruited, four females and four males, from the *Ireland and National Cinema* (CM272) module. We used several sessions due to difficulties in arranging times as students were restricted by their different class timetables since they were from variety of faculty programmes ranging from Journalism, Multimedia and Communications. The focus group provided us with an in-depth understanding of the requirements as we could have one-to-one direct communication and allowed more room for discussion.

Arranging students in a session is one of the difficulties we foresaw. Since this was carried out a few weeks before the semester ended, students were busy with many class assignments and projects. We managed to make 4 interactive sessions (session 1 = 3 students, session 2 = 1 student, session 3 = 2 students and session 4 = 2 students). It was organized in a small meeting room fully equipped with a whiteboard, flip chart and markers. A refreshments were provided during the one hour session.

The researcher led the session as a moderator. At the beginning of the session, participants were given a brief introduction on why the study was being carried out. They were given some information sheets to read and consent was required before the session could proceed. Permissions were asked to use an audiotape recorder during the session. We asked each participant questions individually at the beginning and it slowly became a discussion towards the end of session. The sessions were organized in an informal manner so that students were free to express their thoughts and opinions. After the sessions ended,

participants were acknowledged and thanked for their time spent and opinions given.

Overall, six main questions (see Appendix A) were asked during the focus groups related to participants' close-analysis and their environments when studying film studies. Questions were based on mainly to capture their work task, typical problems, environment and etc. They were also asked about the typical approaches that were used in solving problems when working on the tasks given by the lecturer. Questions regarding the resources they used, problems they faced in getting resources, information needs and learning goals were among the other topics of the discussion. The last section in the focus group were a section called "designing with the users" where we took a brainstorming approach. Participants were involved in a discussion session on features that would help them in their studies in the context of film analyzing, and browsing. In the sessions, participants point out their ideas with guidance from the researcher (moderator). Proposed interface designs were sketched on a whiteboard with new ideas described with example scenarios. They were asked about what features they would like to see if there were tools that could help in their studies particularly focusing on browsing and managing their task in film sequence management.

Usability Testing — In the usability testing lab experiment, 14 students volunteered to participate. Eight males and six females participated in the experiment. Since this is a user requirements analysis, we believed that the number of users were representative enough for the requirements gathering stage and an adequate amount of information would be collected from them. They were our 'wildcard users' in the experiment. A larger number of participants would be used in future experiments once the new version of system was deployed. Our considerations on the number of participants chosen were based on the literature [71, 75, 29]. A group of participants of this size would be adequate and controllable within a one-hour experiment.

MovieBrowser is a single system (stand-alone) that can accommodate all three methods of locating events in a film for further analysis. There were 12 films stored in the initial

MovieBrowser system database. It was developed to provide for three ways of locating events in a movie which are:-

1. browse by keyframe,
2. browse detected events and
3. manual search for a particular chosen movie.

As the initial *MovieBrowser* system used in the PhD thesis of Lehane also needed some adjustment on its interface design, usability testing was carried out particularly to find any usability problems on the original version and did not focus on the system's technical perspective (e.g. retrieval and performance). The main reason for conducting usability testing was to discover any usability problems as advocated in [76, 96] and to get insights from real users [75]. The earlier version *MovieBrowser* was installed in the school lab at the beginning of the semester. An interface screen shot is shown in Figures 3.1 and 3.2. Early in the course, a system demo was conducted in the class to introduce the system to all students. Students were given ample time to familiarize themselves with the system for the first half of the semester before the lab experiment was conducted.

14 students were volunteered for our usability testing. We believe that this numbers of sample can provides an appropriate result in identifying the usability problem from the aspect of system's functionality and not on the efficiency. Justification is also made from the guidelines given by [71] as can be seen in the plot graph in Figure 3.3. The graph shows the number of usability problems found in a usability test with number of n users. From the graph, it can clearly seen that when the number of users reaches approximately 12 users, the number of usability problems found was the same as problems found with 15 users. More usability problems will be identified when the number of users used is between one to nine users. If more test users are added, the results or the problems found would be similar.

The initial usability experiment took approximately one hour. Participants were given an information sheet and consent was required before they could start the experiment. We

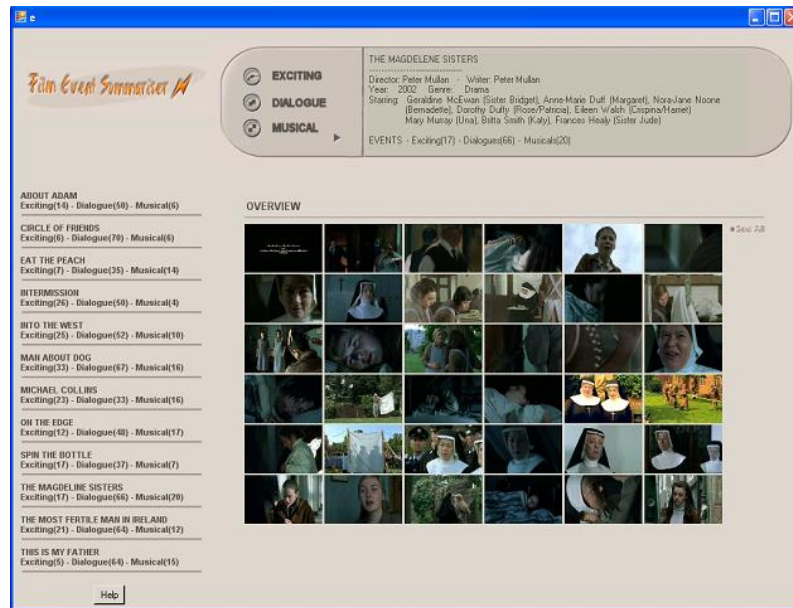


Figure 3.1: Initial version of *MovieBrowser* main page

started the experiment by giving an introduction to the purpose of the experiment, and participants were allowed to ask questions at any time during the session.

In this initial user testing, we use a simple exploring task. The task were selected mainly to identify the usability problem on current system's functionality. Therefore, users were required to explore the system by browsing and playing activities. Users were required to explore the system, browse, play, navigate and search for information. The task description scenario used is shown below.

Imagine that you need to do a close textual analysis on a film provided in the system on a chosen topic given in class recently. Choose any film that interests you and explore scene/part(s) by:

- Browse at all keyframes that the film has listed.
- Browse at any scene/parts that you like (such as fighting, music or conversation) in the film.
- Play the scene/part in the film.

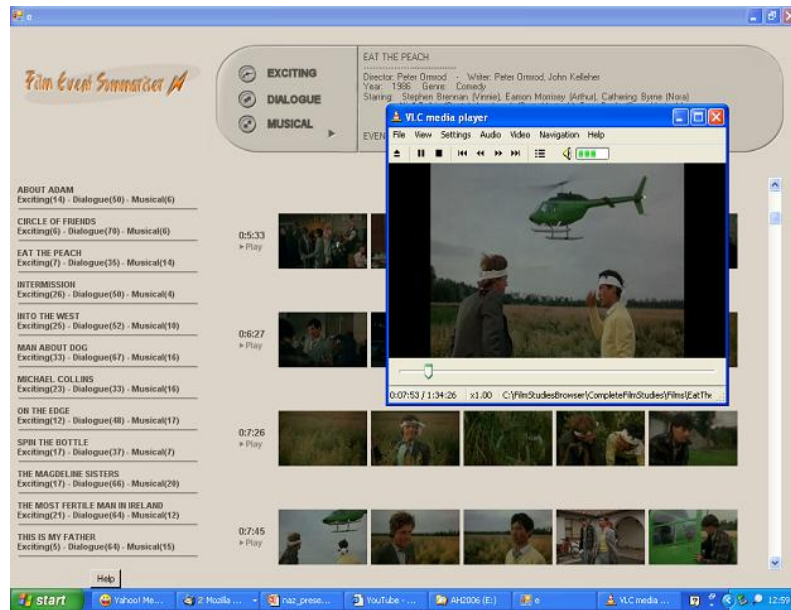


Figure 3.2: Initial version of *MovieBrowser* playback

In usability studies, a scenario is a situation where the tasks created by users are used in a reasonably short and focused activity [29]. Participants were allowed to spend 10-15 minutes exploring the system before the experiment started. We gave a questionnaire at the end of the experiment to capture qualitative and quantitative data. Part A was a pre-test consisting of five general questions on demographic information including age, gender, available study resources, average number of times they watch films and general add-ons information needed for film close-analysis study. Part B was a post-test and was a multiple-type format. A total of 9 questions (see Appendix A) were asked which included five questions with a Likert scale value that ranged from 1 (Strongly Disagree) to 7 (Strongly Agree). The questions were mainly focused on features provided rather than on the system's technical performance. Usability testing is used in practice to find usability problems according to [76, 96]. At the end of the session, a small token of appreciation was given to each participant. An example of the questions regarding system usability are shown as Table 3.1.

The main goal of our usability testing was to capture participants' feedback and opinions on the current system and to acquire a better understanding of the problems students have when using *MovieBrowser* for film close-study analysis.

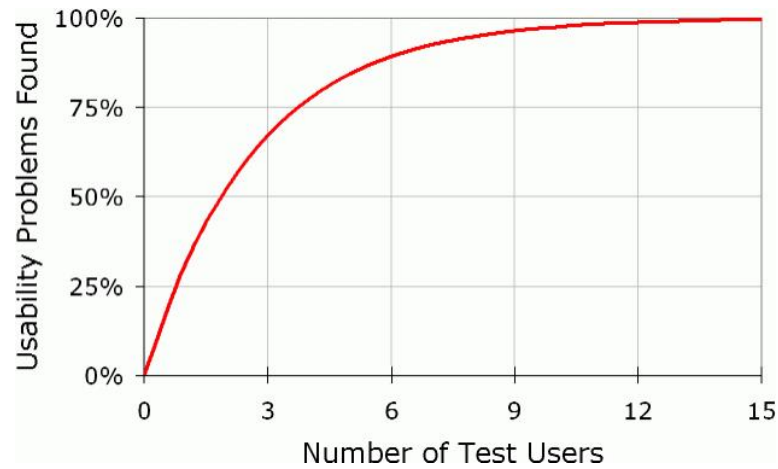


Figure 3.3: Number of usability problems found in usability test. Adapted from [71]

3.1.2 Findings

This section explains the results we obtained from the initial user study.

Observations — From the observations throughout the semester, the screening or watching of movies is an important activity and also used as part of the class lecture. The observations were made and recorded on researcher’s own journal throughout the whole semester when sitting in the classroom. As in the class module organization, the first half of the total teaching hours are used to teach the theoretical aspects of film analysis. This is continued with the second part of the lecture with a screening of a certain film in the classroom using either a VHS tape or DVD displayed on a projector. After the movie screening, the lecturer starts a discussion related to the previously screened film on various issues by giving provocative statements. Even though the discussions in the class tended to be dominated by a few students voicing their ideas during the discussions, these students will normally start a thread of conversation and continuously lead the sessions. Discussions and presenting arguments seemed to be a useful method for generating ideas among students in the class. By sitting in class, we get an overview of what the Film Studies course module is all about. Reviewing related documents such as course module and previous essay assignment, gave us overall picture on the the course learning outcomes which were to make the students learn to apply film theories to Irish cinema (*CM272 Ireland and National Cinema*) in a

Screen:
The screen layout made the task easier
The amount of information is adequate
Learning:
The system is easy to use
The system is easy to learn
The system provides an efficient way to access information
The number of steps per task is just right
System:
The system helped me to compare and contrast scenes/parts more effectively
The system helped me explore the collection more effectively
The system helped me analyze the scenes/parts better compare to regular DVD
The system is overall useful

Table 3.1: System usability questions

broad range of contexts and within other national cinemas.

Focus Group — In the focus group, we generally capture the story of their work processes and overall needs and requirements. When questioning about what does a participant mean by “close study” or “in-depth analysis”, most of them specified that it means watching the film sequences actively, reading the film reviews, making comparisons on movies elements, fusing this all together and doing endless interpretation. Some of participants’ feedback on in-depth analysis definition are shown below:

“[I]look at scene by scene e.g. camera angle, lighting, character, dialogue, sign (semiotics analysis), look at explicit and implicit means”

“[I]look at every single scene and interrogate to bring everything together”

“[I]look at the picture, semiotics in wide area, angle of camera, look in really closely”

“[I]look at the film and see how it influences me. Start by watching the film once, then during a second time take notes e.g. on lighting, then watch the film for a third time, but slowly, and write notes”

Participants were also asked about their typical approaches to solving the given task in their film studies. We got some overview of the patterns on how they carry out their task. The most important activity they need to perform before movie analysis can be done is by watching actively the scenes in order to get an overall idea or “feel” for the movie. Not only watching the sequences, users will seek further understanding and refinement from other resources like reference books or online resources.

“Watching lot of film until I choose 3-4 films”

“Watching it, make notes during the second time watching, see why it interests me, watch reviews”

“I read all films that I think relevant to get general overview, then analyse those scenes in detail, read theories as well”

“Pick certain films that acquired certain knowledge that I have, then watch the film and break down the analysis, then look at semiotics then go to back up theory then go to online e.g. religion in Ireland”

“I look and find a specific scene and watch and recognize similar elements, characters, get scene, book and film critics, read a book first on film theories for few chapters to get general ideas and then decide what film to use, depending on questions given by the lecturer”

“start look at e-journal, watch film a few times, look at critics”

Follow-up questions identify their main resources of information in their studies. All 8 participants in the focus groups give similar answers mentioning that their main resources in studies were from the DVD. According to participants, the DVD is divided into sections (e.g. chapters, directors commentaries) which are very handy to use. The DVD material was used from the university library or from their own collections. The second important resource is from the web. Students will look to the web (e.g. Google, imdb.com, e-journal or wikipedia) on related information. Some of them mentioned that they never use YouTube

(www.youtube.com) in their studies unless only for personal use. Other information that are also important in completing their task are film reviews.

“I usually Google for whatever I am looking for and imdb.com, I have never used YouTube”

“... library but real stumbling for accessing material”

“DVD and internet really help, help me understand”

We also asked participants about the problems they faced in their studies. Lack of film references especially for Irish films were identified as the main current problems they have been facing in their studies since their current module is related to Irish cinema. They need to analyse an Irish movie for their class assignment. Some of the movies are very old and they could not find the material (DVD) from the library. There are some movies still in a VHS tape format but there was a lack of certain material in the library, particularly in Irish Cinema, and the films they were supposed to watch were be very hard to find elsewhere. They also need to know about film theory and sometimes they could not view the film properly due to constraints like the above. A number of participants complained about the difficulty in getting DVDs from the university library. Any audio/visual material in the library such as a DVDs has a limited loan period for only one day. A few of them mentioned that it would be nice if they could view the movie they requested for free and with less physical efforts.

“I think the biggest problem is the library ... 80 people and only a few books in library. DVD rental is very bad, we need more DVD like 2 days rent”

“Hard to find DVD”

“... as far as I know there is no Neil Jordon, or Sheridan DVDs, all are in VHS, but VHS does not have add-on value”

“... the material cannot be found in the library even though it is recommended by the lecturer”

When we introduced the idea of implementing tools that could help users in viewing and analyzing movies, participants seemed to be very interested. They reacted very positively and gave a lot of suggestions. With sample design sketches drawn on the whiteboard, the discussion sessions were conducted. Our discussions were based on the current stand-alone *MovieBrowser* system that was installed in their labs. Participants already had an overview of how the current system worked as it had been installed since the beginning of the semester for them to use. Participants also provided some feedback on what the new tool should 'look like'. At the end of the sessions participants came out with a list of proposed enhancements for a new tool that includes some functionalities of a recommendation features, larger movie database, more interactive interface design, web based application, note-taking facility, extra educational links and more advanced searching or filtering. These can be seen from some of the comments below:

“...recommendations for particular film or scenes, e.g. this scene is good for lighting”

“...can leave comment to refer to in future”

“Nice to be online”

“Need more films definitely”

“Better playback features”

“... written scripts can be accessed”

“... movie break down into segments”

“... language glossary or dictionary to look at connotation and denotation”

“... dynamic and interactive interfaces like timeline, multiple screens to playback sequence”

Usability Testing — Our main aim in conducting usability testing is to support the findings from our focus groups specifically in the context of the users' perspectives. From a total

of 14 participants in our lab experiment, 8 are males and 6 are females. Most of them are in the age range 18-23 years old, except one participant who is older than 26 years old. We found that, 7 out of 14 participants (50%) watch film sequences on average 5 to 10 times before they can start their analysis. 43% watch movies an average of 5 times while 7% watch movies on average 10 to 20 times. This data shows that they really need to watch film sequences very actively before analysis can be done in order to understand the movie content. Other information associated with films that participants will explore more and important to know are such as the film director, film genre, cast, synopsis and reviews. These extra information were important to enhance their reading movies. Since their module related to particular film genres like Irish Cinema or contemporary Hollywood, information on the country is also important. This is shown in Figure 3.4.

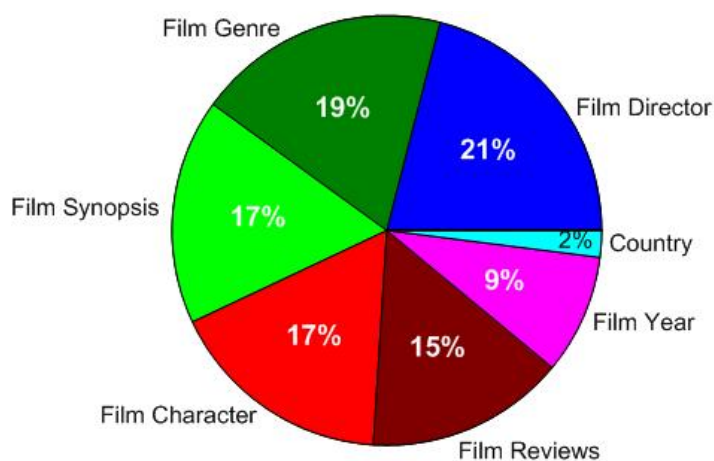


Figure 3.4: Information re movie

When further questioned on the most important medium of reference or resource in their studies, DVD-watching became their main resource with the highest percentage (34%). This finding tallied with our responses in the focus groups session when all participants (8 students) also mentioned DVD as main resources. The second highest percentage is from the reference book recommended by the lecturer, which is 27%. This is followed by class lecture notes (18%) and other compositions of web resources (e.g. imdb.com, e-journal,

Google scholar and wikipedia). None of the participants refer to YouTube¹ as their web resources. This might be because YouTube only has short video clips which are not enough material for analysis. The graph as shown in Figure 3.5 illustrates the above findings.

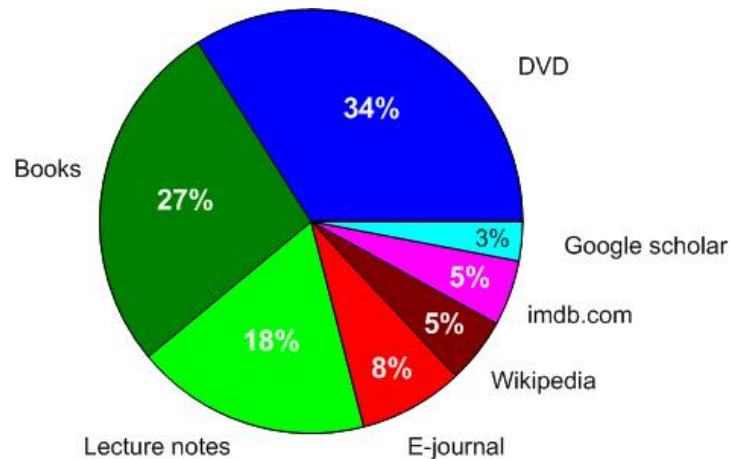


Figure 3.5: Study resources

Table 3.2 shows results of the users' perceived satisfaction related to the initial system interface and interaction design, where the scale is 1 to 7 (the higher the better). The "adequate amount of information" criterion has the lowest mean score (mean: 3.43, SD: 1.50). We relate this result with our current system that has little information about particular films that were included in the system, information such as the director's name, year, writer and cast list, which even then might not be enough for them. The criterion for "explore collection more effectively" shows a higher mean (5.50) with standard deviation (0.85). This is related to the automatic segmentation of each movie into events (Exciting, Montage and Dialogue) that are included in the initial system. We also gave qualitative questions to participants and we triangulated the answers with the quantitative feedback we got. Overall, 9 out of 14 (64%) participants insisted that the major system benefits were the scene breakdown, which could be helpful in their studies.

Based on the functionality provided as part of specific features provided in the initial system, like browsing using keyframes, event categorization into specific dialogue, exciting

¹<http://www.youtube.com>

Criterion	Mean	SD
screen layout makes task easier	4.79	1.31
amount of information is adequate	3.43	1.50
easy to use	4.57	1.50
easy to learn	4.86	1.41
efficient way to access information	4.64	1.82
number of steps per task is just right	4.71	1.44
compare and contrast scenes effectively	5.00	1.36
explore collection more effectively	5.50	0.85
analyze scenes/parts better compared to DVD	5.36	1.65
overall usefulness	5.86	1.10

Table 3.2: Overall initial system usability results

and montage scenes, and playback, we collected participants' data on its usability. In this experiment, we mainly focus on the interface design and interaction. Descriptive data is shown in Table 3.3.

Features	Mean	SD
Keyframe browsing	5.21	1.53
Events categorization	4.79	0.89
Playback	4.07	1.86

Table 3.3: User feedback on system features

Browsing by keyframe and event categorization shows good feedback in terms of perceived benefit for the student. However, in terms of the usability interaction, it still needs some improvement as some comments below indicate:

“It is easy to locate certain sequences which you need to analyse”

“My studies include scene by scene analysis and this system is a very effective way of doing this”

“It is not easy to use. Playing a clip is not immediately obvious. I tend to click on the picture to play the keyframe (like YouTube) instead we are expected to click on [play] text label ”

“For the nature of film studies, keyframes need to be accessed quickly and eas-

ily without having to rewind and fast forward to find them as scene need to be watched numerous times which is very time consuming”

“Musically it is especially useful. However in terms of dialogue characterization I feel it is more difficult to skip scenes”

“I can see its usefulness, but it is still a little ambiguous”

“Relatively easy to find a particular event”

When questioned on the disadvantages on the current system, 8 out of 14 (57%) mentioned that the playback sequence is difficult to use. From our observations during the experiment also, we found that participants could not figure out the location of the video player window as it is located on the desktop taskbar and they need to click it first to view the player window on the screen. They missed a few seconds of the viewing sequence playback in the process of locating the player. Some participants did raise their hands during the experiment asking about the player location on the screen. The play button also does not look like a button, but looks like a normal text label. A few of the students also stated that the system is hard to learn initially and difficult to use. Only after a while did they have a general idea on how the system works. Some feedback from participants on the question regarding system disadvantages particularly emphasizing on interaction design appears below:

“Playback within sequence is a bit difficult”

“It would be better if there was an event wider choice of films”

“At first I was unaware how to access the screening of the movie as it was on the tool bar”

“... not enough films, hard to learn initially”

“... and filter search confuse me and I was not fully sure of its purpose”

“It would be nice if I could just click on a picture to play the part of movie”

We also asked participants about the overall advantage of the system when considered in their own usage context and the feedback were mostly regarding features' usefulness (event categorizations) to their studies. Some of the feedback is given below:

“I feel as a student easier access to films that already subdivide by category”

“The best aspect of *MovieBrowser* is the ability to split the scenes into musical, dialogue, exciting, musical”

“The 3 categories of exciting, musical and dialogue and the thumbnail make it easy to see exactly what I want to”

“Again I feel as a student the easier access to the films, the more likely to see them for my studies. It is also easier to write an essay if the film is already subdivided by category”

We collected a list of feedback comments from participants after the usability testing. The feedback mentioning interface design improvement, more functionalities and extra information, larger movie databases and more accessible within campus is below:

“Need better playback features within sequence”

“... discussion on films or specifics scene”

“I would like to see the cursor change to indicate buttons or functionality for [play], [see all]”

“Provide any available reviews of films and also a synopsis”

“More Irish films”

“A proper search engine which would find key points in film such as for e.g. shouting. A more clearer filter system ...”

“... window player needs to pop up on screen and not just in the toolbar”

“More categories e.g. wide shots or close up for use of analyzing cinematography”

“... and available(accessible) to view films at more labs”

Overall, students were satisfied with the experiments and would like to have a software tool that can help them in their future studies, especially for viewing movies. 8 out of 14 participants said that the initial version of *MovieBrowser* is a useful system but needs some enhancements. We used methodological triangulation techniques to identify problems, needs and requirements from the methods we used in this stage which is from a combination of observations in the classroom setting for a semester, focus group, qualitative and quantitative data from the usability testing experiment. A triangulation according to [29] is a technique for handling a rich amount of data from several resources. Figure 3.6 shows a process in a triangulation in identifying a problem list.

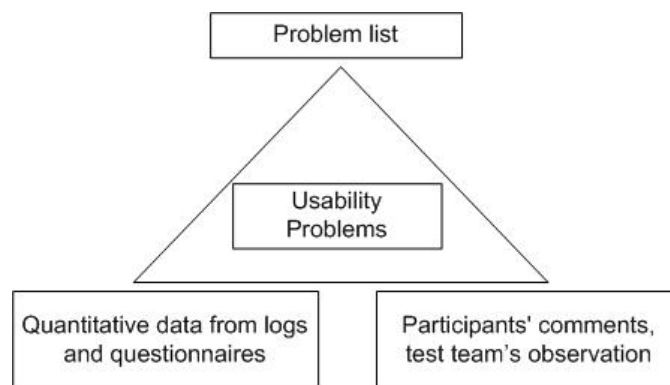


Figure 3.6: Triangulation process. Adapted from [29].

