

# Visualising Digital Video Libraries for TV Broadcasting Industry: A User-Centred Approach

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## ABSTRACT

Finding a suitable video fragment in a vast video archive is mostly a complex task. Even professional users have to skim many hours of stored video data before they find the desired content. In this paper, we present a user-centred software engineering approach that is employed to create a novel news video explorer for TV broadcasting industry. This approach helps to ensure the balance between the technological progress in the field of information retrieval on the one hand and the needs and goals of the end users on the other hand.

## Categories and Subject Descriptors

H.1.2 [Models and Principles]: User/Machine Systems—*Human Factors*; H.5.2 [Information Interfaces and Presentation]: User Interfaces—*User-Centered Design*; H.3.3 [Information Storage and Retrieval]: Information Search and Retrieval—*Information filtering, Selection Process*

## General Terms

Design, Human Factors

## Keywords

User-Centred Software Engineering, Searching and Browsing Video Archives

## 1. INTRODUCTION

In TV Broadcasting industry, professionals frequently have to search a vast video archive. Finding the desired video is often a difficult task using search engines for commercial or professional use. Moreover, retrieving a suitable fragment of a few seconds mostly requires users to skim many hours of stored video data using traditional video player software. In order to optimise this task, more advanced video browsers and visualisations are currently being employed in several research projects [2, 3, 6, 12, 14].

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HCIR '09 Washington DC, USA  
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In this paper, a User-Centred Software Engineering (UCSE) approach is being employed to construct novel video information retrieval visualisations for the TV broadcasting domain. As a first step in this approach, TV researchers are interviewed and observed while they are working in their natural environment. This results in a better understanding of their practices and problems and helps taking the needs and goals of end users into account from the beginning of the process. By observing the end-users before any design takes place, the resulting visualisations can offer increased ease of use, efficiency and satisfaction [13].

The work in this paper is carried out within the context of the AMASS++ project [7]. This project aims to investigate the alignment and summarization of multimedia archives. The visualisations presented throughout this paper are built on top of the AMASS++ annotated news video corpus.

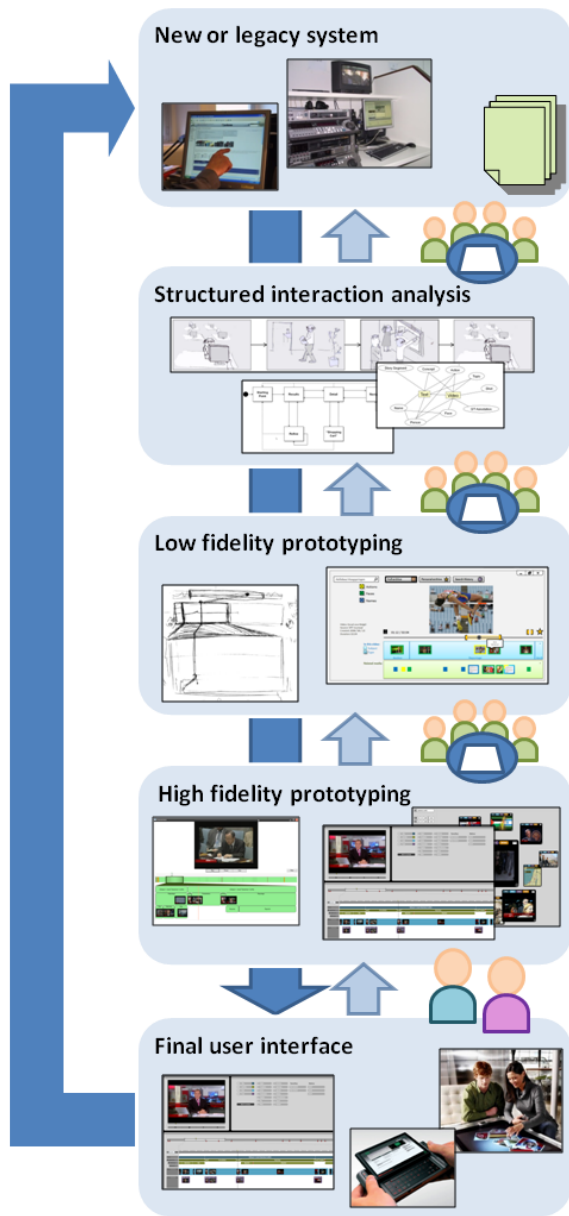
In summary, the major contributions in this paper are:

- a *UCSE process* employed in cooperation with a TV broadcasting company;
- an *interactive prototype for exploring news videos*, resulting from the aforementioned UCSE approach. The visualisations employed in this prototype are suited for TV researchers.

