ADIVI – Add Digital Information to Video

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German Abstract

Das Angebot an Videos im Internet und deren Nutzung hat sich in den letzten Jahren vervielfacht. Höhere Bandbreiten sowie neue Formen der Datenkompression haben die technologische Grundlage geschaffen, dem Wunsch nach umfangreichen und spezifischen Informationen einfach und schnell entsprechen zu können. Bereits jeder zweite Computerbesitzer nutzt den Computer für den Wissenserwerb, häufig Inhalte die Online angeboten werden. In jüngerer Zeit haben videogestützte Informationsangebote an interaktiver Kontur gewonnen und werden immer häufiger als komplexe, interaktiv nutzbare Wissens- und Informationsmedien eingesetzt. Eine aktuelle Entwicklung hierzu ist Hypervideo, das neben der sequenziellen Anordnung von Bild und Ton in einzelnen Videoclips auch Querverweise (Hyperlinks) innerhalb eines Films bzw. Verknüpfungen mit weiteren Informationsbausteinen enthalten. Mit steigender Anzahl an technischen Realisierungsmöglichkeiten für diese Form der medialen Wissensvermittlung im Rahmen gruppenbasierter Szenarien rückt auch das Spannungsfeld zwischen den möglichen Vorteilen audiovisueller Hypermedien und der tatsächlichen interaktiven Nutzung dieses Potenzials in den Vordergrund des kooperativen Wissenserwerbs. Das vom ZGDV entwickelt kooperative Hypervideo System ADIVI (Add Digital Information to Video) zeigt hierzu neue Konzepte für den Wissensaustausch innerhalb von Gruppen auf der Basis audiovisuellen Informationsinhalten.

Introduction

Within the past years video has become a medium of increasing importance for the Internet due to the higher bandwidth and new techniques for data compression. Videos allow to communicate complex and dynamic information in an intuitive and simple fashion. This makes video an ideal means for educational purposes considering the widespread use of online content for continuing education. Thereby, the quantity of video content on the Internet as well as the associated services have tremendously grown over the past few years. Video-based information technologies and services have been introduced as a new form of knowledge media. They show new concepts regarding information retrieval to support individual users as well as group participants in acquiring knowledge.

Hypervideo - Annotation and Linking

The hypervideo application ADIVI (Add Digital Information to Video) allows to use video in just the same manner as common document types, providing means to interactively annotate and explore a video stream, to discuss aspects of the document in a group, and to generate a report summary of the annotated media.

The system that has been developed by ZGDV in Darmstadt allows to create a video-based hyperstructure, a hypervideo, which can be shared by several users over a web server.

Hypervideo is defined as a video-based hypermedium that combines non-linear information structure with dynamic audio-visual information presentations (videos presenting realistic images or animations). Within a hypervideo, video information is linked to different kinds of additional information (e.g. written or spoken texts, pictures, or further videos). In a simular manner as common hypertext in the World Wide Web, hypervideo allows to highlight details (such as persons or objects) in a video sequence that now can be annotated or commented by means of additional media. Such highlights are also referred to as sensitive regions. The visualization of such sensitive regions can help to emphasize important objects within the video, increase the visibility of details or just inform the user of the availability of additional information, which can be accessed on a mouse click as depicted in figure 1.

The process of generating a sensitive region and defining a link to additional information can be understood as a video annotation. One main difference between sensitive

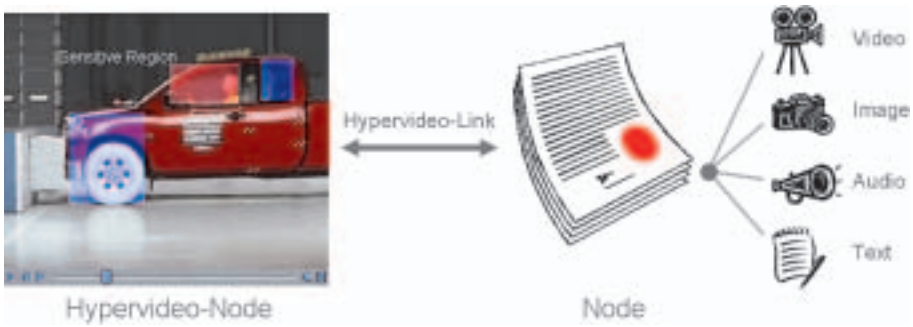

Figure 1: Concept of hypervideo

regions in a hypervideo and links in a hypertext is that the sensitive regions have spatial and temporal characteristics. This allows to highlight a specific object or person within the video over a predefined time interval.