3.1.3 Discussions

Based on our findings from the initial user study, these informed our subsequent system redesign. The basis for our design direction is to provide implementation of basic features but considering a richer interaction, particularly on the viewing sequence of the film and at the same time improve the previous usability problems. Other features included will perform as add-ons that assist users in their viewing or playback activities. The design directions were describes into parts as below:-

- **DVD as the most important resource of reference** - considering the difficulties of

using the DVD as the major resource of information dissemination being used by students in Film Studies for analysis purposes, the online version will be considered as the primary mechanism for students to access film content.

- **Event categorizations were important** - Movie content broken down into events will remain in the future design but will have to slightly change in the way the interaction and interface are designed by adding dynamic timeline features.
- **Temporal sequence as navigational orientation** - Based on the previous system design, a dynamic timeline feature, which can provide a strong temporal orientation to navigate and give better visualisation of the three movie event segmentation (dialogue, exciting and montage) might be useful.
- **Scene-based keyframe view as navigational orientation** - based on feedback on how easy it is to navigate movie content, an interaction according to keyframe scene views might be useful to be included.
- **Usability of the playback** - We found that the viewing sequence is an important activity. Therefore, playback is an important feature for non-linear navigation and playback. A better playback feature as requested that has functions like play, pause, fast-forward, and rewind will be considered and will have a static space/area for viewing on the screen layout.
- **Note-taking information** - We will include note-taking features just to provide a facility to make notes on specific scenes or on the whole movie for later usage, to help users while they engage with watching sequences even though in the first time viewing, notes are not really important. Based on feedback we got from our user study, notes might be important for second or later viewing of a movie.
- **Access by genre/director** - the film director and/or genre is the main useful information to be added to what is already present, based on our findings from the questionnaires

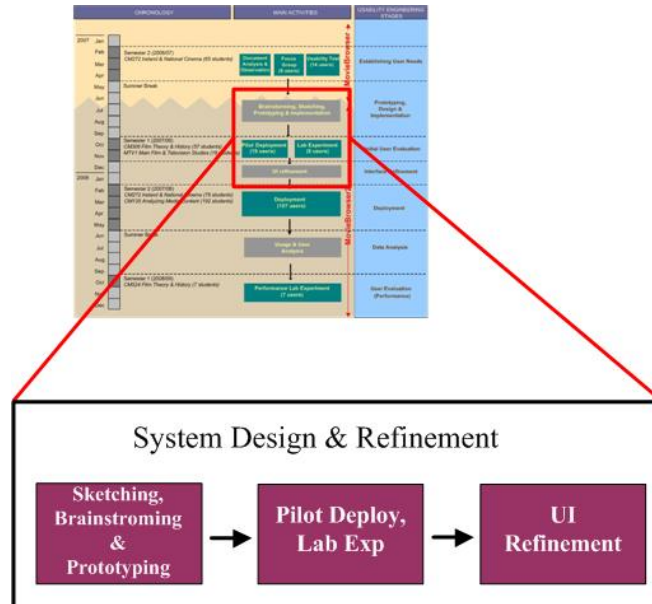
- **Incorporating the use of technology (in the software tool) into their learning**

Focus groups provided valuable insights that helped to define and determine users' real needs, problems and requirements. We got ideas about how they carry out their tasks in their studies. The sample of users we choose looks small but we believe it will represent the whole population sample as they can be considered a very homogeneous group — they are taking the same course module. While the usability testing experiments on the initial system gives us an indication of the system's functionality problems, which need to be fixed, information from this early requirements stage will also be useful as input to a new version of the *MovieBrowser* system.

Our users, like any group of people, were individually different. Each person may have their own preferences in fulfilling their requirements on a certain task, but at least by starting a user study we get some insight into the input of where to start first when tackling a system re-design. We know that the end result does not fulfill each individual user's needs but by implementing a user study for some sample users this will give us feedback on what are the most important issues in this work.

Handling the user experiment will also depend on the budget and time that are available. Testing must be carried out during the semester and there were some difficulties for us in gathering together all students in one session. Students were considered homogeneous because they were from the same class module. They have fairly similar knowledge and behaviour in using the system. From our user study, we get general ideas on their typical tasks, problems, needs and requirements when analysing and browsing movie content. We foresee some design direction towards the film studies context. It is a big challenge for us also to decide on what features to be included as all suggestions for enhancements from users are moving towards a better tool enhancement in supporting the film analysis task. We could not provide the entire wish list requested by the user group. Future design suggestions can only be derived from the study, as it always is in cases like this.

3.2 Design



3.2.1 System Design

In order to develop an application that best supports users' tasks, we used extensive usability engineering techniques from the Human-Computer Interaction field in the design process. We iteratively sketched a mock-up user-interface based on student feedback from the first iteration. System design and development involves an interactive process, with sketching and prototyping. The system then underwent initial user evaluation (i.e. pilot deploy and lab experiment) and some refinements of the interface design based on user feedback. When the following semester began, it was deployed in the university, which resumed in February 2008 with another new batch of Film Studies students. The deployment efforts and its findings for this new system will be explained in detail in Chapters 5 and 6. Both qualitative and quantitative data were collected and analyzed.

We incorporated multimedia analysis techniques to support movie analysis and browsing for students of film studies into our new system design. We use a movie content analysis engine developed within our research group as explained in Chapter 2.

The key multimedia techniques used in our new application are:

- **Scene detection** — to automatically segment a movie into a number of non-overlapping scenes. Camera shot boundary detection is used first to determine shot bounds and segmented shots are then clustered back together by considering their visual similarity and temporal distance to yield scenes, which are composed of sets of shots
- **Scene classification** — to automatically classify the nature of a scene into either *Action*, *Dialogue* or *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 in the classification.
- **Keyframe extraction** — to automatically select the most representative still image from a sequence of video. For each scene and shot, the most average (common) frame in visual terms is determined and selected as the keyframe.

The above are all active research areas in the field of multimedia at the moment and steadily improving in terms of their accuracy and robustness. More information about the above techniques is described in [55]. Taking advantage of these automatic content-based analysis techniques, numerous possible application scenarios can be imagined and a large number of novel demonstration systems could be built. In our work, we use the above techniques as the main back-end in our application.

The new system was designed and developed by the researcher for a duration of 9-months and incorporate the movie content analysis engine as the main technology component which was described above. The requirements for the system development as listed below:-

- Windows Server 2003 Enterprise Edition
- VLC Streaming Server and player

- Apache Web Server 2.0.55
- PHP 5.1.2
- Microsoft SQL Server Database

From this chapter onwards, the new system will be referred as MOVIEBROWSER2. The previous background system will be referred as only *MovieBrowser*. MOVIEBROWSER2 is a web-based system and use the streaming technology to play the movies on the users' screens, which can be accessed within the university area and restricted to students who are enrolled for the course. Among the effort involved in developing the system was the process of transcoding and digitizing a movie that was carried out either from VHS tapes or DVDs. A number of steps were taken by the researcher for this purpose including the digitizing process from an analog to digital signal by using specific software and devices. The playback format used in the system is MPEG-4. The researcher used the VLC plug-in player for streaming the movie at the client side. VLC is a free cross-platform media player (www.videolan.org) which supports a variety of multimedia formats. Other than its use as a media player, VLC also can be used as a streaming server. Both the video streaming server and the movie database are at the same server location. MOVIEBROWSER2 was developed using PHP programming, HTML and JavaScript. For the database, the researcher choose Microsoft SQL Server because it is powerful in managing large amounts of data.

A diagram in Figure 3.7 illustrates an overview of the process of transcoding and developing the system taken by the researcher. Ulead Video Studio 10 was used for video tape digitization. The VCR output (video + audio channels) is plugged into an Optibase MPEG-1 encoder (hardware) card. Ulead Video Studio 10 will capture the video and audio from the Optibase MPEG-1 card and save it as an MPEG-1 file. For a DVD capture, DVDCrypter is used to rip the VOB chapters from a DVD into a single large VOB file (audio + video + subtitles). Then the transcoding from MPEG-1 (tape movies) and VOB (DVD movies) to M1V is carried out for the video analysis process. FFMPEG is used to transcode from MPEG-1 and VOB to M1V. Goldwave is used for WAV audio analysis. Transcoding from

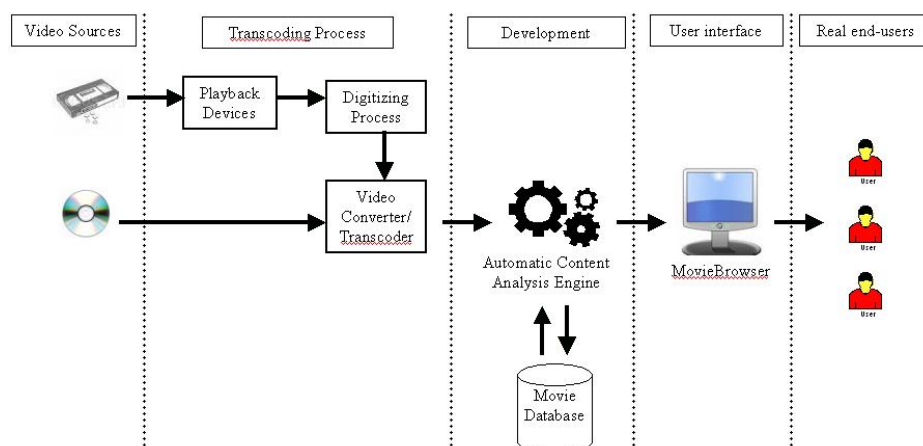


Figure 3.7: Overview of system design architecture

MPEG-1 and VOB to MP4 was carried out with Super because it produces better quality than FFMPEG. The frame size used for the video was 320x240.

3.2.2 Initial User Evaluation

This section elaborates on our first cycle of user feedback on the MOVIEBROWSER2 prototype. Our aim in this cycle was to get feedback on our initial prototype. It was carried out during Semester 1 of the academic year 2007/08 which is between October and November of 2007. Two Film Studies modules which took place during this semester were *CM306 Film Theory and History* (lecturer Dr. Debbie Ging) a course for undergraduates and another one *MTV1 Main Film and Television Studies*, a course module for Masters students (lecturer Dr. Pat Brereton).

We incorporated the specific set of new features that could support the process of reading movie which we divided into four main categories:

1. Selecting a movie
2. Browsing within-movie
3. Playing a movie
4. Social interactions



Figure 3.8: Earlier version of MOVIEBROWSER2 - movie selection interface

Example of screen shots of the earlier version of MOVIEBROWSER2 are as shown in Figures 3.8 and 3.9. Figure 3.8 shows the page for selecting a movie; a) filtering movie using drop-down list, b) list of movie posters, c) and d) movie reviews and notes sections. Figure 3.9 shows an example screenshot for browsing within-movie with functions; a) play entire movie, b) events category selections, c) play the scene from keyframe view, d) play-back controller button area and e) note-taking area with button.

The first cycle of user feedback was conducted in the laboratory experiment with a small batch of film studies students. We conducted a lab test experiment with 8 students who volunteered as participants. We did not specify any special user task for our initial MOVIEBROWSER2 prototype. Students were asked to explore and use the prototype during the session and to give comments on their experience while exploring the prototype. The experiment was conducted in Week-11 and Week-12 of the academic semester in their computer laboratory, after the class ended. A short open-ended questionnaire was given as a method of data collection at the end of the session.

With this new batch of students, we would like to view their opinions on our initial re-design system. We asked students about what benefits they thought they would get as

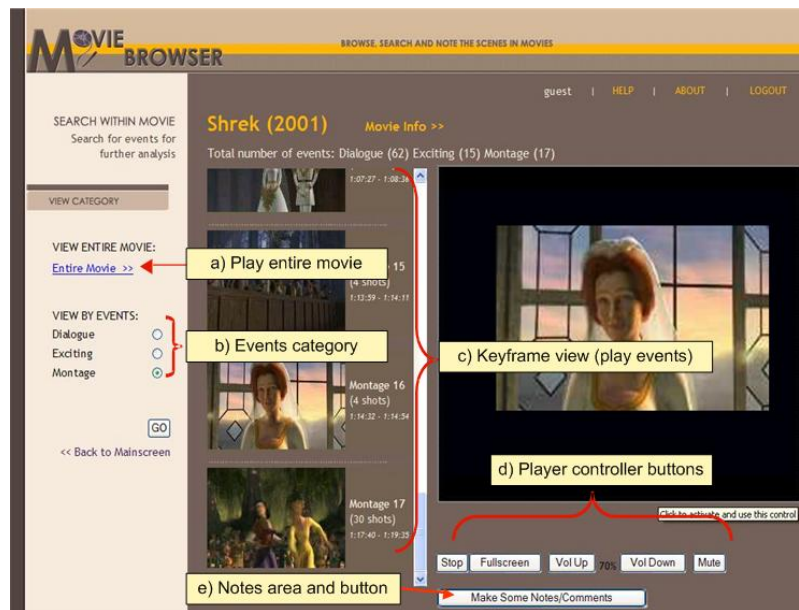


Figure 3.9: Earlier version of MOVIEBROWSER2 - browse within-movie interface

a Film Studies student when using the MOVIEBROWSER2 prototype. The current features available (i.e. event categorizations, notes-taking, web-based) were mentioned as beneficial in enhancing reading and analysing sequences, save time and efforts. Below were the opinions we collected.

“Being able to see certain types of scenes in a film is a big bonus. It is a lot handier to be able to pick them than to go through a DVD looking for them. It is a time saver”

“I think that MOVIEBROWSER2 will be really useful for students who have to analyze a film as they can go to the scene they need. It would be really useful.”

“You won’t have to carry around DVDs. Films are at your fingertips. You can store your notes on the site so you will never lose them or have to carry them around”

“Easy access to films that would have been referenced in the lecture. Dialogue, exciting and montage mean you can get to the scene you need quickly and the fact they are ‘referenced’ (timecoded etc.) makes it easier to source”

“Easy access to any part of a film I am studying. Notes that other people have made could also help me”

“Easy access to relevant films. Ability to take notes within one window”

“I think it is helpful in terms of giving a good basis of films to choose from. It also aids the interpretation of cinema in the useful way it is broken into various sections”

“I think being able to work with other people in an environment that is almost a collaborative one (i.e., reading notes left by others) is an excellent way to deconstruct a movie, almost as good as having a discussion in real life. Also, by placing a number of movies in a centralized and accessible location, and by breaking those films down into “chunks”, the software saves me from having to do an awful lot of work.”

In this earlier version, we incorporate the notes features as a support function while the user is playing the movie. Notes features are included as an attempt to provide basic social interactions among the students. Students are able write down their notes on any events or on the whole movie. All eight users mentioned that it would bring beneficial to them in reading a movie, except one student still prefer to use paper for writing notes. For them, notes feature could provide the facility for future review, typing things during real-time playing and remembering important things easily. According to them also, by having notes that can be viewed and shared, they can exchange opinions on certain topics on specific scenes or movies. Not only that, they might get different insights or interpretation as different people will have different points of view and this is good to be shared in their learning process.

“Writing notes are key to recording my understanding of a film. If something occurs to me that has never occurred to me before I can record it easily”

“Being able to write notes while watching the movie is beneficial as it means

you can write down the information as it is fresh in you mind. You do not have the problems of trying to remember the film afterwards”

“No, I would tend to use paper. But for those who would rather type, it would save them having to toggle between word”

“Absolutely, especially since I can touch-type and can keep watching the movie while taking those notes, meaning I don’t miss anything important while I’m glancing down at a piece of paper.”

With the experiment also, we identified some usability problems that need to be fixed like wrong button design, and some interface refinement as feedback given by users like more movies should be added in the database system. We also got fruitful comments, thoughts and suggestions which shows an earlier indication, that our efforts in adopting the technological possibilities into the real world setting is worthwhile and would bring a positive outcome.

“The volume buttons are the wrong way around when you click up it goes down. Sometimes when I clicked on a scene a box would come up saying please wait that it would not play. Apart from that I think its brilliant!!!”

“On the homepage the rollover links on the films to the left of the page don’t work correctly. All links should be the same color before you rollover. You should be able to delete/edit any comments/notes you have made after it has been saved.”

“Really good idea. You will probably get plenty of ‘visitors’ just wanting to watch a film, not just for academic reasons. As such, this means you might be able to ‘sell advertising space’ on your site if you could come to the agreement with DCU and the film studios. Good luck with it.”

“I think MOVIEBROWSER2 has excellent potential as a learning resource. I especially think it could be useful for the module we take in Irish Cinema, as

the films we are supposed to watch can be very hard to find. If it were possible to have such films put up on MOVIEBROWSER2, I think it would be very advantageous. Actually, as an aside, Irish film could be a place to demonstrate the commercial potential of MOVIEBROWSER2-like software. At present, as far as I know, there are no plans to digitize the Irish Film Archive. If the films in the Archive were made available online and tied into a pay-per-download model, the entire catalogue could potentially find a new audience and earn some more money for the filmmakers (as well as making things easier for film students like me !)”

“The browser login is great, logged in easily. I would like to have an avatar represent my user id. Because I was off campus I could not watch the VLC movies, even though I had VLC installed. There was an error, with the plot outline for *Man About Dog* (2004), its the plot for *Michael Collins* (1996). It would be AWESOME if I could access this off campus-perhaps using the college server as a proxy. I would also like to be able to see ALL film cover pictures (“Man about Dog” is missing). The Note Saving feature is a great addition and seems to function well enough, unfortunately the notes feature is hidden. Accessing the notes user interface only appears after clicking on a movie clip (notes options should be constantly visible after login, maybe on a Navigation Bar to the left or next to the film pictures. I would love to see some kind of chat feature on this website.”

We also collected some data from our user logs during the pilot deployment. We deployed the earlier version for 4 weeks only (week-9 to week-12 of the academic calender). Prior to that, a short demo and introduction were given in both classes. It is worth noting that the prototype still underwent some technical configuration setting particularly on the streaming part and only provided a few basic features. The main objective of this pilot experiment was to get initial usage information and user acceptance level of the early

Interaction Logs	#clicks	Percentage
Select events category	41	28%
Select a movie using drop-down list	37	25%
User play entire movie	30	20%
Play an events by clicking on keyframes	21	14%
Note-related features	19	13%
Total	148	100%

Table 3.4: Logged activities during pilot deployment

version of the system before commencing refinements and longer deployment with more rigorous interaction logging (full, semester-long deployment was subsequently conducted, see Chapters 5 and 6). Thus instead of being comprehensive at this stage, we focused on being selective in terms of both the usage capture and the student users.

From both classes (a total number of 75 students), we found 19 students voluntarily using our initial version based on log data. There is no enforcement in using the earlier version as it is not part of their class requirements. Table 3.4 describes user activities in terms of number of clicks made on the interfaces and their percentages. We got some general overview on their activities such as browsing through the events buttons (i.e. either Dialogue, Exciting or Montage) in terms of number of clicks (28%), selecting a movie using drop-down list (25%), playing entire movie (20%), playing a scenes from the events segmentation keyframe (14%) and notes related features (i.e. make notes/comments) (13%). These interactions mainly provide us with some overview of the activities that occur at this initial stage.

Summary — The reason we conducted an experiment in the lab setting and at the same time with pilot deployment was to get earlier feedback on the qualitative data from the questionnaires given. We could not get these data from the pilot deployment process only as data were collected via automatic captured logs.

Based on the qualitative responses in the lab experiment in this initial user evaluation, we got some indication that the earlier re-design system has potential benefit to students on the features that are currently included, even though not much usage was found from pi-

lot deployment. All 8 users perceived that such a tool will be beneficial and useful for film studies students. Not only that, users also added other suggestions for further improvements besides reporting the current problems which need to be fixed. Some usability problems encountered in the design layout were also identified such as wrong button used, and missing movie information contents.

We tried to get student's point of view on the notes features that we included in our re-design system. From the comments, generally we got positive reactions in our attempt to incorporate a basic social interaction function in sharing notes among students. However, one student still prefers to use conventional methods in writing notes using pen and paper.

3.2.3 Refinement and Deployment

In the refinement of the interface design, we will focus our attention on the reading activities of movies since this is our user's main task. We would like to support the process of analysis and browsing of movie content in our tool. Comments and feedback from the initial user evaluation were valuable in this stage. The system we re-designed tries to incorporate some features that could support the main processes of reading and browsing movie content which are:

1. Selecting a movie
2. Browsing within-movie
3. Playing a movie
4. Social interactions

The features that we included in the re-designed system have an aim to support each of the processes of reading movies. Among the features focused are the technology of movie segmentation into particular scene and browsing design features using the keyframe and a timeline. Each category of design with its rationale will be explained further in detail in the next chapter.

A new semester commenced in February 2008 (2007/08). This is the semester we deployed the system with yet another new batch of student groups taking the Film Studies module. Our deployment effort will be further elaborated (Chapter 5 and 6) and illustrates our findings and discussions. As with all the cases of deploying versions of MOVIEBROWSER2 in practice, the purpose of the deployment effort was to validate the usage of the developed system in a real environment with a real user group.

3.2.4 Discussions

Developing, designing and deploying a system prototype was indeed a challenging task for us because it involves real user groups composed of real students who worked in a real learning environment as they studied for the module on Film Studies and had real tasks to perform on searching and browsing movies as part of that module. Some of the larger issues we encountered were the students' availability and co-operation. Students were very busy with their time schedules and sometimes it was very difficult to get their involvement. Students always appeared to be busy with their assignments, presentations and other projects especially towards the end of semester. This is a critical time also for us as we also need to evaluate our work at the end of semester. We could not evaluate or get feedback in the earlier semester since the users would not have been as familiar with MOVIEBROWSER2 and still lacked course knowledge. We also needed to deal with different lecturers' teaching styles as they change every semester, however, we were very lucky because we got full support from the lecturers.

3.3 Summary

In this chapter, we briefly explained the process and stages we underwent in developing a MOVIEBROWSER2 tool for use by students of Film Studies in Dublin City University. We followed a design process of usability engineering and the most important aspect of our work is the involvement with real end-users from the very beginning of the process.

The work started with an interaction with one module of 65 students taking *CM272 Ireland and National Cinema* course. User requirements and needs were gathered using methods like focus group, observations, usability testing and questionnaires. An earlier version of the re-design tool was then evaluated with real-users through pilot deployment and lab experiment with a number of new students from another new batch of students. Feedback was collected for further system refinement before it was deployed to another group of users.

In the following chapter, we will detail the interface descriptions and the specific features that were included in the tool we developed. The interface screen shots and the design will be rationalized.

Chapter 4

The MOVIEBROWSER2 System: Interface Description and Design Rationale

4.1 Introduction

We believe that in order to develop sound, practical and useful new media applications, the perspective from multimedia technology should not be used alone in terms of its progress and experimentation but be combined and balanced with conventional and established work practices of use and the way human users have been carrying out work tasks. This is because the introduction of a new technology should be used to enhance rather than completely overturn established work methods. The discipline of Human-Computer Interaction and especially a series of techniques in usability engineering [72] has been developed in order to identify existing practices from the end-user point of view and to then guide the development of new (interface) technology into established work practice.

Based on our approach described in Chapter 3, we listed our arguments for the reasons we developed MOVIEBROWSER2 as follows:

- To incorporate the use of technology — particularly technology in video content analysis and segmentation of movies, into student work tasks.
- To incorporate deployment and usage monitoring — deployment and usage monitoring for a duration or period of time in our effort to get real usage data from real user groups. Analysis of human-machine interactions by involving real user groups at all stages of the process and real requirements and needs could be obtained in order to be more realistic and to fulfill a more user-oriented approach in our work. Human-machine interaction can further be analysed through interface design features that follow some guidelines to better facilitate user interaction.
- To bridge the divide between technology and user perspective — this covers both the particular user setting we are using as well as the work tasks and could allow us to bridge from the Computing perspective into another type of work or setting in the Humanities in a real environment and with real tasks.

4.2 Features and Design Rationale

We follow simple principles in implementing our interface design. Nielsen [73] has suggested that simplicity is a key factor in designing for usability. Many studies have been carried out that take simplicity as their key factor in designing an interface. Karvonen in [44] presents how simplicity and beauty can affect a user's experience and interpretation of the design, and how perception varies according to cultural background, age, and user experience. Other work that focuses on simplicity in design is described in [47]. In this paper, the authors describe their ideas in designing an interactive TV system and follow simplicity principles in balancing the complexity of a multimedia information retrieval tool with the usability of the functionality it can provide. The authors put emphasis on the simplicity in

the design as their main priority rather than advanced functionality.

Our specifications we have in mind in re-designing the movie browsing system is to make it more tailored to the work task of film studies students as they will be our real user group. A film studies student's major activity is 'reading' a movie. Reading movies could be enhanced by incorporating some technologies like video content analysis and viewing event segmentation (i.e. dialogue, montage and exciting) into the system which they use for reading a movie and this in turn could lead to further idea generation during their work task.

MOVIEBROWSER2 provides the main features that could support the process of reading a movie. We describe our design rationale behind each of the sub-processes which we divide into four major categories:

1. Selecting a movie
2. Browsing within-movie
3. Playing a movie
4. Social interactions

The following sections will elaborate more on each of these processes, specifically on the design rationale.

1. Selecting a movie

In conventional practice, a student will use a DVD player with a TV set or use a movie media player on their PC/laptop as a medium for playback of a movie. He/She will search for a particular movie either from the DVD rental shop or from the library by looking for the movie film poster. As to whatever medium used for browsing the content playback, the analogy would be the same in an online system.

In MOVIEBROWSER2, we adopted the same analogy. Once a student has logged into the system as shown in Figure 4.1, they will see a list of movie posters with some other information (i.e. titles, genre, year) on the left side of the screen as shown in

Figure 4.2. The user can filter from the list by selecting the movie genre and/or director from drop-down boxes. Some of the listed movies are marked with red colour 'Advanced' text besides the movie poster. This means the user can view that particular movie with extra or advanced features for further browsing and navigating activities. The other movie without that advance option will have a standard playback option as in a standard DVD player interface. We simply design that way for our further investigation on system usage analysis.