## 2. USER-CENTRED PROCESS

To provide suitable visualisations for the target group, we followed a user-centred software engineering approach. By involving end users from the beginning of the development process, it is more likely that the visualisation of the final user interface corresponds to their needs and goals [13]. The development process that is applied, is based on a framework for user-centred software engineering [4]. Figure 1 shows all stages of the process, including extracts of the artefacts that were used during each stage.

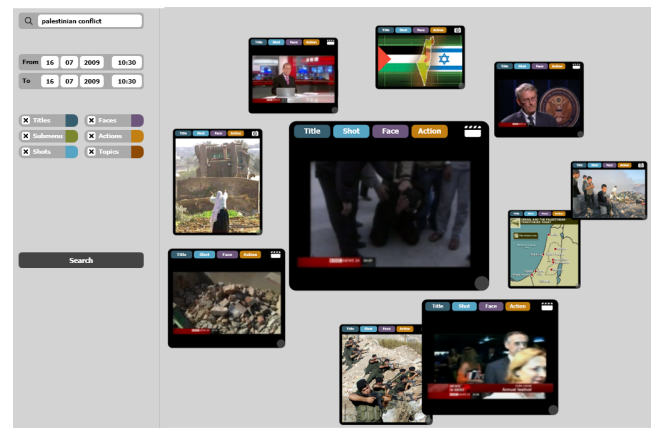
The end users involved in this development process are TV researchers. In the first stage of the process, where the *new system* is examined, a Contextual Inquiry (CI) is conducted in cooperation with the TV broadcasting company. A CI involves observing and interviewing end-users while they are performing their daily activities. This user study learned us that TV researchers need to browse large amounts of data. Their main job is to search video fragments of news broadcasts presenting particular people or situations that will be used in a TV programme or news broadcast. Based on keywords and other search criteria (e.g. date, programme title) the archive is searched to find suitable video fragments. Currently the videos in the archive are annotated



**Figure 1: The user-centred process that was adopted for the development of the user interface.**

manually, which allows the selection of appropriate archive videos. However, once a video is selected from the archive, the TV researcher has to browse the entire video manually in order to find and select a suitable fragment. Moreover, to carry out the different tasks, the user needs to combine several separate applications, which decreases efficiency.

The CI resulted into a scenario of use and an accompanying storyboard, that exemplify how one integrated future application can be used for searching archives, browsing an archive video and adding video fragments to a favorites folder. The storyboard was used to discuss the application with the stakeholders and provided the first data for the *structured interaction analysis*, in which a dialogue model and a conceptual model were created. Each artefact created in these early stages, was used for prototyping the UI.



**Figure 2: The search user interface.**

The first *low-fidelity prototypes* of the user interface were created using pencil and paper and Powerpoint. Following, the *high-fidelity prototypes* were created in .NET. During several iterations, the low- and high-fidelity prototypes were verified in stakeholder meetings, features were added gradually and a graphic designer was involved for the detailed UI design. The UI designs and visualisations, included in the high-fidelity prototype, are discussed in the following section.

### 3. NEWS VIDEO EXPLORER PROTOTYPE

During the aforementioned UCSE process, a news video explorer prototype was iteratively constructed. The user interface of this system contains two major parts: a *search user interface* and a *video browser*. While the former helps with finding the suitable video, the latter supports end users in skimming this video to locate and save content of interest.

#### 3.1 Search User Interface

In order to find the right video, users start with entering a search query containing a keyword and/or date range in the search user interface (see Figure 2, left). Based on this information, the system retrieves a set of relevant news videos (see Figure 2, right). The location and size of each video thumbnail indicate the relevance with respect to the search query: the most relevant videos are bigger and located in the center of the screen. By replacing and resizing the video thumbnails, users can also sort the search results themselves.

Each video is represented by an animated slideshow of key-frames, which are computed by the shotcut detection algorithm described by Osian et al. [9]. When a video seems to be interesting, users can double click on it to open the video browser. We employed a keyframe-based abstraction technique since these have been shown to be effective in helping people quickly obtain a general understanding of what is contained in a video [2].