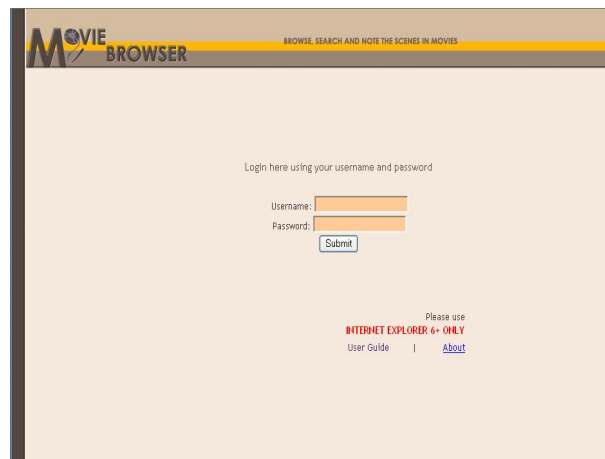


Figure 4.1: Log-on interface

Our design rationale

The selection of a movie based on the film poster as a metaphor of choosing a DVD from the rental shop was chosen in our design. A metaphor can be useful for two reasons according to Nielsen [73]. First, metaphor can provide a unifying framework for the design and second, metaphor can facilitate learning that can allow users to create their knowledge. A film poster could be useful for an overview at a glance in the selection as occurs in actual practice, as people will browse among movie posters while searching for a DVD from a shop.

Drop-down list movie filtering based on genre and director was identified as the most associated movie information most students are looking for based on our findings

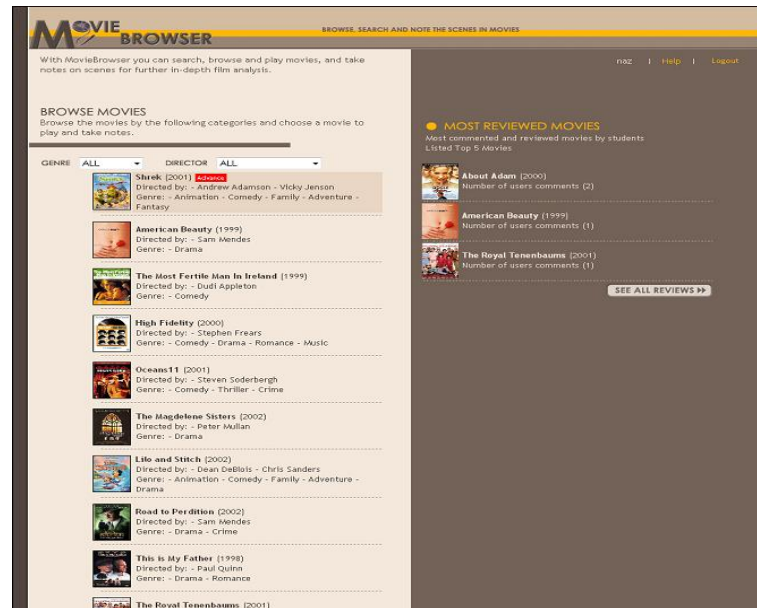


Figure 4.2: Movie selection interface

from the user requirements stage as described in Chapter 3. That is why we incorporate these two filtering options in our design. Likewise in the classroom also, the lecturer always discusses a movie based on a particular individual director and movie genre (i.e. comedy, drama etc). The movie analysis is not influenced by whether it was a box-office hit movie or not. Figure 4.3 shows an example when the user filters the movie by the *Romance* genre. The system will display all movies under the category of *Romance* without any specification on director.

2. Browse within-movie

Once the movie has been chosen, more details on the selected movie will be displayed on another page with information like title, director, plot and cast lists. Clicking on the “Play” button on the left side of the screen will start streaming the whole movie from the beginning to the end without any scene categorization. The user can filter scenes of the movie by choosing the *Exciting*, *Dialogue* or *Montage* radio button options provided on the left side of the screen or from the timeline at the top playback area. A list of selected events category will be displayed as a keyframe list for

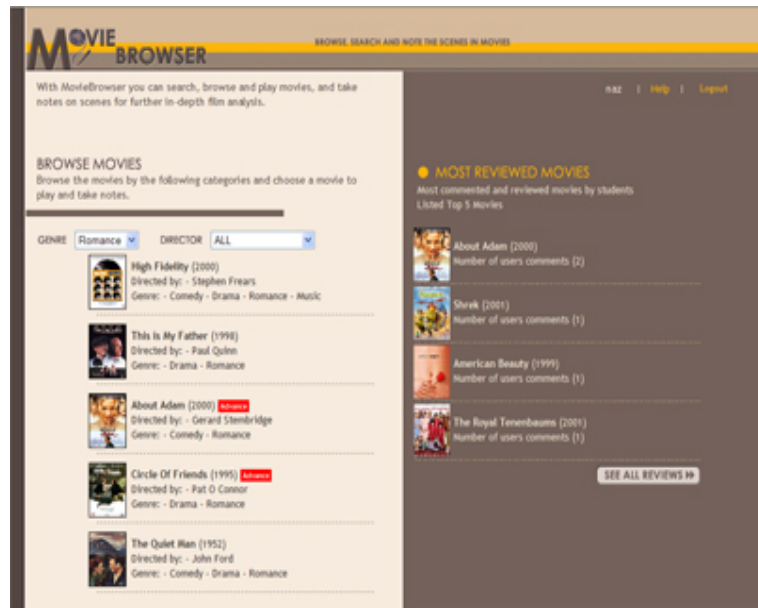


Figure 4.3: Movie selection interface - filtering by genre

each event with event category number, number of shots and event duration. The user can click on the interested keyframe to play the particular scene. Figure 4.4 shows a screenshot of choosing and playing an *Exciting* event from the movie. Other than navigating from the radio button (as mentioned above), the user can also browse using the timeline bar on the upper side of the screen. Each timeline represents a segmented scene of a dialogue, exciting and montage that is identified in each movie. The timeline bar uses different colour coding to differentiate between the three major segmented event types. The colour is also standardized with the borderline colour of the keyframe that are listed in the keyframe view area. Once the user has clicked on the timeline bar, the specified keyframe location of the movie will be brought to the top of the list. The panel for the keyframe list can be interchangeably viewed between the movie information by clicking on the "Movie Info" hyperlink at the top of the timeline bar as in Figure 4.5.

Our design rationale

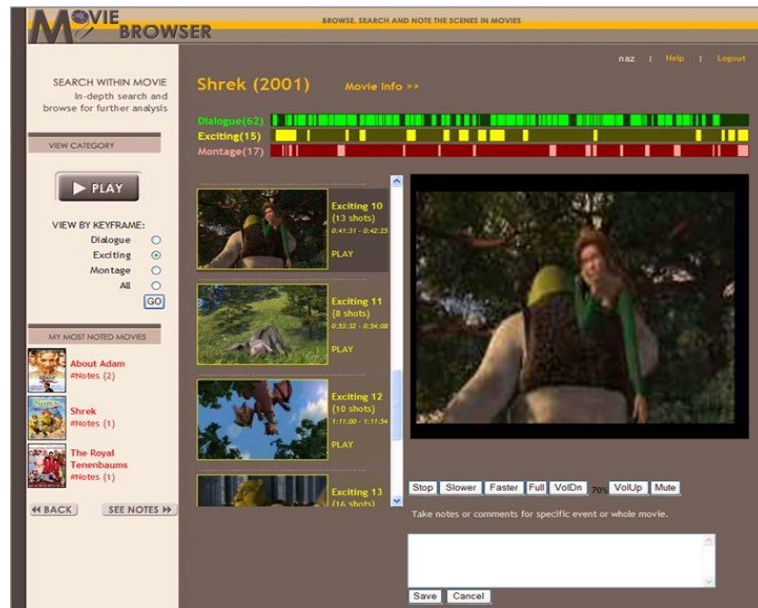


Figure 4.4: Browse within-movie interface



Figure 4.5: Movie information area

Browse within-movie can be performed further (Figure 4.4), which displays the particular movie in more detail. This page provides an overview of the selected movie. The user can glance through at the beginning to have some overview of the movie content. The screen layout was designed in such a way to ease the process of reading the movie as all information can be found within one page. (i.e. the playback area is located on the same page). The reason for our layout design was while the user is doing playback, they could engage with some extra information on screen without having to jump to another page. We try to reduce the granularity level in our screen jumping so as to reduce also the user being lost during the navigation process.

The graphic timeline bar features could be used to help students to visualize detected events better with the use of different colour coding (green, yellow and red). The timeline bar could also help the user to visualize the overall structure of the whole movie of segmented events integrated into the system. Timeline features have been used in many applications especially for visualization purposes as for example in the Lifelines application [79], where timelines were used for exploring medical records. Another example of the timeline used in a medical application domain is in [14]. These are examples of advanced design of a timeline in a medical information system that are used to help in the process of visualizing complex data and decision making. Timelines also can be used to visualize video content as it is incorporated in the VAST MM video browsing system [38].

The use of similar colour-coding in the timeline bar in MOVIEBROWSER2 and the keyframe list would help students to identify the respective location of events in a movie. The keyframe listing can also be good guidance when exploring and navigating movie content with the selected keyframe displayed together with some other information on particular shots for easy scene recall.

Browsing within movies is actually following a well-known mantra by Shneiderman [86], “Overview first, zoom and filter, details-on-demand”. As the main page for movie selection will overview all film posters available in the database, the user then

make a selection and filter to a particular movie, then on the second page they will find out more detail on the movie content, as browsing within-content indicates.

We used a calm-mode colour theme which is considered suitable for browsing and playing with a darker background instead of a bright colour theme. In this design, we used a combination of brown-based colour coding. The used of bright colours is used only for the timeline bar, simply to emphasize or highlight the events in the movie so that it will be eye-catching for the user.

3. **Playing a movie**

Standard buttons as can be seen in the normal media player were provided in MOVIE-BROWSER2 as for example play, pause, stop, full screen, volume adjustments and mute for the user to use. We consider the major activities of reading a film as an active viewing of movie. Thus playback is an important process in the users' tasks. The playback area in MOVIEBROWSER2 can be seen in Figure 4.4 at the right side of the interface.

Our design rationale

This process is the most important activity that the user will carry out in the whole process of reading a movie. The layout of the playback areas is a simple design to cater for easiness in viewing. It is located in a static area on the right side of the screen. We try to reduce users' eye movements by locating on the right side of the screen. The other parts of the screen are filled with extra information regarding the movie with the bottom area of the playback being the note taking area. The notes area located underneath the playback area is to provide engagement while viewing a movie.

The playback activity was surrounded by movie information or a keyframe view and will definitely reduce eye-movement for the user during the viewing process. By having it this way, browsing and playback are no longer separate processes. We try

to combine process (2) and (3) mentioned above. The user can blend together the processes rather than have them as separate stages.

The static playback area with the same 'look and feel' like a normal movie player with stop, pause, slider bar etc. buttons, were designed for simplicity of use.

4. **Social Interactions**

In MOVIEBROWSER2, we provide a feature so that at any point during the playback, the user can make notes by clicking on the 'Make Some Notes/Comments' button underneath the playback area and then make a note on an interesting scene or the whole movie perhaps, which can be saved and viewed later and even shared with other students. As can be seen in Figure 4.6, by clicking on the 'Save' or 'Cancel' buttons the user will save or cancel the notes taken. If there are other users already making notes on the particular scene, their comments will be displayed with the date and time they were written. There are two types of notes that were supported; 1) comments for the whole movie (shared view among users), and 2) notes or comments for a specific scene only. These comments can be managed by the user by deleting, saving or printing their own notes for future reference.

The movies which have the most number of notes made by users will be automatically displayed on the user's work area where it can be easily accessed faster for further reading. The movies displayed in this section are based on most commented or noted on either for scenes or for the whole movie, as made by the logged-on user. For example, Figure 4.5 shows three movie posters listed under the 'My Most Noted Movies' section (*The Royal Tenenbaum*, *Shrek* and *About Adam*). This means that the logged-on user already has three movies which contain notes. For the first-time user, there will be no movie posters appearing in that area.

On the right side of the earlier screen (as in Figure 4.2), there are sections for 'Most Reviewed Movies' in which the movie reviews can be shared by group members. This means that members in the group can read others comments or reviews made

on particular movies by their friends. The top 5 highest commented movies will be displayed (as in the figure, only three movies are commented on by the users). By clicking on the movie posters in this section, users will be linked to the movies and can browse as usual. These comments or reviews can be printed and saved as text documents for further analysis and use.

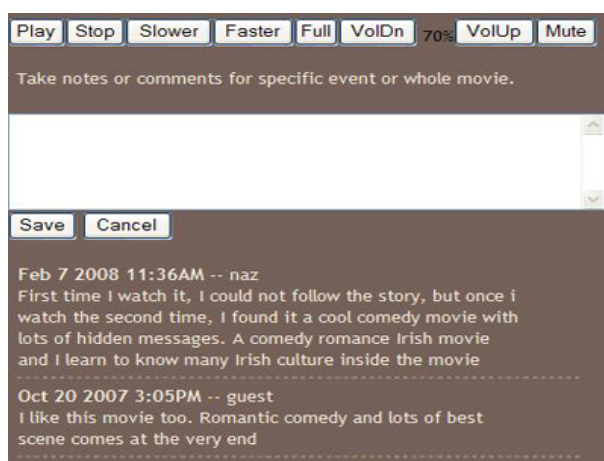


Figure 4.6: Example of notes section

Our design rationale

Based on our observations from the user study, the classroom was handled as a way of promoting discussions by the lecturer after the screening of a movie was carried out. The lecturer provoked the students with some topics and the students provide their arguments. There are no right or wrong answers in reading movies. Our attempt for information sharing on the notes or reviews given on the particular movies sections in MOVIEBROWSER2 is try to support these kind of interaction or discussions.

A significant aspect of computer-mediated education is the ability to design for interaction. There are three types of interaction: instructor-to-student interaction; student-to-student interaction and student-to-content interaction [5],[103],[69]. An interaction through exploration and discussion will lead to deeper student learning, thus it would allow for the creation of knowledge. People generally can remember [5]:

- 10% of what they read
- 20% of what they hear
- 30% of what they see
- 50% of what they see and hear
- 70% of what they discuss with others
- 80% of what they experience personally
- 95% of what they teach to others

The learning stage above is very useful and is currently being employed in many social network applications. Among the social network applications that have such components are Flickr¹, Amazon² and YouTube³.

Note-taking features allow users to make notes of any important points while they are engaged with their playback. The incorporation of note-taking is based on our initial user study as described in Chapter 3.

4.3 Pedogology Perspective

In this section we describes some pedagogical possibilities which lie underneath our re-design tool and re-design decisions. Pedagogy is sometimes referred to as the correct use of teaching strategies or theory of educating. Another definition of pedagogy from Longmans Dictionary, is the ideas and methods that are about the different ways of teaching things to people. A pedagogy concept according to Lusted [56] is more than a teaching style or controlling students in classroom to encourage learning. It is an important concept as he phrased as:

*... it draws attention to the **process** through which knowledge is produced.*

¹www.flickr.com

²www.amazon.com

³www.youtube.com

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 bonus features for teaching film [10]. 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 has significant educational applications.

Other research carried out into investigating the benefits of having add-ons in film analysis are in [11]. This paper describes generic elements of film analysis and covers mainly DVD add-ons like director's commentary or interviews with directors, actors or cinematographers. For example, a director's commentary in a DVD is useful when the film narrative was perceived as complex or unintelligible. Certain scenes and situations explained by the director could give a user a clearer understanding of the meaning of the film. The add-ons can also serve as a 'shorthand' for more general benefits of the new medium in teaching film.

The authors in this paper also made some suggestions for teaching new media including film using DVD add-ons and come out with a taxonomy of the potential teaching benefits as listed below:-

1. Adaptation and the study of comparative grammars — with so much add-ons from the original resources, students can compare and contrast media better than before. Students want to learn the skills of narrative construction and scriptwriting and DVD add-ons can aid in this process.
2. Film style and generic language — some DVD producers hire renowned art experts to write for add-on features such as additional commentaries and reviews in order to satisfy dedicated audiences, another indication of a separation between film education and the movie industry. An evaluation of such texts could possibly re-affirm their usefulness within film education and the movie industry. A relationship between film education and the industry could also be highlighted.
3. Political economy and corporate knowledge — for example, add-ons that focus on

how a film was made can help to develop critical skills for students. There is business-related research outlining the phenomenal success of the technology in widening the scope of film consumption and its possible future. Some add-ons provide evidence of the placement of the film text within the production company's stable of films, which is a very useful business study.

4. Audience reception study — this can be assisted by add-ons in which students can explore the contextual relationship between the film and its historical antecedents. This is important for an appreciation of historical and classic film texts as well as framing audience appeal for new generations of film study.
5. Additional benefits for language acquisition — there are language options incorporated with every DVD which could be used to encourage the development of language skills among viewers.
6. Useful documentary material for the study of a range of media debates — Some broad media and film debates around race, class, gender and censorship for instance are facilitated by extra material provided on a growing number of DVDs. These add-ons could serve as an important resource for educationalists at all levels to connect with their students in critically analyzing issues around intercultural debates and other important topics raised by add-ons.

Our current design of browsing movie content could also provide a positive impact and will aid in film analysis and could provide an indirect process of reading a film. In relation to the MOVIEBROWSER2 system we developed, we believe that this new strategy and 'tool' is also useful to help students to acquire the skills of reading film in future and there are some elements of it that could maximize the potential of their learning. The following explanation will enlighten the possibilities of pedagogy underneath our movie browser tool.

As a student attempts to grapple with the complex audio-visual material which makes up the film text, the tool we developed could assist in breaking down conventional patterns of viewing and helping the reader to appreciate the grammar and structures of film making.

Such a tool might help 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 a film works for audiences and allow them to write about the film from the inside⁴.

Enabling the film to be seen and navigated with a timeline bar outlining exactly where the sequence is in relation to the whole film for example, might be very useful when students are trying to grapple with narrative construction and the different functions of any given scene in a film. 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 in parallel, as they experience the film. Such initial impressions are necessary to later help develop a more reflective as well as an intuitive engagement with the text content. 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, could be potentially an excellent method in encourage students to appreciate structural similarities and differences within the text (film content).

Many key film theories and debates, which would be assisted by MOVIEBROWSER2, include the Auteur theory for instance. From the film-making glossary⁵, Auteur theory brings the meaning as;

Literally the French word for “author”; the theory ascribed overall responsibility for the creation of a film and its personal vision, identifiable style, thematic aspects and techniques to its film-maker or director, rather than to the collaborative efforts of all involved (actors, producer, production designer, special effects supervisor, etc); the theory posited that directors should be considered the ‘true’ authors of film (rather than the screenwriters) because they exercise a great deal of control over all facets of film making and impart a distinctive, personal style to their films; simply stated, an auteur can refer to a

⁴Oral conversation with module lecturer (Dr Pat Brereton) in January 2008

⁵www.filmsite.org

director with a recognizable or signature style.

Examining the corpus of a director's output (e.g. Warren Buckland's recent study of Spielberg⁶), to test and evaluate the coherence of their output, such a tool would be of great assistance with regards to investigating the 'average shot length', or the balance between dialogue and action, together with other stylistic features in their films.

Another important example of the research benefits 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 commercialized Hollywood cinema. This is because in our tools, we incorporate both category of cinema; Irish and Hollywood.

4.4 Summary

This chapter provided a detailed explanation of the reasons we developed MOVIEBROWSER2 with its design rationale and the features provided for each main process. The rationale we took in the process of designing the interfaces are briefly elaborated with interface screen shots. We follow the principle of simplicity in our design. At the same time, we follow some guidelines in designing the layout interface i.e. the colours used, graphics, layout and the granularity level of jumping.

The main task of students of film studies is to read movies. The design rationale chosen was basically to cater for their tasks in active viewing of movies and to support the task. Not only that, we attempt to incorporate some basic social interactions into the design, even though it was not meant to be a social network application. The facilities we provide were based on our initial user requirements from our user study which could be useful to incorporate, even though further study should be carried out if we want to focus more on these activities.

⁶He analyze Spielberg's blockbusters using standard theories of film in combination with filmmaking manuals [www.FilmsOfSpielberg.com]

Underlying our design was the technology used in movie content analysis that is built into the system. Users' reading of movies could be enhanced by having technologies related to movie analysis as they can view event segmentations for dialogue, montage and exciting for further idea generation. Movies can be compared and contrasted under the same settings of system design.

These were followed by a discussion on the pedagogy possibilities in teaching film studies. On the pedagogy perspective, the computer has been used and has shown some impact in many aspects of education. A tool like MOVIEBROWSER2 could provide some benefits in the teaching of film studies. With some other related work regarding DVD add-ons being carried out, it also possible for a tool like MOVIEBROWSER2 to provide similar advantages for real user groups in the humanities setting. These could maximize the potential of student learning in the particular domain.

The following chapters will investigate the usage from the deployment and monitoring stage of MOVIEBROWSER2 and the analysis of the findings we get from the activities performed.

Chapter 5

Experimental Methodology

This chapter describes the methodologies we used in getting user feedback and in monitoring usage of the tool we developed for supporting film students' tasks in browsing movies as part of their courses. We divide the experiments we have carried out into two stages which are:

1. Deployment Effort and Usage Validation Experiments
2. Experiments on Analysis of User Performance

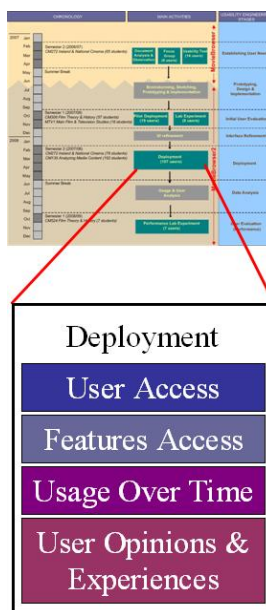
In the first stage of our experiments, MOVIEBROWSER2 was deployed to students taking a film studies course in the second semester of the 2007/08 academic year, and this was followed by an online questionnaire towards the end of the deployment. The second stage of our experiments which is the analysis of performance and was carried out in a controlled lab experiment, were performed in the following semester (Semester 1 of the 2008/09 academic year).

Research Statement Revisited

As mentioned in Chapter 1 of this thesis, a research statement has been put forward earlier as a basis for putting the work reported here, into context and we now revisit this statement briefly.

“Multimedia technologies have enabled production, storage and delivery of large quantities of audio and visual information. The amount of video available nowadays raises the challenge to us to develop applications that help us to organise, browse and find relevant information from this video. However efficiency is not the only aspect to be considered when building such applications. Usability and perceived user satisfaction also plays a major part in the successful adoption of any technology in a larger community. This research investigates how real users take advantage of technologies in a movie browsing system. By designing, building, deploying and assessing the usage of the overall value of a technology in a more user-focused (involving real users) way, the overall impact of a video movie browsing system can be determined holistically. This is the aim of the research reported here.”

5.1 Deployment Effort and Usage Validation Experiments



Our main goal in this first set of experiments is to study and validate the usage of the technology that we implement in MOVIEBROWSER2, into the real users’ tasks as students of Film Studies in the School of Communications, Dublin City University. User feedback

and data was collected and gathered over a long period or time frame, corresponding to a whole semester of the University calendar.

Mayhew in [63], indicates that there are four alternative techniques for collecting user feedback namely usability tests, interviews, focus groups and usage studies. For our situation, usage studies seem the most appropriate for collecting and validating our data since we want to monitor and assess the usage over a semester period for the particular module and students. Of the other tools, usability tests measure specifics of an interface, interviews and focus groups gather feedback on the overall experience. We are not focusing on the specific features of the interface of the tools at this stage of our work, but mainly we want to access the interactions that students have with the system and to see their usage patterns. In order to do this, a longer period of study is appropriate in order to get such data, for example perhaps for the duration of an academic calendar semester. Longitudinal studies have been applied for many other research areas as in [50, 65, 6, 46] as previously mentioned in Chapter 2, especially in determining the usage of specific tools or applications that were developed. Ingwersen and Järvelin in [41] point out that longitudinal studies are one of data collection methods where an investigation has to be performed over a longer period of time especially in order to identify patterns, usage, cognitive levels of the users, etc. The timeframe of the longitudinal study will depend on such things as the users' tasks and their specific goals.

Participants — Our group of real users at the deployment stage for our work are students from CM272 *National and Ireland Cinema* (with Lecturer Dr. Stephanie McBride) which is a second year undergraduate level course of one semester (12 weeks classes) and CM135 *Analyzing Media Content* (with Lecturer Dr. Pat Brereton) a first year undergraduate level module, also of one semester duration. The combined class groups totalled 268 students (CM272 = 76 students, CM135 = 192 students). For the former module, the lecturer used mostly an Irish cinema maker as the focus of their main study topic within the module while the latter module used many different movies (e.g. contemporary Hollywood). Students taking the modules are from different degree programmes including the B.A. in Communi-

cations, the B.Sc. in Multimedia and the B.A. in Journalism. In both modules, the students' main task as part of their practical assessment is to "read" movies and analyse the film in detail based on what they have learned in class (i.e. wide range theories, historical context of cinema etc) and from this "reading" they are required to produce an essay on some topic. There is no written examination at the end of either module. Student assessments are based on the essays they produce from reading the movies. For instance in the CM135 module, students need to produce an essay on any chosen movie, of approximately 1000 words in length. This task involves an individual reading of a sequence of any chosen movie. Each student needs to analyse a movie from various aspects such as grammar of the cinema, *mise-en-scene* (what is in the frame), capturing the essence in the movie, focusing on aspects like music, camera, lighting, etc [9].