#### 3.2 Video Browser

The video browser combines an advanced time slider, based on the time sliders in commercial video players such as Apple Quicktime Player and Microsoft Windows Media Player, with a timeline video visualisation [6]. A time slider is employed to manipulate the current time of the played video

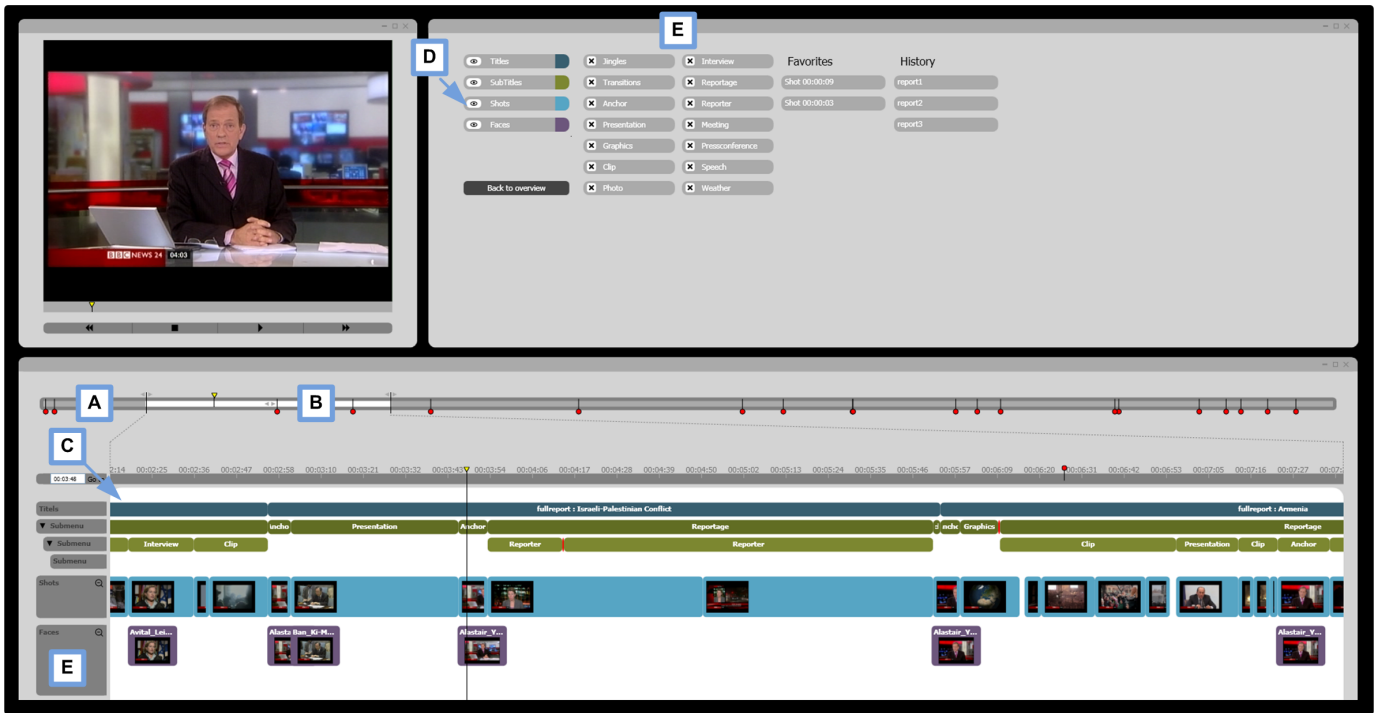


Figure 3: The video browser.

fragment (Figure 3, part A) and to specify an area of interest around this time (Figure 3, part B). The timeline (Figure 3, part C) gives a detailed view on the content in this area of interest.

The combination of the advanced video time slider with the timeline is in line with the basic idea of *focus+context* in information visualisation [1]. *Context*, on the one hand, is visualised using the video time slider, where red dots indicate the parts of the video relevant to the search query. *Focus*, on the other hand, is visualised in the timeline. Similar to other timeline based approaches [11], we use semantic zooming to specify the level of detail in the timeline. By resizing the focus area in the time slider (Figure 3, part C), users can zoom in or out on the video timeline. As shown schematically in Figure 4: a small focus area increases the level of detail in the timeline, a wider focus area decreases this level of detail.

The timeline shows a layered view on the video as computed by information retrieval algorithms for video and manual content annotations [7, 9, 10]. At the first layer, the title of every news item in this video is shown. This layer is further subdivided in several sublayers each containing story and scene information. The two remaining layers of the third timeline contain thumbnails of each shot in the movie and the names of the persons that appear in these shots. For example, Figure 3 shows that the topic about the Israeli-Palestinian conflict starts with the news anchor, followed by a presentation, the anchor again and a reportage. The faces layer reveals the names of the anchor (Alistair Yates) and presenter (Ban Ki-moon) together with a thumbnail.

The video browser contains several mechanisms to keep an overview on the large amount of information that is visualised in the timeline. Each layer can be maximised/minimised by clicking on its *toolglass icon*. In order to hide a layer,

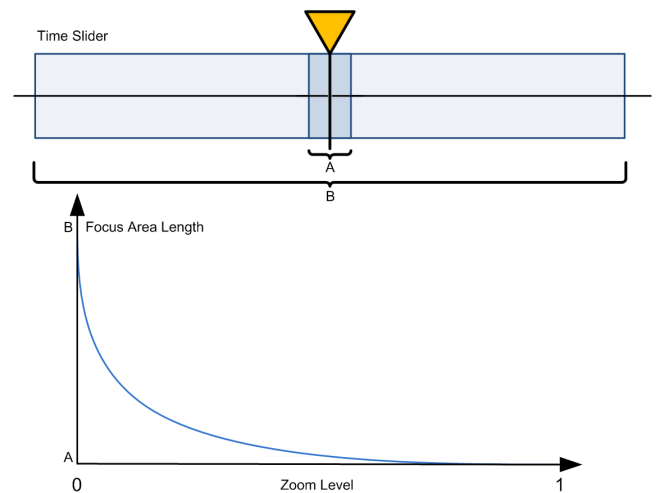


Figure 4: The semantic zoom function.

users can gray out the *eye buttons* (see Figure 3, part D), comparable to layers in traditional graphics software packages. Content filters (see Figure 3, part E) are provided to filter content from the timeline. For example, a user can check the *anchor filter* to remove the anchor blocks from the timeline. Users can also bookmark interesting blocks of content for later use.

#### 4. DISCUSSION AND FUTURE WORK

This paper presented a news video explorer for the TV broadcasting industry, realised by means of a UCSE process. First, the user tasks were observed and analysed, followed by

the creation of structured interaction diagrams. Throughout the low- and high-fidelity prototyping stages, the structured interaction diagrams were used for verification of the prototypes. At several stages in the process, artefacts were discussed and verified in stakeholder meetings.

During the user-centred process, intermediate prototypes were frequently verified in stakeholder meetings. This resulted in interesting recommendations for the news video explorer presented in this paper. Although experts of the domain were involved in these meetings, thorough validation is needed to estimate the value of our news video explorer for TV researchers. Comparative and repeated user experiments could be helpful to improve our prototype and to discover the way in which the news video explorer can change daily practice for the TV researchers over time.

Our current prototype allows TV researchers to search and browse the video archive on their desktop pc. However, for meetings and assembling videos, they often have to move to other locations where it is not possible to consult the videos or different applications need to be used. In their current system, video files have to be saved on a central server in order to make them accessible on multiple PCs and locations. The use of modern devices such as multitouch tables or mobile devices might improve this approach. Therefore, we are currently investigating how the UI designs presented in this paper can be extended to other platforms such as a multitouch table and a ultra mobile pc. While a multitouch application is helpful for presenting and discussing archive videos during editorial meetings, a mobile application can assist journalists for carrying on particular videos or quick searches on location.

As indicated by the arrow on the left of Figure 1, targeting novel computing platforms is done by starting a new iteration of the user-centred process. Tool support [8, 5] for storyboarding and multi-device UI development will be investigated and deployed to provide smooth transitions between several stages in the user-centred process.

Besides video libraries, the AMASS++ project aims to provide technologies for cross-media and cross-language search and summarization in several application domains. Therefore, we will explore text based visualisations that allow users to quickly browse a text and its related multimedia. Additional visualisations of the search results, including map and timeline views, will also be considered here.

## 5. ACKNOWLEDGMENTS

The research described in this paper is based on the results of IWT project AMASS++ (SBO-060051). The authors would like to thank the consortium for their contributions made to this work and the companies of the user committee for their involvement in the user studies and their valuable feedback. Furthermore, we would like to thank Jimmy Cleuren for his contribution to the high-fidelity prototypes and Karel Robert for the graphic design of the user interface.

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