Tasks — As part of our end-user involvement effort, we deployed our system for managing and browsing movie contents to film study students (taking modules CM272 and CM135) for the duration of the whole Spring semester. The modules required students to watch or "read" movies and to write essays on specific aspects of those movies, where conventionally the students would borrow DVD movies from the library or use other resources. In providing an additional means to access the movies but much more conveniently than DVD borrowing from the library, we wanted to monitor the detailed usage of the tool throughout the semester in a natural, contextual, and longitudinal way, in which the task was to watch movies, to understand them, and then to write an essay as given by the lecturer of the module.

Table 5.1 shows the list of movies stored in the library of our system. In MOVIE-BROWSER2, the movies were separated into two categories according to the type of browsing that was supported; basic and advanced. The advanced type of browsing will have features that could enhance user browsing, like the inclusion of a visual timeline, support for keyframe browsing, note taking features and movie playback as briefly mentioned in Chapter 4. On the contrary, a movie listed with the standard category of browsing has only

With Advanced Features	With Basic Features
<i>Shrek</i> (2001)	<i>American Beauty</i> (1999)
<i>About Adam</i> (2000)* **	<i>The Most Fertile Man In Ireland</i> (1999)*
<i>Circle of Friends</i> (1995)*	<i>High Fidelity</i> (2000)
<i>Intermission</i> (2003)*	<i>Oceans 11</i> (2001)
<i>Into The West</i> (1992)*	<i>The Magdelene Sisters</i> (2002)*
<i>Man About Dog</i> (2004)*	<i>Lilo and Stitch</i> (2002)
<i>Michael Collins</i> (1996)*	<i>Road To Perdition</i> (2002)
<i>On The Edge</i> (2001)*	<i>This Is My Father</i> (1998)*
<i>Spin The Bottle</i> (2003)*	<i>The Royal Tenenbaums</i> (2001)
<i>The Quiet Man</i> (1952)*	<i>Eat The Peach</i> (1986)*
<i>The Butcher Boy</i> (1997)*	<i>Poitin</i> (1979)* **
<i>Korea</i> (1995)* **	<i>After 68</i> (1993)* **
<i>Nora</i> (2000)* **	<i>Goldfish Memory</i> (2003)* **
-	<i>The Snapper</i> (1993)* **
-	<i>The Visit</i> (1992)* **
-	<i>The Ballroom of Romance</i> (1982)* **
-	<i>Bent Out of Shape</i> (1995)* **

Table 5.1: List of Movies. Note: * Irish-directed movies; ** Movie used in CM272 module

a playback function with standard DVD-like player interface facilities such as play, pause, slider bar, etc.

The collection of 30 movies come from various genres (comedy, drama, romance, action etc.), ranging from contemporary Hollywood movies to old Irish movies, with production years from 1952 to 2004. There are a few movies that were short in duration (less than 1-hour) that are used in class such as *After 68* [25 minutes], *Bent Out Of Shape* [27 minutes], *The Visit* [19 minutes] and *The Ballroom of Romance* [50 minutes]. These movies were categorized under the standard browsing features due to their short lengths and difficulties in generating event detections and classifications as a result of that short length. We tried to balance the number of movies that are categorised into ‘Advanced’ or ‘Basic’ features. Movies with (**) are examples of Irish-directed movies that are used as part of discussions in the CM272 module by the lecturer, though for the movie reading and analysis topic, and the submission of essays, students were free to choose any Irish movies available.

Experimental Procedures — Our interactions with our subjects as part of these first set of experiments proceeded as follows. We provided a system demo in the earlier part of the semester for each class. The lecturers for each module were acknowledged and informed of the whole procedure before any deployment was carried out and they gave great support and encouragement for the process to proceed. A brief explanation was given to each class regarding how to use the system during a demo presentation and permission was obtained from the lecturers for this purpose. The demo presentation took about 15 minutes using a laptop and was displayed using a projector to the classes. Each student was assigned a unique username and password for our system. Once the demo had been carried out, an email to each student was made informing them of their system username and password together with information on the system (i.e. web links, player installation and other requirements). Once students got the email, the system could be accessed, starting from week-3 until week-14 in Semester 2 of the academic calendar 2007/2008. Follow-up email reminders were sent a few times during the period of deployment.

We administered an online questionnaires in week-13 and week-14 of this initial deployment. Students' usage data logs were captured automatically and saved in our database, similarly to our data collected from online questionnaires. We choose online questionnaires because it is easier to distribute these to a large number of people and is an overall more effective process as compared to other modes of distribution such as paper questionnaires. By using the web tool for designing the questionnaires, a lot of possible designs are possible to achieve as for example a better design with colourful and innovative questions displayed as compared to a paper questionnaire [26]. On the other hand, by collecting data using an online questionnaire it can eliminate cost like printing and mailing [27]. At the end of the deployment, an email was sent to students to thank them and acknowledge their responses and cooperation.

Data Capture — we separated the captured data from the two main resources as listed below:

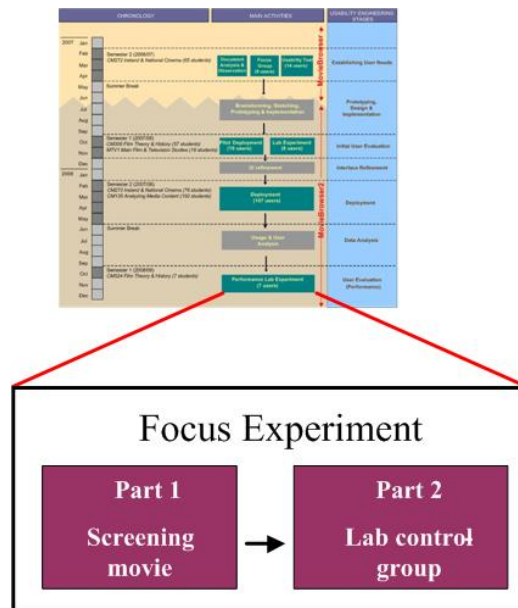
1. Usage Logs — Our objective in performing the deployment to the students in the University was to monitor and assess their usage of the developed movie browsing and playback tool. This is done automatically from the system and automatically stored in the database. Among the logs that were captured were the interactions or user actions with the features that we provided on the screen interface. We would like to record and see students' usage patterns in accessing these features to browse movie content.
2. Questionnaires — The objectives of the administered online questionnaires was to measure subjective satisfaction with the new deployed system and to collect quantitative and qualitative data on opinion and feedback on the value of the technology we implemented. It was composed of two parts (A and B). Part A was on the demographic data on students' gender, age, course information and other preliminary inquiries. Part B was on their overall reaction to the system in terms of their perceived satisfaction, views on the features provided, opinions on the value of technology (positive and negative).

This data was captured and stored securely on a database for subsequent analysis.

5.2 Experiments on Analysis of User Performance

The analysis of user performance experiment was carried out in the first semester of an academic calendar with a new batch of students of the module *Film Studies* during Semester 1 of the 2008/09 academic calendar year.

Experiment Goal — In this performance analysis experiment, the goal is to determine how much better or worse is the system (MOVIEBROWSER2) as compared to existing “state-of-the-art” standard movie media player interfaces. The experiment will immerse students in the idea of learning and reading a film with the use of our movie-browsing technology. Film studies in general is not an exact science and to any given issue or question there will never



be a clear and agreed answer. The analysis of our findings will not only be driven by results we obtain, objectively measured for the duration of a one hour lab experiment, but also by the subjective nature of the human involvement in our experiments. We understand that it is difficult to prove the ‘benefit’ of a movie-browsing system such as ours within a specific timeframe, and ideally it needs a longitudinal and focused study or a large focus user group for example, but we regard this particular experiment as a starting point for future work.

We applied various methods in gathering data for analysis such as questionnaires, observations, and content analysis. These methods are among the typical data collection methods as described in [41]. On the contrary, for a more qualitative approach to data collections, semi structured or open-ended interviews were recommended.

Our specific objectives in doing this experiment is to measures objectively the amount of ‘benefit’ that the MOVIEBROWSER2 could provide as compared to the conventional way of browsing movies, in terms of users’ perceived satisfaction levels, the system’s usefulness and the general performance of students when using the interface.

This final experiment is one of the many interactions we did with our users which started from a user study, an initial *MovieBrowser* lab user testing experiment and then finally our deployment effort. Any deployment experiment brings an element of getting an overall pic-

ture of the usage of a system in a real environment over time. However we still could not get certain elements of information we would have liked such as more specific information on usage, as advocated in our experimental questions, and this information remained still unknown or missing from our previous deployment experiment. Thus we ended up with this final lab experiment in order to fill the missing knowledge as our listed objectives above.

Participants — Our participants for this experiment were from Semester 1 of the 2008/09 academic calendar module which is *CM524 Film Theory and History* presented by Dr. Pat Brereton, the same lecturer but different course module. It is a level 5 Masters class module which is a different group of students from the previous interactions. We recruited all 7 students as there were only 7 students enrolled in this delivery of the module. The number of students in the module was reduced by more than 50% as compared to the previous semester enrolment which was 18 students in total. This is something that is beyond our control.

The aim of module CM524 is to provide students with a theoretical and historical understanding of the development of cinema. One of the learning outcomes of the module is that the student will be able to produce a textual analysis of a wide range of film types. The teaching methods used by the lecturer are by having a lecture and a movie screening each week as part of the same session and this begins with textual analysis exercises. This textual analysis exercise component of the module delivery has been adopted into our study.

Tasks — The task given to students in this experiment is about how to ‘read’ small sequences of a film. Each student needs to produce a small piece of writing based on reading movie sequences (only writing about parts of the film that are requested in the question) and we will compare how students perform this task using MOVIEBROWSER2 versions and using only a standard movie player. Our arguments in choosing this methodology are because we are only concerned with and we only evaluate how participants browse within-movie content from the interface provided to them, either from a standard media player or

from the MOVIEBROWSER2 interface, in order to answer the task question put to them. We are not concerned with how and where they accessed the material i.e. from the hard drive or from URL links. This experiment has been assigned to students as part of the learning process of writing a textual exercise assignment in module CM524 and was thus part of students' module coursework. From the lecturer's perspective, by performing this experiment, the initial level of each students' writing skills could be determined.

In both tasks, each student needs to produce a small piece of writing as a result of reading movie sequences that we have chosen, which are less than 5 minutes in duration. These tasks were chosen because this module requires students to produce a textual essay based on reading movies at the end of the semester. The tasks of reading a sequences was assigned as Assignment 1 by the module lecturer as an exercise before a longer essay were produced. The sequence should not be longer than that as suggested by the lecturer teaching the module because it will be difficult for participants to read/analyse in a shorter period as in this experiment 30 minutes is the time allocation given for each task. The type of task in this experiment could be considered as a creative task as participants need to produce short essays of a maximum size of one page. Dix et. al. mentioned in [28] that experimental task types can vary in form such as creative, structured, information passing and etc. Analyzing a whole movie requires a longer time such as an entire semester and cannot be done overnight. That is our main consideration when choosing the sequences in this experiment. In our experiment, the first task was about reading and analysing the dinner conversation scene in the movie *American Beauty*, while the second task was regarding comparing and contrasting a few related scenes from the same movie that had musical elements in them. Participants need to browse and analyse relevant scenes or sequences as described in the task by using the assigned interface systems as described below:

1. Task 1 — Find the scene below (in the movie *American Beauty*) and perform some analysis of its content. Analyse the techniques used by the director to make the scene more tense between all the family members in the fighting dinner scene where *Lester* (the father) throws away the food plate onto the wall. [Hint: characters smiling to/at

each other in the beginning and there are some recognizable changes in dress etc].

2. Task 2 — Find the scenes below and perform some analysis. Analyse the director's use of music to express the characters' emotion more cinematically. [Hint: you could contrast these scenes — a scene where *Carolyn* (the mother) is driving and singing in the car on her way back home and a scene where *Lester* (the father) and *Angela* (*Jane's* friend) are together in the bath].



Figure 5.1: Task 1 — Keyframe of dinner scene in the movie *American Beauty* [timeframe 1:05:00-1:07:30]



Figure 5.2: Task 2 — Above: Keyframe of *Lester* and *Angela* in a bathtub [timeframe 0:43:35-0:44:12], Bottom: Keyframe of *Carolyn* driving a car [timeframe 1:13:45 - 1:14:38]

Figures 5.1 and 5.2 show examples of the scene keyframe of the sequences as described in both tasks with the timeframe from within the whole movie.

Experimental Questions — Our main experimental question in carrying out this experiment is “Do students who use our newly-introduced technology (in the software tool) get more ‘benefit’ compared to their conventional way of performing their work task?”. We address this main question by dividing into sub-questions as the following:

1. Do students make use of the alternative access features afforded by MOVIEBROWSER2 and spend less time in completing the essay-writing task ?
2. Given the same amount of time, is the ‘outcome’ for those using MOVIEBROWSER2 better or worse than those who use only a standard DVD media player interface for browsing movies ?
3. Do the students who use MOVIEBROWSER2 have a higher level of satisfaction than those using only a standard DVD media player ?

Experimental Procedures — Apart from answering our own research questions, our main consideration in performing this experiment was to make it as realistic as we could. In order to do that, we replicated students’ own real work task scenarios. In their real work tasks, students will find any movie that interests them and read that chosen movie and then prepare an analysis essay based on some specific topic given by the lecturer.

We separated the experiment into two stages which were carried out in week-3 and week-4 of the academic calendar. Since this experiment was considered as part of the module coursework (Assignment 1), it needs to be carried out earlier in the semester. We choose week-3 because this is an appropriate time as students have already completed their registration and are still in the introduction week. From the lecturer’s point of view, the experiment will give an overview of students’ writing skill levels as mentioned before. At the end of the course, students need to be able to write longer essays of movie analysis and this exercise should be useful as their starting work task.

For this experiment, we choose one movie, *American Beauty*. One of the considerations in choosing this as the movie for screening is because it was an award-winning movie which has an interesting plot. After the movie was selected, we sought opinions from the lecturer

on our movie and scene selection. We got feedback that this movie was indeed a strong film, with good scenes, provocative and considered as a ‘smart film’ which has many interesting elements which can be analysed. A ‘smart film’ is a film that is ironic, playful, problematic and has a complicated narrative [Pat Brereton oral conversation : 10th Sept 2008].

In week-3 of the semester, we prepared a slot within participants’ regular class schedule. The screening of the movie took about 2-hours carried out in one of the classrooms. During the session, refreshments were provided in order to provide a relaxed environment while watching the movie. We provided pre-task questionnaires to be filled at the end of the movie screening, together with a consent form and plain language statement of the experiment, in accordance with Dublin City University Ethics Committee guidelines. The pre-test and consent forms were collected once the screening ended. Prior to that, an email informing students of the location and other information regarding the screening were sent to participants with one copy (cc) to the lecturer.

During week-4, one week after the participants had watched the movie, they were brought to our computer lab in the School of Computing for a controlled lab experiment. This took another 1 hour 30 minutes for this session. There were two tasks that participants needed to perform, and these were assigned in a random order. After each task, participants were given a post-task questionnaire and an exit questionnaire once they finished all tasks.

The diagram in Figure 5.3 describes our main activities in this experiment. Box colours indicate the core elements of the process where information was extracted.

Participant ID	Interface A	Interface B
U1	Task 1	Task 2
U2	Task 2	Task 1
U3	Task 1	Task 2
U4	Task 2	Task 1
U5	Task 1	Task 2
U6	Task 2	Task 1
U7	Task 1	Task 2

Table 5.2: Within-group design. Notes: Interface A = Standard player interface, Interface B = MOVIEBROWSER2 interface

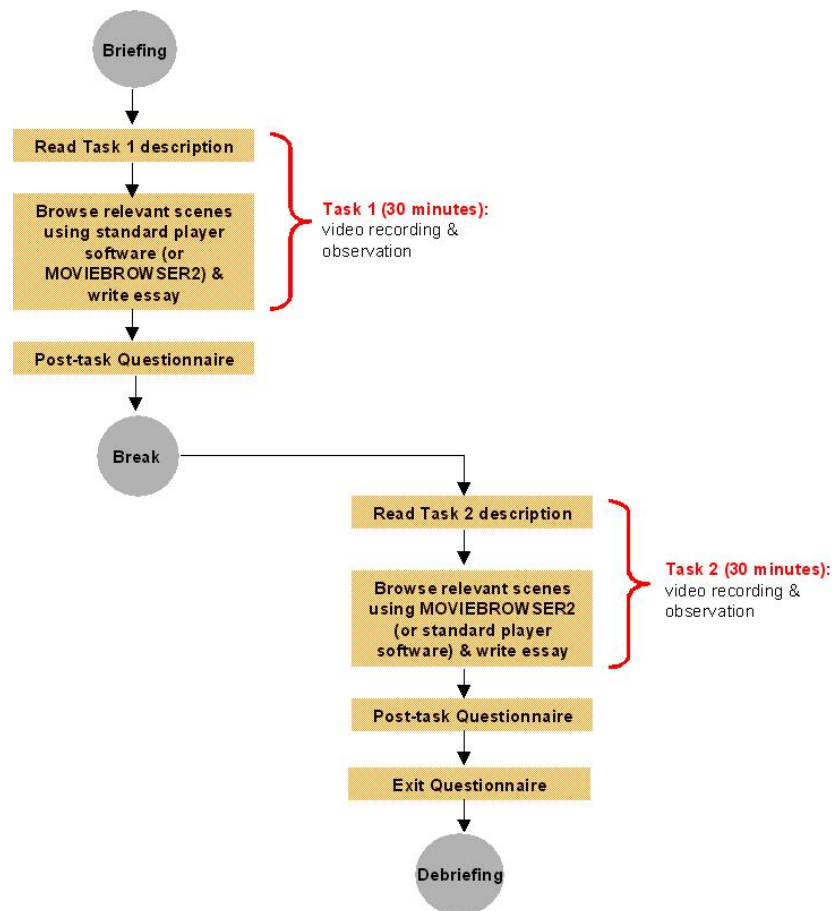


Figure 5.3: Main experiment procedures

Participants started with Task 1 first either with the standard media player or with MOVIEBROWSER2 as according to Table 5.2. For instance, U1 must perform Task 1 using interface A (standard movie player) then Task 2 using MOVIEBROWSER2. U1 launched the Quicktime player icon on the desktop to play the movie. U1 can start doing their analysis and write their essay (a maximum of one page) using WORD which was also available on the desktop, and this process will take approximately 30 minutes maximum. Meanwhile, U2 began with Task 1 using MOVIEBROWSER2 then followed by Task 2 using the standard movie player. For MOVIEBROWSER2, participants will be given a username and password for their login.

A reminder was made 10 minutes before the session ended to individual participants.

Once the first task finished, participants needed to submit their WORD document as a module assignment through the email address provided. After the email submission, they were given a post-task questionnaire. The same process continued for the following task. Refreshments were provided during the sessions. When both tasks were finished, an exit questionnaire was then given and the cycle of the experiment ended.

There are three CCTV video cameras that captured some of the interactions among participants. We could not capture the interactions among all participants due to limited number of video cameras available to us. Besides that, video footage was only used as our secondary support data for our observations. Prior to that, permissions were asked from the participants. Finally, a debriefing was made where we engaged in the process of discussing course syllabi and movie contents with the users after both tasks had ended and closed the session nicely.

In order to reduce and control the learning effect during the task performance, we choose a within-groups design in the task assignment mentioned above. The use of each subject in only one condition is referred to as a between-groups design. On the other hand, when using each subject for different conditions, this is referred to as within-groups design [94, 28]. Due to the smaller number of students enrolled in the module, we implemented a within-groups design. We describe a within-group design as shown in Table 5.2. Each participant performed all tasks given [Task 1 then Task 2] and a random assignment sequence was made for each participant. With this design, participants' experience in Task 1 being used to influence performance to another condition in Task 2 would be reduced.

Data Capture — Data capturing (quantitative and qualitative) for this experiment were measured from various resources as below:

1. Time to complete the tasks - measured from the time the email submission was sent by participants
2. Amount of interactions - measured from observations, video camera footage and screen automatic logs

3. Perceived satisfaction - measured from responses to questionnaires
4. Essays answer quality rating - measured from the essay quality rating either “Very Good”, “Good” or “Basic”

Questionnaire design — We administered a pre-task questionnaire in week-3 of the module which is about collecting data on demographics such as age, gender, education background, computer literacy, frequency in watching movies and familiarity with the movie *American Beauty*. In the following week-4, a post-task was given mainly covering several parts such as one’s experiences in performing the task, experiences in using the system/interface and the user’s opinions on specific features provided. It is also consisted of open-ended questions for qualitative data collections. Finally in the exit questionnaire, the questions were mainly on the comparison between the two interfaces used in performing both tasks of browsing and analyzing movie contents and the users’ experiences and opinions on the experiment as a whole. The role of the questionnaire was as an instrument to collect quantitative and qualitative data in answering the research questions.

5.3 Conclusion

This chapter elaborated our experimental design and methodology in exploring our research questions.

We designed our experimental setting in such a way that our research is informed at all major stages of a system development lifecycle, using a number of information-gathering tools offered by the HCI community. The two most important aspects of our experimental methodology that distinguishes our research from that of others are:

1. Frequent interactions with real users (students and lecturers) in the form of focus group, in-class observations, discussions with lecturers and students, and continuous feedback, in a real task and with a real user environment

2. A semester-long deployment of our MOVIEBROWSER2 system to a class module, during which students' natural usage patterns were monitored and their opinions after the long-term use, was captured through questionnaires.

Close interaction and long-term observation meant that we were able to obtain the most natural and realistic knowledge of our student/lecturer use of the MOVIEBROWSER2 system. With these efforts, we tried to maximise the input from students/lecturers at all stages of our experiments. Our analysis is not only driven by the results we got from our experiment carried out but also from some other broad subjective topics. The presentation and analysis of results of our findings from these experiments will be represented in our next Chapter 6.

Chapter 6

Usage and User Analysis

This chapter elaborates the findings and discussion on both sets of experiments that were performed and previously described in Chapter 5. The findings from both experiments try to answer the research statements in this thesis.

6.1 Experiment 1 - Deployment Effort and Usage Validation

The deployment experiment was mainly carried out to study and validate the usage of the newly-introduced tool by Film Studies students and identify any issues that are arose. This section elaborates on our findings and discussion from the first set of experiments on deployment efforts. Data analysis is represented both using quantitative and qualitative methods.

6.1.1 Findings

An explanation on the trial's findings is divided into several categories as follows:

1. User assessment
2. Features assessment
3. Usage pattern over time
4. User opinions and experiences

The first three categories are based on log data that was automatically captured during the trial deployment and the last was based on post-trial questionnaire data (quantitative and qualitative). We perform some simple session boundary determination in managing our log data as explained in Section 6.1.3.

User assessment — Table 6.1 shows an overview of the number of students participating in the deployment experiment. From the table it can be calculated that out of the total number of 268 students in both classes, 107 students (40%) accessed MOVIEBROWSER2.

Students	CM272	CM135	Total
Total student	76	192	268
Total student participate	33	74	107
Percentage	43%	39%	40%

Table 6.1: Overview of participation in the trial

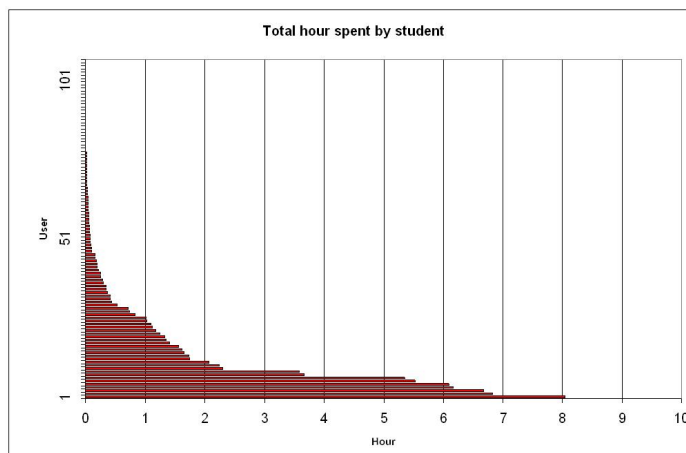


Figure 6.1: Hours spent on system

From the actual log data collection, we see that on average, almost all 107 students accessed MOVIEBROWSER2 at least 2 times during the trial period. Figure 6.1 shows corresponding times in hours spent on the system. As can be seen from the chart, a vast majority of the students which is 90 of them (84%) accessed the system for less than 2-hours. Only 17 users (16%) from the total groups accessed is between 2–8 hours in total.

In thinking about the number of hours our students used the system over the semester, it is worth remembering that:

- MOVIEBROWSER2 was used as a complementary tool in the movie analysis classes where the lecturers encouraged the students to use the tool and a short introductory sessions was conducted during the classes;
- MOVIEBROWSER2 featured some movies that are not available from the University library's DVD collection especially for Irish movies;
- MOVIEBROWSER2 can be accessed only within campus (this was one of the complaints from many students) - this means those students who want to work on their essay at home during the weekend or evening are unable to access the system;
- MOVIEBROWSER2 was developed for a specific technical environment in which it was deployed (computer labs in School of Communications), consisting of Microsoft Windows XP, Microsoft IE v6+ and VLC player. Thus compatibility with other machines and browsers when some of the students tried to use their own laptops was an issue.

The total access duration time was around 86 hours during the trial (CM272 = 57 hours, CM135 = 29 hours). Results revealed that access time for CM272 was almost double the other module. This may be because the assignment for the former class required the students to use Irish movies as examples which were mostly not available in the university library, whereas the assignment for the latter class was not restricted to Irish movies and was thus much more accessible from conventional sources (e.g. library, DVD rental, cable TV, etc.). From the total movie collection, 23 (77%) were Irish movies with 7 contemporary Hollywood (23%) added to the collection. Our justification in having students from the CM272 and CM135 module was because these two modules were running during our trial semester and they had a similar nature of textual analysis assignment. The only difference was for CM272 where students choose only Irish-directed movies as their resources as

compared to CM135 in which they have more variety in choosing movie selections including Irish movie collections (no movie restrictions). Thus in this work, we are not focusing on comparing each module specifically but mainly to examine student access patterns.

Figure 6.2 shows the frequency of Irish and Hollywood movies accessed during the trial deployment. As can be seen from the chart, all 7 Hollywood movies that were stored in the system library were accessed a total of 73 of times (39%) with the movie *Shrek* (2001) mostly accessed and viewed by students, 24 times. Irish movies were accessed in total 116 times (61%) with the movie *About Adam* (2000) the most frequently accessed, and viewed 21 times, followed by *The Butcher Boy* (1997) at 20 times accessed. A few short movies like *The Visit* (1992) and *Bent Out of Shape* (1995) have no access at all by students. Another two movies were found with no access at all, *This Is My Father* (1998) and *Eat the Peach* (1986).

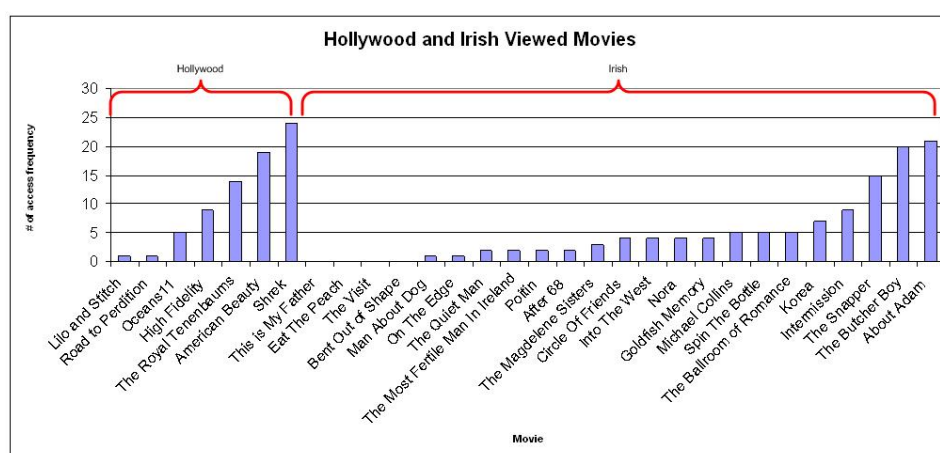


Figure 6.2: Movie accesses by frequency

Features assessment — We divided our movie collection into ‘Advanced’ and ‘Basic’ as shown in 6.3 and the reason behind this idea was to see the pattern of user interactions when some added technology features are incorporated. The advanced type of browsing consists of features that could enhance user browsing and navigation of movie content. These features are mainly designed to enhance the reading based on the three event categorizations (i.e. montage, dialogue and exciting) and we wanted to see the pattern of user interactions

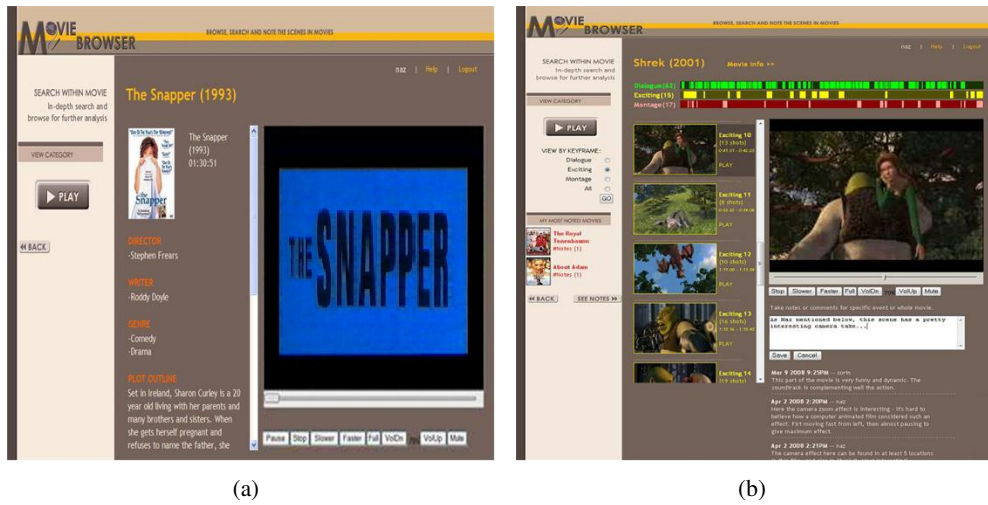
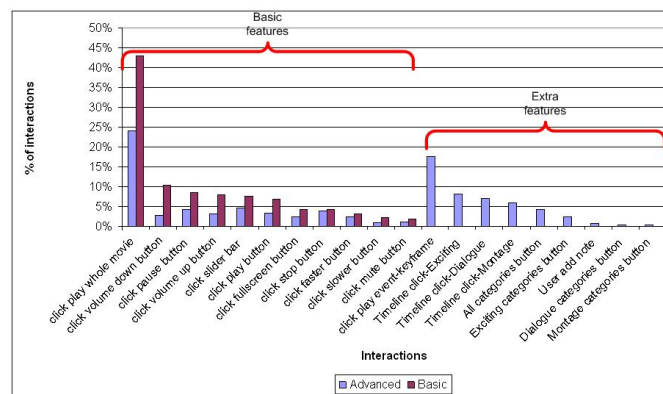


Figure 6.3: Example of screenshot page (a) Basic and (b) Advanced

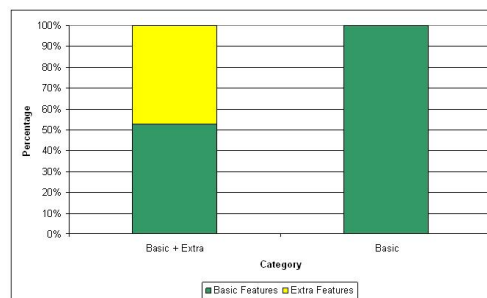
when some added technology features are incorporated.

User interactions are captured and represented in Figure 6.4 (a) and (b) from the number of clicks made. The result shows that the percentage of interactions on the features: ‘Basic’ [A] and ‘Advanced’ [A+ α] have similar patterns in the playback movie activity. ‘Click the whole movie’ has the highest interaction that shows activity in watching the whole movie, while ‘click play button’ denoted the activity of playing a movie after being paused. User activities such as watching or playing sequences were logged as user-action entries such as ‘click pause button’, ‘click stop button’, ‘click play button’, ‘click slider bar’ and so on, labelled in the chart as basic features. These are standard interactions that are mainly related to conventional movie playing activities as normally found in the video player (i.e. play, pause, stop, slider bar and volume adjustment). As for the advanced screen, there are some ‘extra’ interactions on top of the standard playback activities as shown in the chart. These extra features were provided in the advanced screen as well as standard movie playback. The result reveals that the amount of interaction of playback-related features was spread out into that of extra features in the advanced page. In percentage terms, there are 47% extra interactions found on the extra features as captured in the advanced screen (see Figure 6.4 (b)). Examples of advanced features included were timeline visual, scenes playback of

event categorizations, note taking and shot keyframe view. Other than exploring through the timeline that represents event categorization, we also added a button interaction that plays similar functions to looking for event segmentation. However, the interaction of this seems quite low as depicted in the graph (i.e. Dialogue/Exciting/Montage/All categories buttons) and does not exceed 5% of interactions. User added notes shows among the lowest interactions looking at the number of clicks and is further discussed in Section 6.1.2.



(a)



(b)

Figure 6.4: (a) Advanced vs. Basic interactions, (b) Total composition (%)

There is an indication that users are engaged more on the advanced page and this result is also reflected by the increased hours spent on the advanced type as can be seen from Table 6.2 with 45 hours spent as compared to 33 hours in the standard or basic interactions. This result indicates that the advanced features made the students stay longer on the system using the event segmentations that underlie the features. Users managed to jump from one point to another point easily in the movie using visual representations of a timeline or the shot keyframe view. Instead of playing sequences from the normal playback interaction for

example either using the pause button or slider bar, the playback of sequences shifted to playing from the shot keyframe view as depicted in the chart with the highest percentage (18%) as shown in 6.4 (a). These artificial divisions were found to influence usage among the students.

More clicks does not necessarily mean that there is more usage. It might mean that it is more complicated or features new things, thus users need to explore more to find out what they are looking for. The findings in the qualitative comments given by students reveal a list of system-likes for these extra features (see Table 6.6) as well as some complaints from students about having no advanced features for some movies. With these positive comments, a better indication of user preferences are shown. Based on user comments, more interactions and longer time spent is not perceived as negative during the deployment.

This analysis was not meant to compare between basic screen [A] vs. advanced screen [A+ α] but mainly in monitoring the usage pattern of some value add-ons features provided on top of the standard features and whether it would influence usage in an unnatural way.

Type	Hours Spent
Advanced screen	45
Basic screen	33
Total playback activities (Advanced and Basic)	78
Total accessed hours in the semester	86
Other activities*	8

Table 6.2: Advanced and Basic Page Hours Spent. * Other than playback activities.

Figure 6.5 shows the graph of total number of viewed movies by users under both categories. As can be seen from the chart, the total accessed frequency on movies was a bit higher in the advanced page (107 times (57%)), while the basic page has a total number of 82 times (43%). It seems that students still accessed movies even though the particular movie was available under the 'Basic' type of browsing.

We also provided other features on MOVIEBROWSER2 mainly to know how users make movie selections. Features included filtering movie collections based on film-director, film-genre or no filtering at all. These features were not directly related to the advanced and

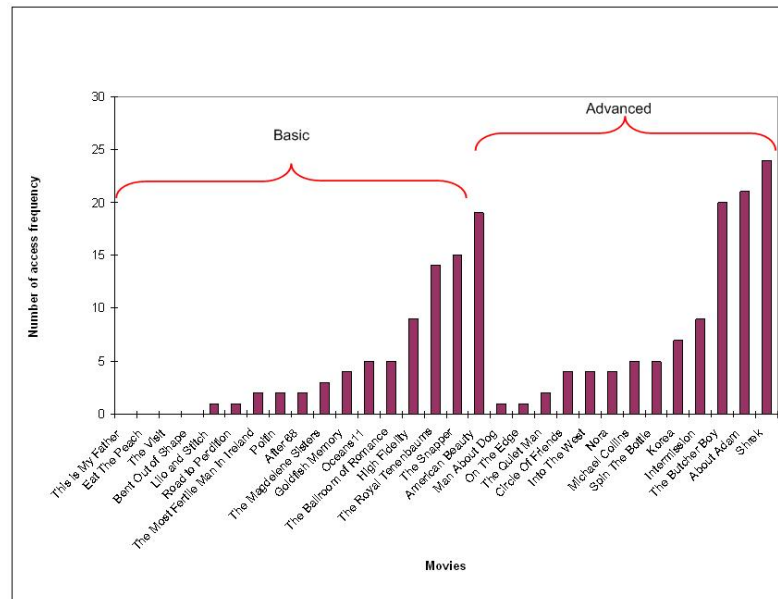


Figure 6.5: Advanced vs. Basic viewed movies

basic types of browsing and watching but mainly on the movie selections. In the percentage of log interactions, we noted only 11% of interactions filtered the movie collections based on film-director, 17% based on film-genre with the rest (72%) no filtering at all. We listed all movie posters in the front page of the system by default. Film genre seems an important factor in students' actual textual analysis as the topics given by the lecturer are normally based on movie themes. An example of the textual analysis topics given to students in the CM272 module is [64]:

Martin McLoone lists a series of recurring themes in Irish cinema. (McLoone, 2000, p 128). See over. Discuss the articulation and interrelation of themes in an Irish film(s) of your choice.

Usage pattern over time — Figure 6.6 illustrates the group usage for the trial over the semester. From the figure, it can be inferred that students start using the system from the 10th March with few users logging into the system. The system seems to have quite heavy usage approaching the deadline of the assignment submission that was on the 9th May 2008 for both modules. It is generally believed that this pattern of usage corresponds with our

previous observations on our user studies that even though the topic was given early by the lecturer (i.e. week-6 for CM272 - 14th March 2008), students tend to concentrate on their assignment just before the deadline. The lecturer advises the students not to do last minute assignments since reading and analysing movies cannot be done within a short duration, it needs longer time so that the skill of reading will evolve. Huge usage was found around the month of April until the early weeks of May. The process of reading and understanding movies starts by watching the movie many times before the essay can be written on paper.

These usage patterns also strongly show that, students were engaged with other assignments from other modules and have to follow some priority deadlines. Based on some informal conversations with a few students implies this is a strong facts. A few email reminders were also sent to students regarding the deployment and we found that once an email was sent, there was some usage recorded.

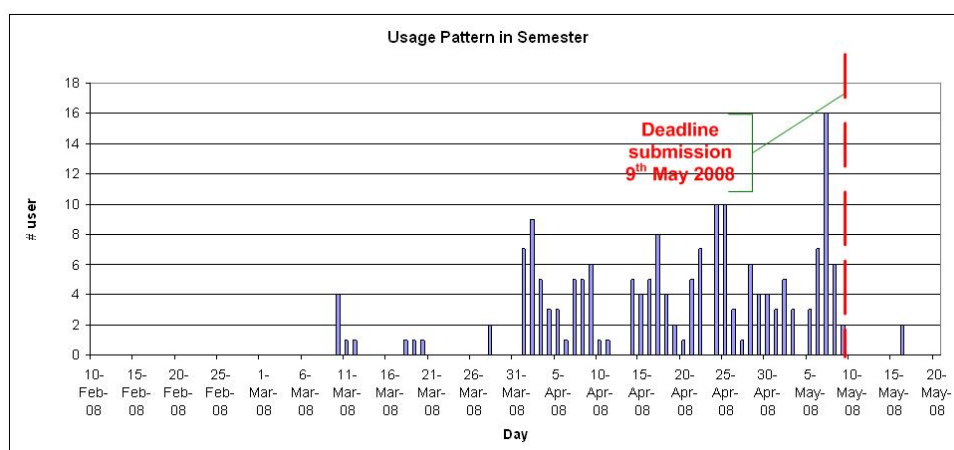


Figure 6.6: Student's usage in the semester

We also noticed some usage was captured after the trial deployment by students as they still had access to MOVIEBROWSER2. They still access the system even though they have submitted their essay assignment. This usage pattern shows a significant findings on their intention and positive acceptance. At this time, usage is more toward leisure and not for assignment purposes.

User opinions and experiences — Out of the 107 students who accessed the system, only 60 students (56%) responded to the questionnaires that we administered within week-13 – 14. This is shown in Table 6.3 and illustrated by a diagram in Figure 6.7. Analysis of these 60 responded questionnaires yielded results as described further in this section.

Module	#Total Users	#Trial Users	#Respondents
CM272	76	33	13 (39%)
CM135	192	74	47 (64%)
TOTAL	268	107	60 (56%)

Table 6.3: Overview of respondents in the questionnaires

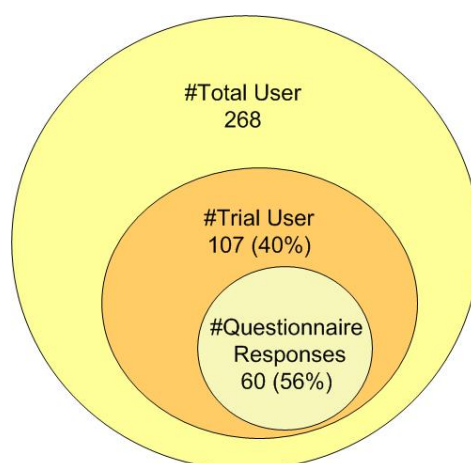


Figure 6.7: Participation in the experiment

The vast majority of students were in an age group between 18-20 years (see Table 6.4), with 23 males and 37 females. They were drawn from a variety of faculty programmes such as the BA in Journalism, BSc in Multimedia, BA in Communication Studies and BA in Contemporary Culture and Society, which are all under the Faculty of Humanities & Social Sciences, DCU. The composition of students by programme is illustrated in Figure 6.8. Nearly half of the students (45%) from the total responses were from the Communications Studies programme.

From these 60 students, 56% of them accessed the MOVIEBROWSER2 from PCs in their school laboratories which are located in the same building as their classroom, while the rest

Age	Number of students
Younger than 18	2
18-20	47
21-23	6
24-26	1
Older than 26	4

Table 6.4: Students' age distributions

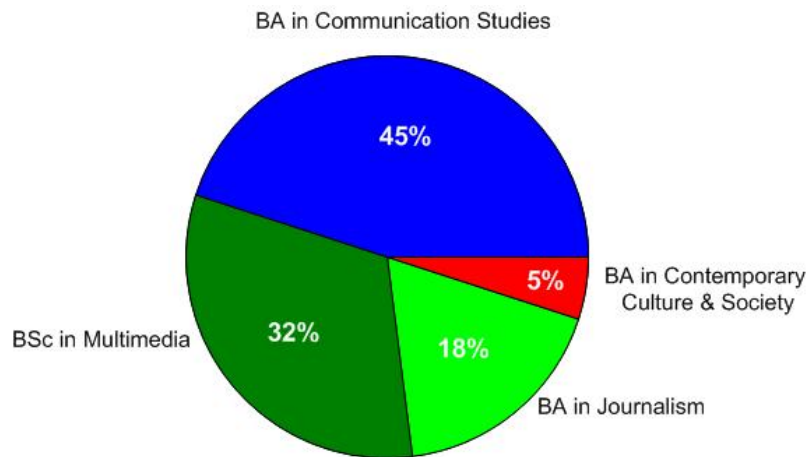


Figure 6.8: Students programme compositions

used their own laptops (37%) or PCs in the library (7%) as shown in Figure 6.9(a). These results indicate that students prefer convenience in order to access from their location.

A pie chart in Figure 6.10 illustrates the composition of different motivation factors among students in accessing the system. As can be seen from the chart, user convenience in accessing movies online was noted as the main motivation from the majority of students in the trial deployment (39%). Providing a tool that can be accessed online makes a user feel greater convenience as compared to conventional access such as going to the library or DVD shops for a DVD rental. The second factor which motivated access, was the movie resources available (37%) provided by MOVIEBROWSER2. This percentage was composed of different variations of access needs for Irish and Hollywood movies. From our observations throughout the study, we found that it was difficult to get DVD copies for an Irish movie due to a very old production year and some are only available in a VHS tape for-

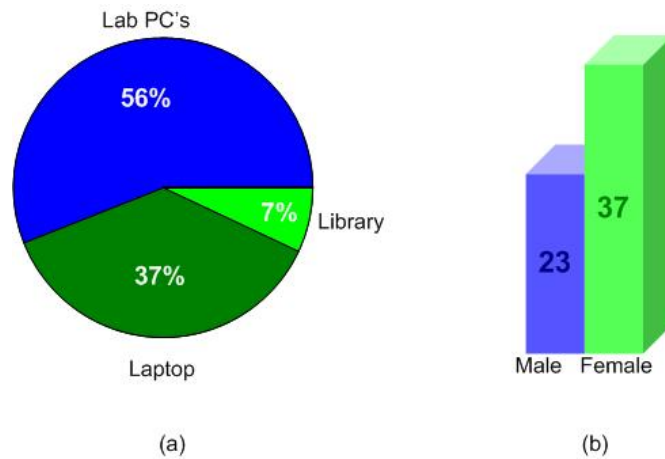


Figure 6.9: (a) Access method, (b) Gender composition

mat. Due to those difficulties, students found that MOVIEBROWSER2 can assist them in their effort in getting material faster. One of the modules (CM272) used only Irish movie selections in their textual analysis requirements. In contrast, Hollywood movie resources were much easier to obtain as they are available in DVD format. Difficulties in getting a DVD for a particular film was one of the problems we noted in the user study [Chapter 3: Section 3.1.3]. The technology of video content analysis that we provided in our system contributed to the third motivating factor in using the system by the students (24%). We informed students during our system demo that MOVIEBROWSER2 supports a video content analysis technology that was developed in School of Computing which makes available the movie scenes broken down into several categories of events.

We gave a set of questions (see Appendix B) on overall reactions to the system using a scale from 1 to 5 (1=Totally Disagree and 5=Totally Agree) and plotted their opinion scale rating in Figure 6.11. Since this experiment mainly to explore the benefit from the technology (in the tool) to students, the questions were selected and chosen mainly to capture the potential benefit either from the system or their work tasks (i.e. Film Studies domain). As depicted in the diagram, in all statements, at least 50% of participants gave a positive opinion either 'Totally Agree' or 'Agree' while negative opinion does not exceed 10% of the total number of responses. In general, we get above average values with modes and

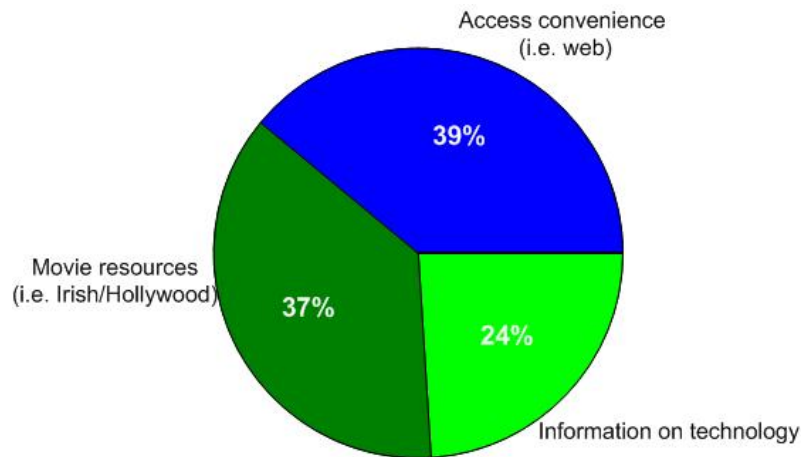


Figure 6.10: System access motivation factors

median equal to 4 (Agree) for all differential statements. Table 6.5 summarises the means and standard deviations on all statements. Generally all statements have above 3 as their means which shows that the higher the mean the higher their satisfaction or total agreement.

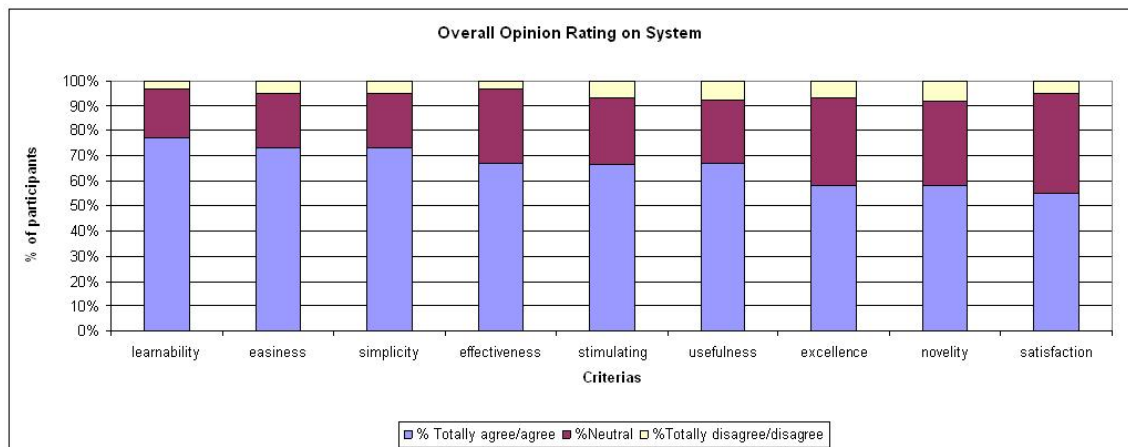


Figure 6.11: Overall system perception

Overall comments given by students affirm these ratings and include the following extracts.

“I love it !” [P1].

“Easy to understand and use” [P58].

Statement	Mean	SD
Learnability	4.05	0.81
Easiness	3.98	0.91
Simplicity	3.98	0.85
Effectiveness	3.88	0.83
Stimulating	3.70	0.81
Usefulness	3.88	0.99
Excellence	3.73	0.88
Novel	3.62	0.87
Satisfaction	3.62	0.83

Table 6.5: Overall system.

“Yes, I seem to watch more movies with the interest of study in mind (i.e. looking at camera angles, edits etc) which I never done before having the browser” [P4].

We captured students’ opinions on their learning perception as related to their studies and how the tool might support their learning and we used a Likert scale from 1 to 5 for that rating (the higher the better). Figure 6.12 summarises all statements given in this survey. Statement 1 was (“The features provided in the tool were useful in my studies”). This statement gets the highest positive response as compared to the rest of the statements (68% of students totally agree or agree) although 13 students (22%) gave “Neutral” responses. Statement 2 (“The movie collection is useful in my studies”) draws out nearly half participants to totally agree or agree (47%) and 20% (12 participants) gave the opposite opinion. The results reveal that the 30 movies stored in the library seems not enough for students to choose from. One participant made comments such as (“I feel there are not enough movies on it. A huge range of movies should be on it ...e.g. European and Hollywood etc. ” [P24]). The following statement 3 (“The tool helped me to support my information needs”) elicited 52% of responses as total agreement. Statement 4 (“The tool helped me to enhance my ability to read films well”) and statement 5 (“The tool helped me to discover new ideas in my work”) elicited 43% and 37% each for totally agree or agree opinions. These

statements are more abstract and more related to the learning ability of individual students and their skills which seems difficult to justify. However, we read some positive comments such as (“Helped me look for styles used in film, i.e. camera cuts, shots etc.” [P55].) and (“The tool helped me to choose what film to use for my assignment ” [P53].). The last two statements (“The tool helped me to explore the collections better”) and (“The tool helped me to analyse the scenes better than a DVD”) draw out more than half of opinions in total agreement (53% and 58% each). The results reveal that the tool provides more facilities for browsing movie content which might be an extra advantage as compared to conventional DVD browsing.

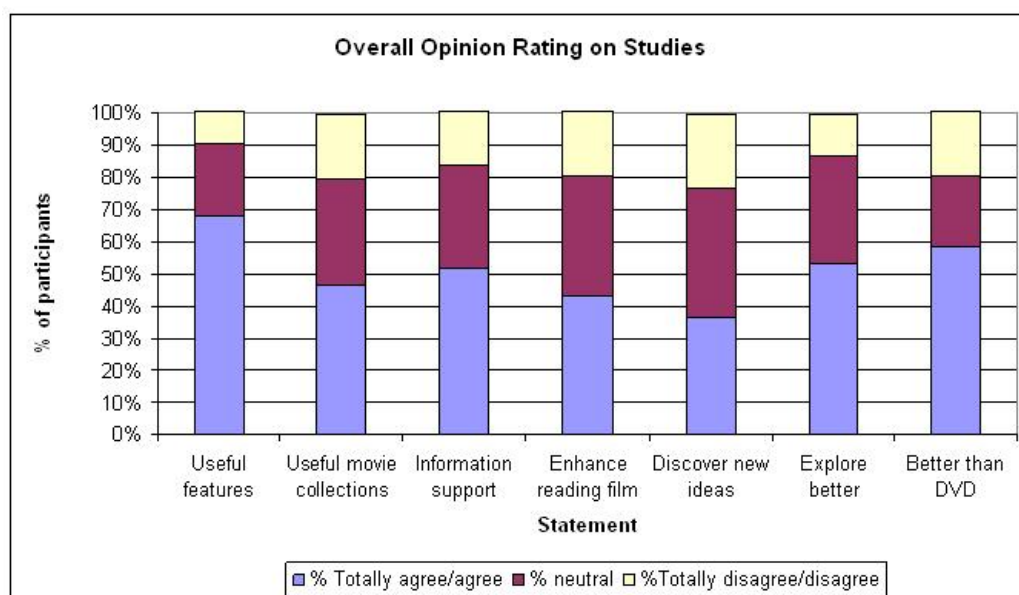


Figure 6.12: Overall perception towards studies

In identifying what are the features or functions students like or dislike most particularly in the system we developed, we gave students a qualitative question on each. Table 6.6 summarises several items mentioned most frequently by users of the system — both likes and dislikes, based on questionnaire responses. From the Table, it can be seen that note-taking was among the most frequently mentioned features as 21 (30%) out of the total (71 mentioned) and this is followed by event categorization (24%), timeline (18%), keyframe view (11%) and playback of the movie (8%). These responses mainly corresponded to the

advanced features that had been adopted in the system.

Features	System-likes	System-dislikes
Note-taking	21	1
Event categorization	17	-
Visual timeline	13	1
Keyframe view	8	1
Movie playback	6	-
Other:		
System design	4	3
Access	2*	3**
Limited movies	-	10
Streaming problem	-	9
Compatibility	-	3
Total Mentioned	71	31

Table 6.6: Frequency of mentioned system features. *convenience, **less coverage

The idea of having the facility to take notes while playing a movie scene seems advantageous. 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 visual and keyframe view 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 as some comments show.

“The timeline feature was probably the most useful feature on the browser” [P44].

“The timeline as it breaks down the film into the various sections - montage, action, dialogue, etc. — this makes it easier to carry out a more in depth analysis of the movie” [P11].

“Timeline. Much easier to navigate through a film ” [P49].

The actual interaction logging supports these comments, as the use of the timeline features of dialogue, exciting and montage was the highest of the frequently used (21%) from the total actual interaction logs, followed by the keyframe view or playing from the keyframe (18%) (see Figure 6.4). An event categorization or segmentation into several

movie chunks (exciting, montage, dialogue) that underlies the timeline and the keyframe list representation also shows positive feedback.

“I found the combination of timeline and event categorization very useful since I can select those parts of the movie that contains the events of interest” [P2].

“I liked the way I could go directly to the exciting or montage parts” [P59].

“The way the film is broken down into all the parts where there is dialogue etc” [P5].

The first five system features reveal the results as we predicted in terms of its potential for higher interactions among students. However, we noticed some other features about the way that the system was liked from reading participants' comments which we categorise under system design and access. For example, in the system design layout, comments were mainly on the clear presentation or organization layout design which makes it easy to navigate. The rest of the frequently mentioned items were on the convenience of access as an online-based application without having to borrow a DVD from somewhere else.

On the other perspectives as shown in the right column of Table 6.6, we also collected feedback on what matters distracted our users (did not like) from the question they were asked on system dislikes. There are very few comments related to system features as there was only one mention found on each for the timeline, notes and keyframe view aspects. We also noticed a system access scalability problem as the most-mentioned issue in feedback on the 'system-dislikes' column. The highest frequently-mentioned issue was about the limited number of movies that were stored in the library which might restrict usage. Other comments we read were such as system compatibility (i.e. MAC user/Internet browsers). The trial version of MOVIEBROWSER2 was only compatible with Internet Explorer and Windows only. The system design (dislikes) was related to the lack of function, like not being able to change the password and the advanced type of browsing did not apply for all movies. Ease of access in the 'system-likes' column, was meant as a convenience factor by users, but in the 'system-dislikes' column, it was meant as less coverage of access.

When comparing the frequency of mentioned items which were either likes or dislikes, we noticed that no issues arose much on the “system design” and “features provided” aspects. Most of the system dislikes were related to the system scalability issue.

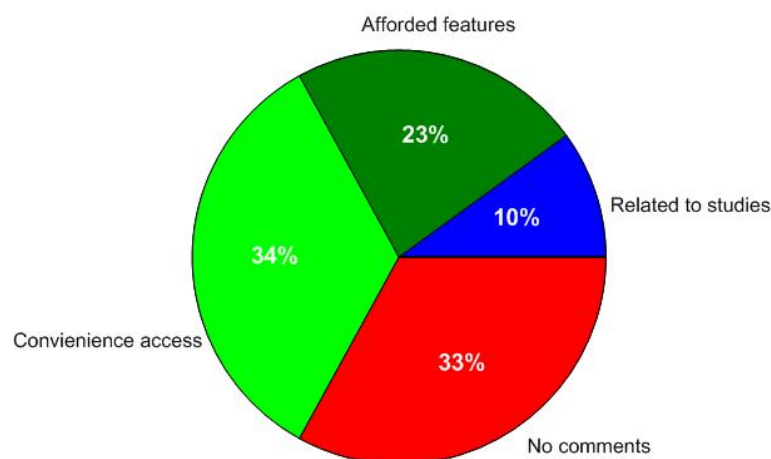


Figure 6.13: System’s potential benefit

We collected qualitative data on students’ opinions on the system’s potential benefits as described in Figure 6.13. As shown in the diagram, 34% of the participants gave comments on the convenience of access (i.e. the fact it was a web application) as a major potential benefit. Developing a movie content browsing system as a web-based tool was one of our main objectives in this study having known that students of film studies’ main problem was to get movie resources for their textual analysis. Among the comments made by participants was (“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” [P41].) and (“The ease of using it rather than searching for DVDs elsewhere” [P32].). These comments imply that there are difficulties in the conventional way for students to get movies such as from the University library or rental DVD shops. The second potential benefit from this kind of tool was from the features that were provided (23%). The fact that MOVIEBROWSER2 presented movie content into specific events and different ways of browsing its content creates some potential advantages. Being able to read and analyse movies with extra ‘help’ as given by

other DVD add-ons like the director's commentary might give participants points to praise as some comments show ("It was useful for jumping to scenes and allowed me to browse faster than if I was using a DVD" [P6].) and ("It enabled me to see the structure of movie as a whole" [P23].). Having deployed the system for the module in Film Studies in the University and also with great support from the lecturers made the participants feel that the system really brings great potential to them. We collected comments from participants as 10% of them praised it in terms of their related studies. The following comments show their thoughts (" I think I benefited from it because it made me 'look' at a movie and helped me to learn how to study a movie more rather than just view it" [P24].) and ("It has help me to better understand the various aspects of "reading" a film and I now feel more capable of doing such" [P10].). The rest of 33% of participants, did not give any comments on the question.

We also asked a question to the students about their overall experiences in using MOVIE-BROWSER2 after the semester was completed. Among these 60 students, 43 of them (72%) said they would use it in the future. We calculated the positive and negative expressions of their overall experiences and we estimate that 19 of them (32%) gave positive expressions and only 4 (7%) gave a negative tone of expression while the rest 37 (62%) did not express either positive or negative expressions. Examples of positive expressions include emotion (i.e. "I'm very happy/discovered ...") and feature usefulness (i.e. "I found it is useful/able to ...") and negative such as system the limitation (i.e. "Not enough/database is too small ..."). Some of the user comments really show what the new tool meant to them as Film Studies students advocated in the following extracts:

"Very happy with the system overall, I think I would like to use it more in the future as I found it useful" [P27].

"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" [P49].

"Brilliant system! Hopefully in the future it will work on MACs and on differ-

ent Internet browsers!”[P45].

“I was able to complete my assignment using some of the skills I had required on this site. The tools provided for reading a film were new to me and my work benefited greatly from these” [P47].

“I got to watch a film that is unavailable on DVD, so that was of huge benefit” [P43].

Finally, we listed the main ‘wish-lists’ based on the feedback. Some of these list elements appear due to the difficulties in the implementation and would not be expected during the development design stage. The list of entries were categorized below:

1. Larger and varied type of movie database (i.e. Irish, Hollywood or Europe)
2. System compatibility (i.e. Internet browsers and MAC users)
3. Improved access (i.e. off-campus)
4. Technicality constraints (i.e. high-speed access)

We also believe that these ‘wish-list’ elements contributed as the main reasons for low usage during the trial. Our users mainly want to access movie resources to be used in their textual essays. Having difficulties in the conventional way of assessing DVDs, means the tool is appreciated much by the students. We did not receive many complaints on the design aspects of the features we provided (i.e. navigation, colour-coding, page layout, buttons, graphics, ‘look and feel’ etc.) and these can be considered as minor things. We believed that for the future, whatever the design for a similar system to this, it could be of potential benefit if these four ‘wish-list’ elements could be improved.

6.1.2 Dealing with Mismatch

We also incorporated a notes feature into MOVIEBROWSER2. Being able to write down comments or ideas at any point of a movie was identified as an important and useful feature from the very beginning when initial student needs were captured (Section 4.2, Chapter

4) and thus incorporated into the system. However, the feature was underused during the deployment period according to the interaction log data (used by 3 students only during the deployed period which is 1% of the total interaction logs). This shows an interesting mismatch between what our users said would be beneficial and what they actually used in practice. Interestingly, in the post-trial questionnaire we got very positive responses regarding the benefit of this feature even though they did not actually use it ! Two of the three participants who actually used the notes feature commented very positively about the feature in their post-trial questionnaire (the other participant did not respond to the questionnaire).

“Notes taking, it helps you keep track of information you are taking down on a particular part of the movie and helps you remember” [P25].

“I liked the note-taking the best as I could take notes quickly and easily during a sequence” [P4].

“Note taking section is very useful” [P39].

“The way that events are organised, the ability to take notes, all movies on the course were available and they are not readily available elsewhere” [P22].

“I like note taking and timeline” [P8].

This is a result that perhaps indicates how conventional usability engineering based on capturing user requirements/wishes is not sufficient in developing a novel interface, and we want to analyse this point further. An email was sent to students asking questions regarding their use (or no use, in fact) of notes. We asked them why they did not use this feature during deployment. We got an email reply from 15 participants. We expected not to receive a higher response to this email inquiry in accordance with the low usage rate of notes during the deployment and bearing in mind also that students will normally participate well when taking part in using the system during their actual module. The reasons for not using the notes feature during the trial was analysed and grouped into several categories and the comments to explain why notes was underused can be found. Possible reasons for this

mismatch can be explained in the following way:

1. “I don’t want my colleagues to steal my ideas” — Privacy issue
2. “I like to write with pen and paper” — Preference for conventional practice
3. “I wanted to do it at home” — Access limitation
4. Interface design issue

“I don’t want my colleagues to steal my ideas” — Privacy issue

The sharability issue gave us a reason for not using this feature as commented by the student.

As some of our participants mention:

“I didn’t use the note-taking feature because I didn’t want everyone in the class to be able to see my notes . . . and also I just generally find it easier and faster to write my own notes” [P14:Follow-up Email].

Notes used for class essays are different from the notes written in a product review on the Amazon website¹ for example or funny comments written on social network websites such as Facebook² or Bebo³. In the context of an online educational tool, students might feel reluctant to leave notes as they don’t want the 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.

A possible solution to this would be to have ‘private’ or ‘public’ switching mechanism for user’s notes, similar to the popular blogging web sites and personal photo/video services (e.g. Flickr⁴ and YouTube⁵) do. By setting ‘private’ as the default and highlighting this fact to the user up-front, the need for privacy in notes will be satisfied and thus users in an educational or competitive setting will be more willing to make use of this feature.

¹www.amazon.com

²www.facebook.com

³www.bebo.com

⁴www.flickr.com

⁵www.youtube.com

“I like to write with pen and paper” — Preference for conventional practice

The second reason for the mismatch between practice and survey was regarding the conventional way of taking notes, which is more preferable. This is the most commented point given by 7 out of 15 responses which includes one of the participants who used the feature during the trial [P8:Follow-up Email]. It includes faster use and convenience to hand-written notes using pen and paper which works commonly in practice as the following comments show:

“Wrote down my notes instead as I felt it was easier when doing my essay on the film I watched” [P8:Follow-up Email].

“For me personally I find it much easier to handwrite notes rather than type as I am faster at that !” [P2:Follow-up Email].

“I tend to write notes down and keep them in files and folders, storing files on computers is awkward for me and I prefer to read from paper than a screen” [P4:Follow-up Email].

“I did not use the notes taking feature of MOVIEBROWSER2 because I preferred to take my own handwritten notes while watching the film. I prefer to write short hand or in a way I will understand best myself and I can take notes down in pen quicker” [P9:Follow-up Email].

“Although I would find note taking feature extremely useful, I often tend to work with notepad or the text pad open, placing my notes there directly to my local drive” [P12:Follow-up Email].

The above quotes indicate that these participants’ main use for the notes was personal and to be used for his/herself alone: if the act of commenting (noting) is only for personal use (i.e. to help write the essay), writing in a physical notebook or writing online may not make a big difference. However, the popular commenting features of a social websites as mentioned above are mainly used to be shared with other users — in which case writing online is much more effective. While ‘convenience’ was voiced as one of the reasons as the

above quotations indicate, this could be inter-twined with the first reason (privacy issue), resulting in little use of the notes feature.

“I wanted to do it at home” — Access limitation

The third reason for mismatch between what users did and indicate they would like to do, was related to system access restrictions that covers on-campus use of the system only. We noticed that even though the advantages provided by a web application only does not necessary provide the facility to users if it is not designed for greater access coverage.

“For me it was the fact that MOVIEBROWSER2 was just available in the computer labs in college that I didn’t use the note taker. If I just kept notes on that, then when I went home to actually write it would have been no use. I just jotted down in a pad as I watched; other than that it was a wonderful service and worked perfectly” [P13:Follow-up Email].

“I found MOVIEBROWSER2 extremely innovative, the fact that it could not be used off campus meant I didn’t use it very much. Also the limited amount of movies available was also a deterrent for me using it for my assignments. I found myself working from home using a DVD of the movie I choose to write about” [P10:Follow-up Email].

It is not certain whether off-campus access would have resulted in more use of the notes feature, but for some participants that was the issue as the above quotations imply.

Interface Design Issue

The rest of the comments were related to some technical or design issues during note-writing raised by users such as the need to pause during playback in order to make notes and some buffering problems occurring during the trial which makes users reluctant to proceed in using it. We discovered that this issue might need to be looked at further more specifically.

“... I would have had to pause the video to take notes” [P14:Follow-up Email].

By having this list of reasons, we could further take more consideration on how we could re-address this matter in future system improvement or similar system development. More specifically:

- Commenting or the notes feature of an online application needs to consider the usage context before deciding whether such a feature can cause privacy issues. For example, providing private/public options for each comment could help.
- Adding more value to a commenting/notes feature may enhance the usage. In doing so, the note-taking action should be viewed in the context of the overall task (in our case, movie viewing). Thus, for example, entering any text on the textbox could automatically pause the playback and at the same time capture the timeframe of the played point of the movie and become the heading of the entered text. Such value-added response may encourage more use of the commenting/notes feature.

We conducted further follow-up short interviews with one of the note-users (the other two users did not respond to our call) and managed to capture her experiences in using MOVIEBROWSER2, particularly the note-feature. The user was from the *CM272 National and Ireland Cinema* module. We found that she relies on MOVIEBROWSER2 for a movie *Korea* (1995) for her assignment resources due to difficulty in borrowing a DVD from the library or other DVD rental specialist. This movie was one of the movies used in the module by the lecturer. She has logged into the system for several days (5-days in total) and viewed the movie a few times (2 times watching the whole movie followed by a few times watching sequences and making some notes). The information we got was tagged with system log data. An example of notes and quotes which seems important to her essay theme writing are shown below:

May 5 2008 10:16am - strong images of eels

May 5 2008 10:16am - “Me and my father, it was always me and my father, ever since I can remember, we were the last to fish the fresh waters for a living”

May 5 2008 10:29am - The stars and stripes seems out of place in the Irish funeral scene

May 5 2008 10:38am - about the Morans: “they’re the ones that betrayed the cause”; “He’s their lackey ”

May 5 2008 10:44am - ”Sometimes I feel too old, like I’ve lived to long in my father’s world. His past goes with my dreams”

We asked her further on the notes feature. According to her, it was so useful and made so much sense because of the way it works (able to note particular part). Privacy issues are not the main problem for her as long as the design of notes provides some options for private/public notes. The only difficulty was the technical problems that gave some constraints as mentioned earlier. This information that we captured gives us some insight into what the students need from this kind of tool in their studies.

6.1.3 Interaction Logging Scheme

As the main purpose of the deployment of MOVIEBROWSER2 was to monitor usage by the students over time, it was important to facilitate the recording of user interaction. The system’s web interface logged each of the major user actions (i.e. log in, select a movie, select an event, play whole movie, pause, add note, and log out) along with user ID and the corresponding timestamp as an entry of log data. The analysis of this interaction log data was then conducted by looking at this set of entries, either filtered by individual user ID or by summing up.

Interaction logging and determining session boundaries is a typical problem, not a new issue and an on-going topic of research especially in the context of Website usage monitoring [33, 17], as it is impossible to know whether a user was doing other activities while

viewing the website in concern, whether she left the room entirely with the website still on the computer, and so on.

In determining the session boundaries for MOVIEBROWSER2 log data, we used the following scheme: determining the start of a user session was simply by selecting an entry that starts a new user action (and its action is 'log in' in all cases). We treat the data as a continuous session of watching movies to simplify the calculation. These user actions mainly consisted of list of actions related to the process of watching a movie (i.e. start session → user select movie → either play/browse/navigate/take note → end session). Each user action was identified based on the timestamp of the start and the following actions where the total time were calculated. In certain cases of user entries, where there was a time interval of over 2 hours between adjacent action entries by the same user, it was revised into 120 minutes (2 hours) only. A user's usage time in between each entry that does not exceed 2 hours remains the same. We set 2 hours as the overall length of the movies in the system and a threshold in the user actions boundary: a user might do other things or leave the room for a couple of hours in between the watching process and continue to watch later. In short, a session was calculated as a daily basis interaction from start until end with each timestamp entry was calculated and summed up. The exact calculation of session determination is impossible, but with this scheme at least we can get a rough picture of the overall and user-specific usage.

6.2 Experiment 2 - Analysis of User Performance

This section discusses the findings we obtained after the deployment stage of our experimental evaluation, reported earlier. The analysis was based on data collected from 7 students who enrolled in the *CM524 Film Theory and History* module given by Dr Pat Brereton. We captured their overall experiences via tasks given and questionnaires. In the deployment experiment described in Section 6.1, we use an explorative approach in discovering our findings. In the experiments reported now, we use an explanative or predictive

approach that is guided by our underlying experimental questions in discussing our findings. More objective measurements were thus derived and used for this experiment which we could not get from the first set of experiments, and so these second sets of experiments are complimentary to the first.

6.2.1 Findings

We divide our investigations into two parts as below:

1. Part 1 — Movie Screening
2. Part 2 — Controlled Lab Experiment

Participation in these experiments by the students is included as one of the lecturer's teaching methods for the module. During the semester, the module consisted of lectures and screenings each week along with 1-hour seminars or workshops which begin with a textual analysis exercise, followed by seminar readings and presentations of book or chapter reviews [8]. For the rest of the explanations in this section, we will refer each participant in the experiment as U1–U7.

6.2.1.1 Part 1 — Movie Screening

We began this experiment with the screening of the movie *American Beauty* (1999). This first part of experiment was performed a week before Part 2 took place. Our participants were recruited from the module CM524 *Film Theory and History* (Masters level). The expanded session took over 2 hours and 30 minutes and was carried out in the students' classroom, an environment familiar to them. The movie was played using a DVD player that is available in the classroom with a large data projector. The environment was like watching a movie in a cinema (e.g. the light was turned off) and some refreshments were provided during the screening. This scenario was created to replicate students' real activities in watching a movie at home in a relaxing environment. We did not reveal the movie title to students until the day of the experiment in order to reduce any knowing effect. From our

observations, everybody seemed to concentrate and enjoyed watching the movie. This can be seen from participants' facial expressions and reactions (e.g. laughing at certain funny parts and their sitting behaviour). In general, participants were very pleased and inspired during the screening session.

We collected some data from a pre-task questionnaire. Table 6.7 summarises participants' characteristics such as demographics, movie watching tendencies and their level of computer experience. As can be seen from the Table, participants comprised four females and three males. Four of the them are older than 26 years and the rest are between the ages of 21 and 23 years with a variety of background areas. In terms of the overall tendency to watch movies, two participants watch more than 10 times a month, one participant watch on average 3–4 times in a month while the rest watch on average between 5–9 times. All of them have watched *American Beauty* once or two times before the screening session was conducted. On this basis, it can be assumed that all participants had a similar known effect from the chosen movie. All participants have the same level of computer experience (moderate) except for one participant who has a higher level compared to the others.

UserID	Gender	Age	Bg. Education	Watch movie (#month)	Watch it before*	Comp. exp.
U1	F	>26	Psychology	≈ 5–9	Yes	Moderate
U2	M	>26	Communications	>10	Yes	High
U3	M	21–23	Communications	>10	Yes	Moderate
U4	F	>26	Journalism	≈ 5–9	Yes	Moderate
U5	F	21–23	Art English & History	≈ 3–4	Yes	Moderate
U6	M	>26	Humanities	≈ 5–9	Yes	Moderate
U7	F	21–23	Art English & History	≈ 5–9	Yes	Moderate

Table 6.7: Participants' characteristics for the movie *American Beauty*(*)

In the pre-task questionnaire we captured participants' preliminary opinions on technology that could be useful in their film-reading tasks and for this we used Likert point-scales, varying from 1 (Very Useful) to 5 (Not Useful at all) as shown in Table 6.8. As can be elicited from the table, a majority of participants score for a higher usefulness rating (either

Statement	U1	U2	U3	U4	U5	U6	U7	Mean
watch movie online	1	2	2	2	1	1	2	1.57
use of DVD extras	1	1	1	2	2	1	2	1.43
browse specific scenes	1	2	1	2	1	1	2	1.43
non-linear scene jumping	3	2	1	2	1	1	3	1.86
use of technologies	1	1	1	3	1	3	2	1.71

Table 6.8: Likert results on pre-task statements. 1(Very Useful) – 5(Not Useful at all)

Very useful or Useful) in all statements. Being able to watch a movie online is perceived as useful instead of borrowing a DVD from the library. Similarly, add-ons that are available in any DVD were perceived as useful in assisting students in carrying out their task which indicates that any extra information that could help them accomplish their task is useful to have. We asked questions on the usefulness of being able to browse through a specific scene of a dialogue, exciting or montage section in a movie and the responses given were such that it was perceived to be useful in their studies. There are a few scores can be seen on the rating of 3 (Not sure) especially for the last two statements. One of the statements is regarding the usefulness of being able to do non-linear scene jumping during watching and playing a movie. The last statement is regarding the use of added technologies in the students' studies in general with some examples given such as scene categorization, movie content searching, characters or text search, etc. These statements were perceived as useful in their studies with means of 1.86 and 1.71 respectively. The results of the point-scale 3 might imply that these students still could not have imagined having these technologies available to them in their studies as they always get used to the conventional ways of completing their film-reading tasks, namely using a DVD. None of the participants' scores are negative (Not very useful to Not useful at all). It is worth noting that this batch of students were not using the MOVIEBROWSER2 system in their module, as had been used by the previous groups of students during the deployment stage. This batch of 7 students was only introduced to the MOVIEBROWSER2 system during the lab experiment, so there were no pre-conceived ideas or views on it.

We also captured information prior to the lab experiment on how participants normally

play DVD movies in a conventional way. Participants indicated that they normally use a DVD player with a TV when playing a movie but sometimes they also use media player software on a laptop or PC (e.g. Media Player, QuickTime, VLC Player, etc.).

As a re-cap what we learned from this screening experiment was that, we can make some generalization of participants on their demographic data, level of particular movie knowledge and preliminary opinion towards the used of technologies in their studies. Our findings show that participants have homogeneous characteristics, initial knowledge and no major outliers were found. We replicated the process of reading a movie before the control-lab experiment could be performed and made it as real a scenario as we can.

6.2.1.2 Part 2 — Controlled Lab Experiment

Our primary objective in doing this experiment in a controlled lab, as stated in Chapter 5, is to measure objectively the amount of ‘benefit’ that the MOVIEBROWSER2 could provide as compared to the conventional way of browsing movies, in terms of users’ perceived satisfaction levels, the system’s usefulness and the general performance of students when using the interface.

In this second part of experimental setup (a week after screening the movie), participants will complete the reading tasks of pre-selected sequences in the movie *American Beauty* (1999). Participants will use either the MOVIEBROWSER2 or the DVD player interface. One participant could not attend but participated in the other session. The way they are being divided is using the within-group design as described in (see Table 5.2 in Chapter 5). For the MOVIEBROWSER2, the interaction logs were captured automatically by the system while for the DVD interface, they will be observed by volunteer researchers from our research who took notes on what they click (buttons pressed) and their overall behaviour in accomplishing the task like writing notes on paper then typing essays in WORD. Some guidelines were given to the colleague researchers before the session especially on what they need to observe such as the number of clicks participants do on the player interface (e.g. play, slider bar, pause, stop and etc.) and report overall user actions in accomplishing

the tasks in a pre-designed form made by researchers (see Appendix). Only at this part, the researcher get helps from the colleague researchers in collecting data, thus ‘we’ denoting the researcher and a group of people. Each task needs to be completed within 30 minutes. Three CCTVs were used (with participants’ permission) to record the session. We could only capture a few participants only due to unavailability of video cameras. The CCTV footage was used to verify the observations made by colleague researchers.

These experiments were mainly carried out to answer our main experimental question, which can be phrased as “Do students who use our newly-introduced technology (in the software tool) get more ‘benefit’ compared to their conventional way of performing their work task?”. To answer the main question, we formulate a number of sub-questions as the following:

- Q1. Do students make use of the alternative access features afforded by MOVIE-BROWSER2 and spend less time in completing the essay-writing task ?
- Q2. Given the same amount of time, is the ‘outcome’ for those using MOVIE-BROWSER2 better or worse than those who use only a standard DVD media player interface for browsing movies ?
- Q3. Do the students who use MOVIEBROWSER2 have a higher level of satisfaction than those using only a standard DVD media player ?

Q1. Do students make use of the alternative access features afforded by MOVIE-BROWSER2 and spend less time in completing the essay-writing task ?

In answering this question, we examined the user log data from both system variants (DVD and MOVIEBROWSER2 interface) for each task. Data were collected from MOVIEBROWSER2 on the interaction clicks and from the observation sheets for the DVD interface where colleague researchers manually recorded the number of interaction clicks made and the button pressed (i.e. slider bar, stop and etc). The sessions were recorded (with

student permission) using CCTV as part of the experimental protocol. A CCTV content was then used for verification in this process and in determining participant activities during the session.

Table 6.9 describes the actual log data collected on both tasks that are extracted from the log files and from the colleague researcher observations. As can be seen from the Table, when the task was carried out using the DVD interface, highest interactions were on the slider-bar for both tasks. On the other hand, while using MOVIEBROWSER2 the interactions were no longer at the slider-bar but shifted into *event-keyframe* that referred to playing the scene from the keyframe view and also from the respective timeline bar either *Dialogue* or *Montage*, depending on the question. Figure 6.14 describes the interaction percentages in the process of analysing, browsing and playing movie content both using standard player and MOVIEBROWSER2 on both tasks.

	TASK 1		TASK 2	
	DVD	MOVIEBROWSER2	DVD	MOVIEBROWSER2
Dialogue	0 (0%)	8 (25%)	0 (0%)	2 (3%)
Exciting	0 (0%)	2 (6%)	0 (0%)	0 (0%)
Montage	0 (0%)	2 (6%)	0 (0%)	24 (37%)
event-keyframe	0 (0%)	14 (44%)	0 (0%)	27 (42%)
slider-bar	52 (58%)	1 (3%)	59 (72%)	2 (3%)
pause button	16 (18%)	0 (0%)	11 (13%)	0 (0%)
play button	13 (15%)	0 (0%)	11 (13%)	2 (3%)
slow button	6 (7%)	0 (0%)	1 (1%)	1 (2%)
faster button	1 (1%)	0 (0%)	0 (0%)	2 (3%)
full screen button	1 (1%)	1 (3%)	0 (0%)	0 (0%)
stop button	0 (0%)	4 (13%)	0 (0%)	4 (6%)
volume-up button	0 (0%)	0 (0%)	0 (0%)	1 (2%)
Total	89	32	82	65

Table 6.9: Interaction logs for a given tasks. Notes: Dialogue, Exciting and Montage referred to timeline bar; event-keyframe referred to play scene from keyframe view

As shown in the figure, the interactions were mostly via the slider bar when using the conventional DVD while in the MOVIEBROWSER2 tool, we found far less usage of the slider bar. In the MOVIEBROWSER tool, the process of navigating scenes has been trans-

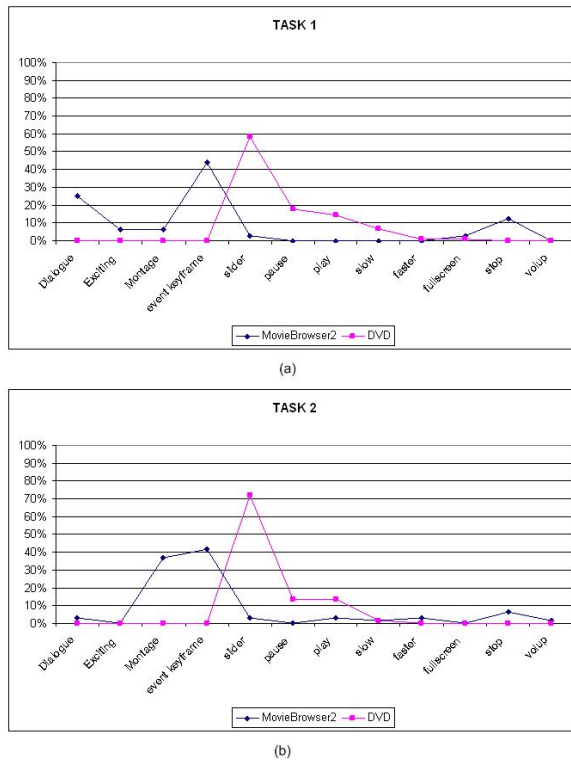
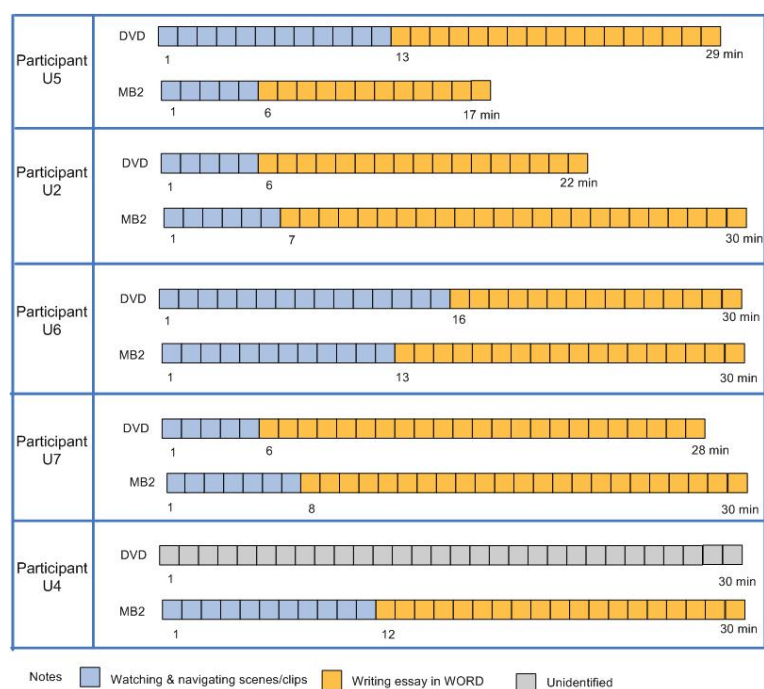


Figure 6.14: Interaction logs on (a) Task 1 (b) Task 2. Notes: On x-axis, (Dialogue, Exciting and Montage) referred to each timeline bar, event-keyframe referred to playing scene from keyframe view

formed into one which uses the added features from the keyframe and timeline browsing. It is worth mentioning here that Task 1 referred to one dialogue scene in the movie while Task 2 was related to two montage scenes, consisting of different background music used by the movie director in which participants need to compare and contrast. Therefore, the total interaction clicks as shown in Table 6.9 in Task 2 shows double (65) as compared to Task 1 in MOVIEBROWSER2 (32). The interactions were also focused on the respective timeline bar.

We also determined for five participants', their time completion on each task and their overall time division of activities including watching and navigating scenes/clips and writing their essay as a WORD document. We refer to the CCTV content in this process and due to limited number of devices we could not plot for the other two participants. Figure 6.15(a) and 6.15(b) show time division and time completion on both tasks for the all par-

ticipants. As can be seen from both the diagram and table, the completion time when using MOVIEBROWSER2 is longer or almost to the maximum for most of participants as compared to standard player DVD that shows some participants finished the task earlier. Only one participant [U5], finished the task with MOVIEBROWSER2 earlier at 17 minutes.



(a)

Participants	U1	U2	U3	U4	U5	U6	U7
Standard Player (min)	27	22	26	30	29	30	28
MovieBrowser2 (min)	30	30	30	30	17	30	30

(b)

Figure 6.15: (a) Time division spent on tasks, (b) Overall time completion in minutes

The findings above tell us that our results only answer the research question in part:

- Conventional DVD interface — usage of the slider bar seems higher and is used as the main interaction during navigation of movie content. This appears to be the ‘only way’ to accomplish the task, working with other support buttons such as pause/play/stop etc. This feature is useful for blind-seeking of movie content.

- MOVIEBROWSER2 interface — participants make use of the alternative access features in completing the task. The process of navigating, and playing clips can be seen from the interaction log clicks captured on the added features and not utilizing the standard button such as slider bar. For example, in looking for music background to appear in the scene, a montage timeline bar is used and further browsing is enhanced using the particular shot keyframe view instead of using a slider-bar.
- Time completion — time taken to accomplish the task when using the MOVIEBROWSER2 interface was relatively longer than when using the conventional standard player even though it was predicted to be faster initially.

Q2. Given the same amount of time, is the ‘outcome’ for those using MOVIEBROWSER2 better or worse than those who use only a standard DVD media player interface for browsing movies ?

In order to answer this question we performed a qualitative analysis and looked at the quality of the essay results from students who completed an assignment as part of this module. This result outcome was chosen for analysis mainly to provide a general overview of participants’ performance of some task as a result of having used either a DVD or MOVIEBROWSER2 interface. Participants’ essays were marked based on a known, pre-defined answer scheme and were categorized into three quality groups or levels, and these categories were formally approved by the module lecturer (i.e. ‘Very Good’, ‘Good’ and ‘Basic’). Table 6.10 represents the results of the essay quality evaluation. As can be seen from the table, participants [i.e. U2, U4, U6] who used MOVIEBROWSER2, and then the standard DVD player stay with the same essay quality. Participants [i.e. U1, U3, U5, U7] who used the standard DVD player, followed by MOVIEBROWSER2 get a better essay outcome. This results shows there is some increased performance relatively either from ‘Basic’ to ‘Good’ or ‘Good’ to ‘Very Good’.

In order to provide more supporting evidence, we look further at the essay quality in

	Task 1	Task 2
Participant	Standard Player	MOVIEBROWSER2
U1	Basic	Good
U3	Basic	Good
U5	Basic	Good
U7	Good	Very Good
Participant	MOVIEBROWSER2	Standard Player
U2	Very Good	Very Good
U4	Very Good	Very Good
U6	Basic	Basic

Table 6.10: Essay quality output

a different way. The essay remarks also show interesting feedback given from the module lecturer. Most of the remarks given on essays after using MOVIEBROWSER2, from the lecturer’s point of view show that participants’ give more deep and critical essay analysis. In the essays, we are able to find these expressions or statements from a variety of analysis which makes the essay quality better as for example:

- Point of view: (“It might suggest/reflecting.../I think.../noted that.../The director succeeds in given.../tells us ...”)
- Compare and contrast scene: (“Elsewhere in the film.../The scene is preceded by.../As the scene progress.../Directly contrast the earlier scene...”)
- Use of different techniques: (“The camera cut relatively fast.../Music helps to distinguish.../The pace of the scene is faster, hinting an explosion to come.../Non-descript colours (grey, brown etc) that complimented with music...”)

An essay that was produced using the standard player generally has the basic type of description of scenes. The essay quality was limited in terms of variety of expressions, points of view and lack of detailed explanations. Table 6.11 elaborates more on the remarks on each essay. From the Table, it shows that students who completed the task using MOVIEBROWSER2 generally have solid remarks that represent richness or variability in the written essay. On the other hand, when using the standard player, the remarks are basi-

cally only basic explanation details on sequences. We are not comparing on each individual participant in this experiment, but referring to the individually produced outcomes from a given task.

	Standard Player	MovieBrowser2
U1	<i>Not much ... more to scene description.</i> Basic	<i>Solid enough but would like have liked a bit more detail [specific of lyrics and music...].</i> Good
U2	<i>Very good comparisons between the two scenes... would have liked a little more description of Lester's dream state as define by the 'off key' music.</i> Very Good	<i>Lots of good stuff from different perspective with excellent conclusion.</i> Very Good
U3	<i>Relatively basic scenarios description.</i> Basic	<i>Solid and good analysis [good on detail of music instrument and effect].</i> Good
U4	<i>Well done/describes.</i> Very Good	<i>Use of several techniques to express this [i.e. camera cut/editing pace]... solid description and compare other parts of the film.</i> Very Good
U5	<i>Describes the scene and lacking of explanation.</i> Basic	<i>Good re string instruments used to express sexual interest ... solid and good contrast of scenes.</i> Good
U6	<i>Lack of details.</i> Basic	<i>Basic description but use of camera techniques in the explanation such as shots mid/long and editing pace.</i> Basic
U7	<i>Good detail but not really well structured.</i> Good	<i>Good contrast and very good drawn conclusion – describes the music effect.</i> Very Good

Table 6.11: Essay quality remarks

By analyzing at the essay outcome and the remarks given by the lecturer in a qualitative way, we answered the experimental question and reveal that the outcome (essay quality) of those using MOVIEBROWSER2 are better or at least stay at the same level (not worse) than participants' current performance. In relation to this as the findings found in the previous question, most participants who get better essay outcome takes longer time to complete the task in MOVIEBROWSER2. We explain this interesting phenomenon from another domain perspective in our discussion section.

Q3. Do the students who use MOVIEBROWSER2 have a higher level of satisfaction than those using only a standard DVD media player ?

Satisfaction were measured by calculating the mean scores from the questionnaire given in the experiment. The level of satisfaction (e.g. 'high' or 'low') will be explored and determined as overall by comparing from the two system interfaces. In preparing to answer this question, we captured participants' responses to using both interfaces using semantic differentials and Likert point-scales of 1–7 (the higher values are better) [28, 72] for a variety of questions from post-task questionnaires. We used a paired sample t-test [78], for the statistically significant differences of means scores with $p \leq 0.05$. However, in this explanation, we would not emphasize the significance difference due to the small number of sample users. We reported the means and standard deviation (SD) on each system variant. \bar{A} and \bar{B} denote the means for standard media player and MOVIEBROWSER2 interfaces respectively. \tilde{A} and \tilde{B} represent the standard deviations for each. Participants perceived satisfaction levels on the system variants are more towards MOVIEBROWSER2 with generally higher mean scores in all aspects. This is represented in Table 6.12 where all higher mean scores can be seen on \bar{B} for all questions asked. The p values are shown in the last column.

Participants considered MOVIEBROWSER2 to be significantly more *easy to use* and *effective*. The scores for the other differentials: *easy to learn*, *satisfying*, *stimulating*, *novel*, *intuitive* and *helpful* were generally higher for MOVIEBROWSER2.

Participants felt MOVIEBROWSER2 can significantly help in : *analysing movie efficiently*, *explore movie scenes efficiently*, *enhance reading ability*, *produce better essays*, *discover new ideas* and *focus*. There is no significant difference in the statement *complete task quickly* which reflects our finding in the previous experimental question that shows they took longer time to complete the task when using the newly-introduced tool.

In affirming the overall satisfaction results shown in the Table, we asked participants how they felt about the task they performed in the experiment using both system variants. Responses from students favoured MOVIEBROWSER2, as can be seen from the extracts below:

System		\bar{A}	\tilde{A}	\bar{B}	\tilde{B}	p
Differential	easy to use	5.43	1.27	6.29	0.76	0.017
	easy to learn	6.00	1.15	6.29	0.95	-
	effective	5.14	1.68	6.43	0.53	0.049
	satisfying	5.14	1.57	5.29	1.50	-
	stimulating	5.14	1.57	6.00	1.15	-
	novel	4.57	1.72	6.43	0.53	-
	intuitive	5.00	1.41	6.00	0.82	-
	helpful	5.14	1.77	6.29	0.76	-
Likert	access movie content	4.14	1.77	6.14	0.69	-
	analyse movie efficiently	4.00	2.31	6.29	0.49	0.022
	explore movie scenes efficiently	4.00	2.24	6.57	0.53	0.019
	complete task quickly	4.71	2.06	5.86	0.69	-
	enhance reading ability	3.86	2.19	5.71	0.95	0.045
	better outcome/essay	4.57	1.27	6.00	0.82	0.008
	discover new ideas	3.71	2.36	5.29	1.38	0.042
	focus	3.71	2.50	5.29	1.38	0.033

Table 6.12: Post-task results for system variants

“If you are looking for a particular scene (i.e. dialogue), you can narrow the search parameter by selecting a category, making it quicker to complete the search”. [U2]

“MOVIEBROWSER2 is more useful because you could browse frames of the film together making it easier to contrast scenes. The DVD media player took longer to find scenes — it encouraged more random watching”. [U4]

“ MOVIEBROWSER2 is easier to use and (provides) more information”.[U6]

We further asked participants about the specific features provided in each system variant in relation to the task of reading a movie. Results as shown in Table 6.13 point to higher mean scores (1 to 7, the higher the better) of perceived satisfaction for the added features in MOVIEBROWSER2. Some comments were extracted from participants’ responses in relation to these specific features.

	System	Means	SD
Standard player	Playback	5.71	1.38
	Overall features	4.71	2.63
MOVIEBROWSER2	Timeline	6.43	0.53
	Shot keyframe view	6.57	1.13
	Scene categorizations	5.86	1.07

Table 6.13: Post-task results: Browse features

“[DVD: Playback] Only really useful for playback, being able to manually move the playback scroll (or button of screen) is fairly useful”. [U3]

“[DVD: Overall features] You must follow a linear pattern when browsing through the movie. It takes longer to remember where scenes are”. [U4]

“[MOVIEBROWSER2:Timeline] Users would have a sense of when certain events in a film occurred. They can then jump into it easily”. [U4]

“[MOVIEBROWSER2:Shot keyframe view] Ease of access. Repeat with ease”. [U6]

“[MOVIEBROWSER2:Scene categorizations] It helps separate scenes into categories that are helpful when studying film”. [U7]

Finally, we asked participants the question of which system they would prefer for their film reading task as part of their studies. Each of the 7 participants chose MOVIEBROWSER2 as the favoured tool to be used. This question was asked mainly to gauge participants’ future intentions.

“It was conducted efficiently. The MOVIEBROWSER2 is very helpful. I would certainly use it again”. [U7]

“I would like to use the MOVIEBROWSER2 again !”. [U4]

These findings answered our third sub-question with results that show participants have a higher level of satisfaction from MOVIEBROWSER2 as compared to the conventional DVD-like method of browsing movies.

6.3 Discussions

Deployment Effort — The results from our deployment trial established the usage pattern on how the students of Film Studies used the newly-introduced application that adopted a multimedia technology particularly in movies and acknowledged what this tool meant to their context of use. The aspects of usage monitoring we used ranged from user assessment, features assessment, usage pattern over time and user opinions and experiences. Out of 268 students, 107 (40%) used the software application for about 86 hours duration during the trial. The access rate for the application looks low in terms of usage but when considering some limitations such as less coverage within campus and restricted to a specific technical environment in which it was deployed (i.e. playback using VLC and compatible with IE only), these numbers show some great effort from the students in trying to use a newly-introduced tool in their studies. Comments received from students also reflect this matter. Some students prefer to access from home and we consider how these limitations affect the low usage from the students. We believe that this does not indicate a flaw in the experiment with 60% of students not using the system. Researcher had no control over the fact that streaming outside DCU which was the main reason for some students not using it. In fact, improved access coverage outside campus for the future was among the suggestions given by the students in this work.

Having an opportunity to use an online application related to their studies was among the most appreciated convenience factors from students as comments extracted from the questionnaires. Students have difficulties in getting the resource materials from the library or any rental DVD shop. By introducing an online application which is usable and handy, they might find this situation as ‘work pleasure’ as compared to difficulties in the prior conventional way. In other words, their physical effort will be reduced in performing the work task. We relate this phenomenon into a theory in work and organizational psychology as flow, identified by Csikszentmihalyi [22] that mentioned someone can experience flow when the technology being used can ease the burden of their physical effort. This is one of the many ways of achieving flow. We can see from the positive expressions on overall

experiences in using the software application that reflected to students 'pleasureness'. 43 out of 60 students (72%) that responded to the questionnaires would like to use the system again in the future.

Most of all movies stored in the application were accessed by the students except a few including short movies (less than an hour duration). It was difficult to identify why some movies were accessed more while some movies were not accessed at all. Does it mean movies that have not been accessed (i.e. *The Visit* or *Eat The Peach*) do not appeal to them or movies that are most accessed (i.e. *About Adam* or *Shrek*) are more popular? It is worth mentioning that the movie choices will depend on students' preferences. They can choose any type of movie and the most important thing is the analysis (i.e. how students interpret the meaning etc.) that are looking for by the module lecturer. With this rationale, we believed the access pattern on the movie choices will depend on individual preferences. On the other hand, Irish movies were accessed more than contemporary Hollywood movie which indicate to the limited resources of Irish movie collections and difficulty to get from the library or DVD rental shop. While for non Irish movies, students especially from the other module (CM135 *Analyzing Media Content*) will have more alternative resources as there will be no restriction in their assignment.

The time spent by students on the 'Advanced' page that provides features for an enhanced type of browsing scenes was found much longer than the 'Basic' page that only can play the movie like a conventional DVD player using standard navigational buttons. This might suggest that students are more engaged with the afforded features provided in the software application. Positive comments on the features provided such as timeline, keyframe browsing and event categorization, supports that students like those features with perceived benefit in their studies, other than the captured logs click which shows higher interactions. From the other domain perspective, this characteristic reflects engagement which also includes the flow or play concept. The design layout might influence the play element in which the movies were categorized into three types of events and can be visualized in the form of a timeline and keyframe shot view. Measuring flow (timelessness) or play elements

in the software application that incorporates novel technology particularly in video from real users (Film Studies) could be an interesting future research path. Some previous work has been carried out in this area such as on play elements and learning [19] and flow in the games application [18]. In this work, we only provide the rationale for this phenomenon as found in our findings. On the other hand, movies that were listed under the basic category of browsing were accessed and viewed by students for 43% of movie access frequencies, while 57% were for the movies under the advanced category. This phenomenon might imply that students still lack resource materials and want to access conveniently as an alternative for not going to the library. Students had been facing difficulties in borrowing a DVD from the library in which the loan material is only available for one day.

The plotted graph on usage patterns over a semester shows heavy usage around two weeks towards the assignment deadline indicating how the new developed software application managed to relate with end-users' activities as they have to follow priority from other modules. These usage patterns also denotes that some students rely on the tool in carrying out the assignment. For example, one student reported that she relied on the tool for the movie *Korea* (1995) which was difficult to get from the library or rental shop. The 'usage' pattern over time as found in this software application shows that it is usable to the students.

User opinion on what system features they like and do not like suggested that they have been experiencing using the tool, thus can indirectly evaluate the system. A user 'wish-list' collected from the qualitative data showed they try to 'propose' more conducive ways in achieving optimum work pleasure in the future (i.e. larger movie database, improved access, system scalability and technicality constraints) which shows an indication of their future intention. The findings especially from the positive user comments and overall statements given regarding learning perception opinion on the system also revealed that the implementation of the application that incorporates novel technology are useful and beneficial. For example, 58% total agreement given by students in the statement ("Tool helped them to analyse the scene better than a DVD") while for the other statement ("The features provided in the tool were useful in my studies") have 68% of total agreement. Apart from

that, the mismatch that was found after the deployment stage when some features (i.e. note-taking) was underused was further investigated and some design suggestions were provided in the future system redesign.

From the procedural design and development perspective, going through all the usability engineering process is worthwhile as the findings from real usage data on how students used the system and what it meant to them ‘proved’ that the tool was usable and useful. We found that by following all the procedural ways in developing the system makes the whole process more approachable and the artefacts we developed were acceptable by the users. Various methods used during the process such as focus groups, usability testing and questionnaires provide a user-driven data requirement. In fact, the deployment (i.e. part of the procedural process), has validated our work in assessing usage and issues (i.e. mismatch issue) were identified. An interface is an important element when a user wants to interact with a computer in performing a task. Following some procedural way of Usability Engineering is worthwhile and at least the developed artefact already consists of these requirements of being usable and could provide a positive user experience as the results show from our findings. We also learned that following the procedural way consumes time as it involves repetitive cycles but the process itself informed the insight of every stage needed in developing a system which has not yet been used in practice.

Controlled Lab Experiment — In this experiment, we examined or investigated objective measurements to elicit more in-depth information on the ‘benefit’ the students would gain by using a newly-introduced software application in the context of their work task (essay textual analysis). The findings from the essay outcome revealed that there are slightly an improving or better results which is also supported by the remarks from the module lecturer that shows students have more variability (more opinions, expressions) in their written essay when using MOVIEBROWSER2. This is a better indication from the lecturer’s point of view. It would be better if this perspective can be further explored to more detail on the improvement from the student’s point of view particularly in their learning. Due to

time limitations we could not explore this matter. We understand that in order to measure performance of a movie browser interface, many factors need to be considered. The link between ‘cognitive’ and ‘pedagogic’ learning and any measurement of the deepening of students’ perceptions of the audio-visual stimulus, using technical or structured approaches, are of course difficult to *prove* in terms of any direct benefits. Any improvements also so much depend on the aptitude and linguistic dexterity of individual students and their motivation. These issues will give another interesting perspective and motivation for future related research.

Our findings also show that satisfaction levels are higher after using the newly-introduced tool with higher mean scores in all aspects of statements given as compared to when using a conventional standard player. User preferences and subjective opinions reflected from the comments favoured MOVIEBROWSER2. All 7 students intended to use the software application in their future learning. In discussing user perceived satisfaction in an experimental setup, especially from the perspective of student learning, we might have expected mixed satisfaction levels as the outcome does not always mean higher satisfaction when a new technology is introduced. In some cases, even though a new system with new technology is introduced, users can still prefer their old ways as their tendency or practice does not change easily. Many factors influence such results. For example, previous studies in e-learning and work carried out in [81, 59] reported that students are less satisfied with the use of a technology in learning due to them already being accustomed to their traditional ways or experiencing frustration or worry during online learning. On the other hand, other studies as in [40, 3] found a higher level of subjective satisfaction from students with a new e-learning tool compared to the traditional classroom learning. These scenarios also reflect our mismatched findings in the notes feature where one of the reasons for the mismatch that we found is that students are already used to taking notes in a conventional way using pen and paper.

Besides expected findings from the focus lab experiment in terms of better performance in the essay outcome and student’s perceived satisfaction level, we also saw surprising find-

ings that show the time taken to complete the task when using the newly-introduced software application is longer than the conventional way for the majority of students. The results of longer time taken to complete the tasks might indicate that students are engaged with the activity being performed using the newly-introduced tool, thus they will find time flies very fast as they are fully absorbed with the activity. In learning, these actual numbers represent the meaning of longer time or engagement (similarly to lecturer's feedback/remarks that show engagement, thus it was used as a 'measurement' in the essay outcome). Looking from this perspective, we cannot say that by having used the newly-introduced tool that afford extra features for navigating and browsing movie scenes in carrying essay analysis, the task can be completed faster than the conventional way. Again, we interpret this phenomenon from another domain perspective, the sub-area of psychology which is flow theory that reflects engagement in carrying out an activity. Flow Theory according to Csikszentmihalyi [21] [pg. 4] is "The state in which people are so involved in the activity that nothing else seems to matter; the experience itself is so enjoyable that people will do it even at great cost, for the sheer sake of doing it". Learning environments that are conducive to flow experiences may help people to achieve a positive outcome [24]. Flow is generally reported when someone is doing her/his favourite activity such as cooking a good meal, or gardening and also often happens at work. Any activities can produce flow provided the relevant elements of flow are present making sure that the conditions of flow are present such as clear goals, time flies, skill balanced to action opportunity and the other remaining conditions [22]. Thus it can also occur during this experiment where the features provided in the application might influence them to navigate and browse movie clips better. We also found from the interaction logs that the advanced interactions provided by the technology for automatic video content analysis that are categorised into several meaningful chunks of related scenes (Dialogue, Exciting and Montage) and underlies the design features (i.e. timeline and keyframe view) provided an alternative for the user for navigating and browsing the required scenes in a more structured and focused manner. The overall higher mean scores in the system aspect indicates students' preference (e.g. *focus*, *discover new ideas*,

stimulating, enhance reading ability).

We cannot claim from this finding yet that this phenomenon shows our design influenced the engagement or playing element which then brought into a sense of feeling intrinsic motivation in completing their assignment from this experiment. We reasoned that they are immersed with the tool from the feedback we collected either from written comments or verbally informal responses. Some students did request permission to use the tool after the experiment and are very interested to learn more. We found evidence from this finding they are more engaged. Our assumption here relates to the learning theory of engagement and flow as described in the psychology field. Having completed the task longer than the conventional way may look as a 'failure' in terms of scientific computing where it should be faster to complete, it does show interesting and good evidence from the perspective of the learning process for a newly-introduced technology.

The flow theory mentioned above, also holds an assumption and principle that humans can be influenced to do something driven by certain basis [15] which in this case they want to get better marks. The focus experiment was assigned as module assignment by the lecturer, thus there is students' commitment in accomplishing it as best they can. Their motivation in producing a good essay analysis might drive their efforts.

Another similar finding in relation to longer time that is taken when using a new technology was reported by Smyth and Cotter [95]. This work shows how a personalized navigation technique applied into WAP technology helps mobile end-users to filter information and navigate web content better. From the user point of view, the technique applied makes it easier to use, thus leads to increased usage. In the findings, they found that for every 1 second of navigation time saved, users invest an additional 3 seconds in accessing content, which provides strong practical evidence for improved user experiences. Looking at this work from the perspective of engagement, it might also be suggested that users are engaged with navigating activities while having enjoyed the process with the help of the technology and thus motivates them to explore more. The use of technology in helping someone's process in their activities in achieving their goals could contribute to high engagement factors.

Limitation — In the deployment trial, we designed and deployed a tool that has a number of technical scalability constraints, thus we could not get optimum usage patterns from the users. In the focus experiment, we used only 7 users in a pre-defined lab setting and limited time frame. 30 minutes duration might not be enough to evaluate essay performance. Future research should include more student cohorts and the experiment should be carried out over a longer time frame (i.e. a longitudinal study). Our interesting findings related to engagement factors we considered as surprising or unexpected, and we can suggest another research perspective of ‘measuring’ the flow or engagement level among students for example.

6.4 Chapter Summary

The results presented in our trial deployment experiments highlighted some interesting patterns for students of film studies in browsing and playing movie content. User access and usage were found to be varied and influenced by many factors. In general, students found the features we provided were beneficial for their studies. Some issues or mismatches arose during the trial. A ‘wish-list’ was drawn up that might be useful for the future system developer. Our biggest strength in this study was the fact that the interactions we logged and observed were from among real users, students of the School of Communications, DCU and this applied throughout our 3 years of experiments. By integrating both the knowledge from the technology on automatic movie content analysis, with the practice of the information seeking process from real end-users, this provides a bridge to the established film studies discipline and helps in assisting new generations of students to ‘think digitally’. However, we discovered that developing an end-to-end system that leverages current research and deploying this into a real usage situation is difficult because some of the technology elements are immature and can easily hinder the usage and perceived value of the system.

In trying to find issues in designing and evaluating an application which incorporates

novel technologies but still matches real users' needs, we had to develop a robust and full system and have it used by real users (in our case, students in film studies classes) in two strategic ways:

1. Deployment — to assess overall usage and usability over time (268 users over a 3-month period)
2. Focused experiment — to assess the level of student performance and satisfaction (7 users in a 2-hour lab experiment)

Our deployment turned into a longitudinal study in a real module over a whole semester, and as this chapter discovered, was found to be a useful (although time-consuming) evaluation process that revealed student access behaviour in using movies to help them write their essays during the semester. A small number of dedicated users dominated the usage statistics figures, actively making use of the novel features provided on our web-based interface; the rest of the users used the system only a limited number of times. Overall, the usage frequency followed the way the semester was structured — very little usage at the beginning of the semester followed by an increasing amount as the deadline for the essay writing approached towards the end of the semester. A mismatch between students' initial wishes for a 'note/comments' feature and its actual usage during the trial triggered more question for us in how users' wishes collected at the requirements engineering stage should be interpreted in the context of usage rather than treated as an isolated feature in itself.

An experiment that accompanied the deployment was designed to address the problem of assessing the actual impact of the system when used in a focused essay-writing task. The findings of the second experiment showed the potential usefulness of the system we developed. The change in work practice from old to new media modalities raises other issues that might hinder the optimum usage of such new media tools. It is quite difficult to measure and prove any improvement obtained during a pre-defined and artificial session as this would be strongly influenced by many factors such as the mental and cognitive abilities of individuals. Any developed tools in the learning area are meant to assist students to

perform their tasks quicker and finish things easier. Bright students will always do things better and quicker. Considering these limitations, the focused lab experiment was designed and conducted with the aim to immerse the student in the task of learning and reading a film with the help of our system's technologies.

We follow a set of design criteria, which were developed at the earlier stage in this work. These design criteria were then used as input to the system design as explained in Chapter 3 and 4. Further discussions were made in this chapter which includes the issues arises from these design solution and general system design suggestions were also highlighted which might be useful for future similar developer particularly in Film Studies domain. The summaries of the design criteria and future design suggestions can be seen in Table 6.14. As can be seen from the Table, features (i.e. language glossary/dictionary, search function, script/subtitle and recommendation) were among the user list we collected during earlier user study but not incorporated in MOVIEBROWSER2, thus in the design suggestions column we made such remarks.

Features	Criteria	Design Suggestions	*Applied
Select a movie	Genre/Director metadata	Access by Genre/Director to be prioritized	Y
Drop-down list	Exciting, Montage & Dialogue events	Browse by classification	Y
Movie segmentation	Visual timeline	Colour-coding by classification	Y
Temporal navigation	Keyframe view	Ability to visualize/navigate events in details	Y
Scene based navigation	Movie information (i.e. Year, Director, Characters, Plot)	Colour-coding by classification	Y
Metadata information	-	Interactivity over the timeline	Y
Language glossary/dictionary	-	Colour-coded keyframe border	Y
Search function	-	Interactivity over the keyframe view	Y
Script/subtitle indexing	-	Essential for overview	Y
Recommendation (i.e. scene, character)	-	From user feedback	N
Movie playback	Playback features (e.g. play, pause and etc)	From user feedback	N
Playing a movie	Comments for discussion	From user feedback	N
Social interactions	Online access	From user feedback	N
Note-taking	Movie database (i.e. Irish, Hollywood)	From user feedback	N
Overall System	Streaming access	From user feedback	N
General	IE explorer and VLC player	Static area to reduce eye movement	Y
		Playback panel for better engagement	Y
		Design for context usage and privacy	Y
		Web-based strongly preferable	Y
		Larger movie database	Y
		High speed access and wider coverage (e.g. outside campus)	Y
		Consider compatibility (OS, browser, player plug-in, etc.)	Y

Table 6.14: Design criteria and suggestions. Note *Y = (Yes) incorporated in MOVIEBROWSER2, N = No

Chapter 7

Conclusions and Future Work

7.1 Conclusions and Achievements

The work reported in this thesis investigated how various perspectives, not only the technical perspective or the rationality for developing a system as is done in most cases today, should be adopted in developing novel technology. In particular, when developing a new application we believe it is very important to understand and interpret the impact of the new application on its user community. By building, deploying and assessing an application that incorporates a number of novel multimedia techniques, as we have done in this thesis, we demonstrate the application of a user-centred design approach throughout the development of a system and its final evaluation by users in a real, holistic, and contextual manner.

It is well-known that multimedia technologies have enabled the production, storage and delivery of large quantities of audio and visual information to users in work and leisure applications. The amount of video available nowadays raises a huge challenge for us to develop applications that help users to organize, browse and find relevant information from this huge video resource. However efficiency of access to video archives is not the only aspect to be considered when building video applications. Usability of the application and perceived user satisfaction when using the application also plays a major part in the successful adoption of any technology in a larger community. The research reported here

investigates how real users take advantage of technologies in a web-based movie browsing system. By designing, building, deploying and then assessing the usage and the overall value of a new technology in a very user-focused (i.e. involving real users) way, the overall impact of a video movie browsing system such as ours can be determined holistically.

In reaching our research aims of our thesis, two main strategic approaches were followed as follows:

- We followed a rigorous application of the Usability Engineering process and methods throughout all stages of development of our application in order to help ensure the system's usefulness and usability;
- We complimented our application of Usability Engineering with interpretation and analysis of monitoring of real world users who were performing real world tasks using the application. In this interpretation and analysis we brought in a number of different perspectives including psychology, pedagogy, HCI and information seeking;

The support of Usability Engineering principles throughout our system development required a long-term deployment of our novel system and monitoring its usage in a real, situated context, as well as a focused experiment to measure specific 'benefits' of the new system. From the deployment, we explored how students of Film Studies in the University took advantage of a newly-introduced application that incorporates a novel technology of automatic video content analysis and we discovered their acceptances, opinions and preferences. These can be categorised into user assessment, features assessment, usage patterns over time and opinions and experiences. Our findings were based on one semester of monitoring usage and follow-up questionnaires.

Based on user assessment, we found that 40% of the total students used the system. It is worth noting that the system has a number of constraints such as the fact that access was only from within the University area. A small number of movies were accessed the most, which shows the context of use; for example Irish movies were accessed most due to limited resources from the main University library. From the assessment of system features, we

found that students liked and appreciated the afforded features that were incorporated into the tool and affirmed from both the log usage and questionnaires that the tool brings benefit and is helpful to students in performing their work tasks. When the newly added features provide alternative ways of doing the same task as with conventional features, we can reasonably expect a shift of usage from the conventional to the afforded features. Navigating and browsing the 'Advanced' page shows a pattern of engagement where the time spent was *longer* than when navigating the 'Basic' page. At first this appeared contradictory since the reason for introducing advanced features was to *reduce* the time taken to perform some task. We related this observed phenomenon into another domain, from the perspective of psychology, in interpreting the level of user engagement with the system as denoting a level of pleasure with having the convenience from the use of the new technology as compared to the conventional approach of going to the University library to borrow a DVD. At the same time, students pointed out their future 'wish list' for improving the tool in terms of a larger and more varied type of movie database, system compatibility with other operating systems besides Windows, improved access from outside the University and some other technical constraints. The mismatches that occurred during the deployment on the features we provided (i.e. note taking) vs. their actual usage, were examined further and design recommendations were made. Usage patterns over time showed that the tool managed to relate to students' real work tasks as heavy usage was seen towards the deadlines for assignments. Students' opinions and experiences in using the software applications and what it meant to them were highlighted. They perceived and appreciated the usefulness of this kind of tool being introduced into their studies. These can be seen from the extracts of their comments.

Following usability methods from as early stage of development as possible should ensure the successful deployment of a technology application (in terms of its acceptance, engagement, practical benefits and satisfaction). A newly introduced system can integrate well into end-users' day-to-day activities as long as it was developed with a specific usage context in mind. A course in Film Studies will benefit from a usable online scene-based movie-browsing tool that allows easy access to movies and jumping within different parts

of the movies.

From the experiment we ran after the deployment, we obtained some in-depth information on the benefit students might get from a system such as ours. The findings from the essay outcome revealed that there were slightly an improving or better results which is also supported by the remarks from the module lecturer that shows students have more variability (more opinions, expressions) in the written essay when using MOVIEBROWSER2 that shows an indication of the usefulness of the tool. User satisfaction levels were also higher after using the newly-introduced tool with higher means scores in all aspects of statements given as compared to when using a conventional standard player and also from comments. As mentioned earlier, an interesting finding that we found was the time taken to complete the task was longer when completing the same task using the software application, but it produced a slightly better essay outcome. Again, this phenomenon was explained from the perspective of engagement from the psychology domain perspective.

From a (very) high level, the work we have reported in this thesis can be categorized into three major areas as follows:

1. **Overall System Development** — the research approach we took in the work here differed from the background work of another PhD thesis, which had been driven by a technical rationality. In the system developed in this work, the evaluation was based on not only usage and user analysis but also on interpretations made from psychology and information seeking. The software application was developed emphasizing the usability engineering and user-centred design and was user-driven. The system was deployed into real users (students) and the interaction with real users was our strength over 3 years of experiments with students of Film Studies in Dublin City University. Our aims were to bring a full user-centred approach to end-user interactions, adopt existing video content analysis technology, align the technical rationality of novel multimedia features to a real-world setting, build a usable application when the system incorporates novel multimedia tools that could be potentially useful to the end-users but have not yet been practiced or deployed.

2. **Computing in Humanities** — bridging between real usage with the work that was driven by technical possibilities and investigate the use of technologies in real usage. What is new here is that we filled the gap of assessing real usage from the deployment and monitoring process into real end users in their real contextual environments. Not much work has been carried out beyond the boundaries of technical possibilities from Computing where new video analysis techniques are deployed and used by real end-users in real settings and with real tasks involved in the School of Communications, Dublin City University. User interactions with the new software applications that incorporate these kinds of technologies were assessed and monitored, where such true user interactions are almost never captured or considered.
3. **User Evaluation and Interactions** — our work underwent evaluation following the usability engineering cycle with the main focus on the user and applied into a real-time frame of a student semester of film studies modules at undergraduates and graduate level. A number of strategies of experimentation used explorative approaches in system deployment and usage monitoring and used predictive approaches in controlled and focused lab experiments, in order to identify user satisfaction, overall performance and system benefit.

7.2 Research Contributions

- Our research investigated how various perspectives, not only the technical perspective as done in most research today, should be adopted in developing a novel technology application and understanding and interpreting its impact on a user community.
- By designing, building, deploying and assessing the usage of the overall value of a technology in a more user-focused (involving real users) way, we demonstrated the application of a user-centred design approach throughout the development of a novel software application and its end-user evaluation in a real, holistic, and contextual manner.

- This work demonstrated how technology can be turned into a usable application by following usability methods throughout its development process (rather than just a user evaluation at the end). This work also validates and identified issues arising in the deployment process especially when the work has no existing usage practice. The detailed findings from this work (especially on deployment monitoring and lab experiments) will help the future development of applications in the film studies setting. The reasonably significant contributions for example is in the development of a set of design criteria which includes general issues and guidelines in system design in the specific context of digital video which was explored and highlighted.
- Looking from the holistic view or from the big picture: we cannot develop a new technology and expect it to be useful and usable. Development needs to go hand in hand with all its surrounding components: usage context, usability, usefulness, learning (in the case of educational technology), engagement and interaction. From these considerations, we get better understanding of the artefact that we create, and this helps adjustment and alignments of the technology into the real usage setting.

In Chapter 1 of this thesis we stated our research questions in which this thesis is based. The primary question was “Do students who use our newly-introduced technology (in the software tool) get more ‘benefit’ compared to their conventional way of performing their work task?”. The specific sub-questions are as follows:

- (Q1) Do students make use of the alternative access features afforded by MOVIE-BROWSER2 and spend less time in completing the essay-writing task ?
- (Q2) Given the same amount of time, is the ‘outcome’ for those using MOVIE-BROWSER2 better or worse than those who use only a standard DVD media player interface for browsing movies ?
- (Q3) Do the students who use MOVIEBROWSER2 have a higher level of satisfaction than those using only a standard DVD media player ?

For Q1, we answered it partially as the findings revealed that users spent time more on the newly introduced tool and they made use of the alternative access features in completing the task through the advanced features provided even though the standard features were available to use. The seemingly contradicting fact that the users took longer time with MOVIEBROWSER2 was interpreted from a learning perspective which explains the longer time as proportional to higher level of engagement in using the system as indicated by the student responses to the questionnaire and through researcher observations. For Q2, the student essay assessment in consultation with the lecturer showed that, although the number of tested students, their variability in learning and essay writing skills was an issue, the overall use of MOVIEBROWSER2 resulted in essays showing more various aspects of critical analysis and referring to more example parts of the video, thus receiving better remarks and results as agreed with the lecturer. Q3 was answered by looking at the questionnaires after both deployment and the essay experiment as positive. Based on these observations, qualitative ‘measurement’ and findings, we believe that we have explored and determined that our work (together with deployment experiment) do give impact to users.

7.3 Lessons Learned

Once we accomplished our experimental work and analysed our results, we formulated some lessons learned which include things that were not expected and for each of these we have a number of suggestions.

- **Mismatch between user wishes and actual use** — We followed the usability engineering method from the very beginning and that included the user requirements stage which took place before the system was built. For this we did interviews, observations, etc., but in the system deployment stage we found that note-taking was underused. This scenario shows a mismatch between the needs we captured and the actual practices from the user, yet we built the system after getting user requirements of the usefulness of the feature ! These issues were discovered only during our de-

ployment. In the system testing for the system we developed, we did not foresee this situation as users always give good feedback on the features we provided. Furthermore, they were not really attached to any usage of the software application as it is only for testing purposes before we underwent a real deployment stage. It was the trial deployment which helped us to identify the mismatch, as we could not predict such a scenario before the deployment. This tells us that we should be more understanding and aware of the usage context when designing such applications. Further system design should emphasize even more, the context of usage rather than simply the functions that the features can provide.

- **Access and scalability factor** — The features that were provided in the application software did not raise many other issues in the trial, compared to the benefits of accessibility. The accessibility of the application was clearly the main criteria which led to a higher usage. An improvement in the system scalability would increase the usage among users even more so.
- **Expert user point of view** — From the academic point of view there is always an inherent difficulty reading film as it is a very subjective experience. The academic teaching processes attempts to make it as objective and scientific as possible so that students can learn the skill of writing an analysis of film using robust strategies. This has been an agenda for a long time now in film studies. The quote below extracted from the oral conversation with the module lecturer, shows the importance of this work:
Using the technology to break down the film into constitutive parts (i.e. shot length, type of shot like music), which is where the computing skill come in, can provide students with the experience and capability of really seeing the film using the technology. For instance, breaking the reading process down enables the students to perceive the film as a material form rather than just as content. This helps constitute the textual skills that are needed for academic film studies. Eventually, using technology enables the student to engage with film as an artefact that can be broken into its constituent

materials for analysis. Currently, as DVD's have become the main resource in film studies, the usefulness of various extras (i.e. DVD add-ons) have also greatly assisted film analysis. Consequently having some technology that collate various audio-visual stimuli in such a mechanistic/scientific way helps to maintain a sense of objectivity in the process, while at the same time developing the subjective interpretative capability in the student, which dominates the process of reading film. Bridging the technology gap can certainly assist Film Studies and connect new generations in particular with their new media expertise. Students starting to learn the skills of reading film can be greatly assisted by these new techniques provided in Computing. We should find ways to continue to find synergies between the users and technology and how technological applications can learn from users and vice versa. There is a lot of potentiality in developing this work. [Pat Brereton, oral conversation: 5th August 2009]

7.4 Future Research Avenues

Conducting this research revealed a number of avenues for further investigation including the following:

- **User evaluation perspective** — future work should have considerations of an even further improvement in the software application itself so it can have even better technical scalability. This is so that optimum usage and access can be provided. Such improvements might incorporate more added technology that might be useful for film analysis and might be deployed to a variety of student cohorts other than just students of Film Studies and from this we could explore whether there is any difference in usage or preferences. In the focus experiment we carried out in this work, we used only 7 users in a pre-defined setting in a lab with a limited timeframe. Thirty minutes duration for a focus group meeting might only be enough to evaluate the students' performance in their essay assignment. Future research should include a larger student cohort and the experiment should be carried out over a longer time

frame (i.e. carry out a longitudinal study). This would involve tracking student usage as students' progress from year to year and it would be interesting to discover whether there is an increase in students' literary skills and their skills in film analysis over a wide range of student cohorts in which the added technology might help to inform, frame and develop these skills in their studies. It would be interesting to explore further, the learning perspective of film study students on the potential of this application as a learning tool where this tool could be used as a validation to the add-on technologies we provided (browsing by scene genre and note taking for example), similar to the case for the DVD where add-ons such as directors' commentaries are provided. Interestingly, the media industry should consider supporting research such as this since it could validate their own DVD 'add-ons'. We would suggest such strategies (i.e. DVD add-ons and new tools like MOVIEBROWSER2) as teaching assistance which is also of great use to help students acquire the skills of reading films.

- **Other domain research perspectives** — further new research avenues could be brought into future work based on the phenomena found from this work. Other researchers could look at other domain perspectives in relation to learning theory or engagement factors in learning from a technology that was incorporated into a software application. Flow theory, play and motivation form part of another huge domain area that could be related to the learning for individuals or groups. More input from flow theory in measuring student engagement with the system could reveal other interesting phenomena and correlations with subjective satisfaction, or the overall usage time over a period or number of accesses.

Finally, from the main sets of experiments we have reported here, our research aims have broadly been achieved because we did look at the deployment of novel technology from an overall user-centric picture and not focusing on a very specific, narrow set of issues. We have provided some insights into how multiple disciplines could be interrelated

in explaining and interpreting unexpected outcomes. Work that starts from a technical rationality or possibility, which is subsequently deployed and assessed from the users' perspective might infer that a larger real community of users would appreciate the potential benefits. The results from the present study support the potential benefit from implementing these kind of work practices even though we could not determine an in-depth analysis of *specific* potential benefits, for example from learning theory or engagement which needs further study. However, we fill this gap in our work by looking at both perspectives (system and user) from an holistic view in how the work that starts from a technical rationality could give impact to a real community.

Work beyond the boundaries of technical possibilities or rationalities is possible to achieve and be evaluated. Our work was not on measuring and proving a concept but applying both perspectives and holistically looking at the impact of bridging these two perspectives. Knowledge gained by practicing it infers the other research path to be taken into consideration, particularly in learning. There will be a huge engagement factor to be considered. An article "The New Scholarship Requires A New Epistemology" by Schon [83] argues that a new kind of action research is required that would conflict with the epistemology of the existing research university. He mentioned that apart from the conventional research (name the variables and measures, create a control group, manage assignment of subjects to treatment, objectively validate the results, etc.), there are other kinds of research, such as 'action research'. This kind of research is usually not very embedded in academia at the moment, but it has quality of knowledge incorporated and real benefits to the world, so we should pursue this kind research direction. This kind of research usually requires common sense, knowledge-in-practice, and reflection by the practitioners, and methods usually employed include observations, interviews, reflection on the data generated through such observations and interviews, etc. Our work was partly inspired by this idea, and tried to get fully into the 'messy' real-world in developing a novel technology.

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