In opposition to traditional hypermedia where video is used as an illustrative and often optional medium hypervideo uses video to form the main storyline. Annotation is grouped alongside with the video. This allows the recipient to follow the path of the video as well as to explore the additional information at his own pace. Different learner characters, speeds, and interests can therefore be served.

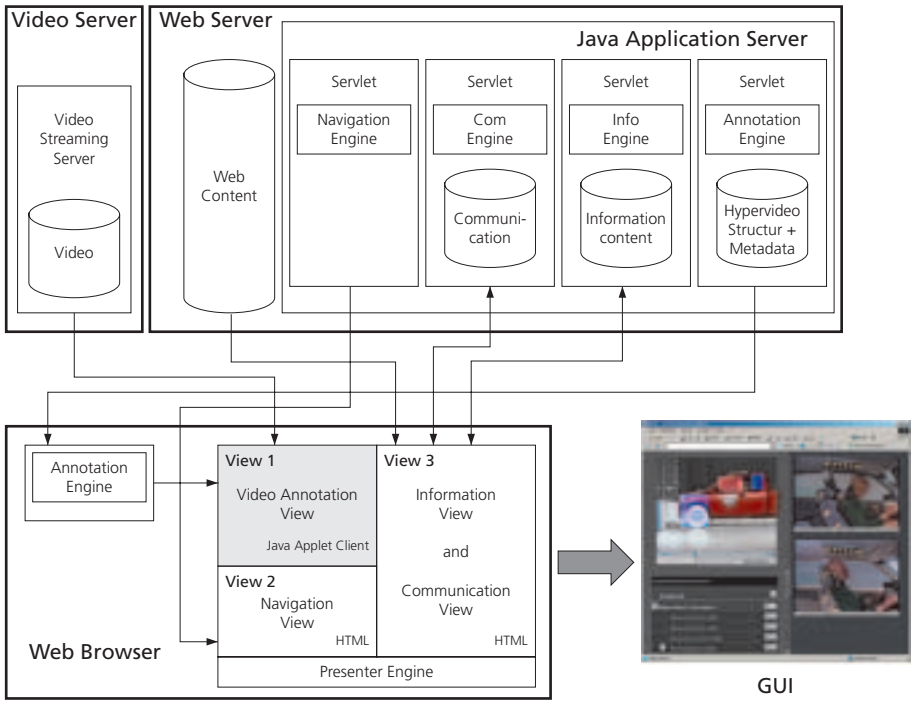

Figure 2: System architecture

Group Collaboration

In today's globalized working environments collaboration increasingly depends on advanced means to communicate and collaborate over great distances. Wherever video data serve as content for such collaboration a collaborative hypervideo environment holds the potential to greatly improve and accelerate working processes. Figures 1 and 3 show how automotive engineers can discuss the results of a crash test by means of the ADIVI hypervideo application. Instead of exchanging coordinates and timestamps via e-mail the discussion can be applied directly to the video itself and shared over a collaboration server: »Have you seen this deformation?«

The approach provides specific facilities to jointly elaborate on video materials and to change a hypervideo presentation according to the transfer of knowledge present in any group. In this way, a community could build their own hypervideo content based on conversations and dialogues between the participants and, at the same time, exchange and construct new knowledge between participants. Our hypervideo-based environment simultaneously establishes a sort of archive to preserve ongoing discussion issues for later use. As a result of the direct combination of details in the video content with the contributions of the participants in the community, an effective access mechanism can be installed to meet the requirements of an extensively unobstructed communication process as required.

The overall design approach for a collaborative hypervideo system encompasses several steps: (1), information is mainly presented by audio-visual media; (2), knowledge can be created collaboratively on the basis of video presentations by means of both the annotation of links and written e-communication; and (3), the process of knowledge building is reflected in resulting visualizations in the hypervideo structure. These general principles are expressed by denoting hypervideo as a complex 'dynamic information space', where each learner can add his or her contributions to a video presentation and share them with the community.

The Hypervideo Client

The web-based hypervideo system is based on a client-server-architecture. The repository for the hyper structure is located on the server allowing real-time exchange and synchronicity for all users. A client can provide two different modes of operation. The presentation mode allows the user to extract information from the common information space. In the authoring mode new information is contributed to the information space.

The hyperstructure is merged into the presentation at runtime. This allows the presentation to be adapted and implemented by different modules. Different graphical front-ends therefore can be provided. The major web-based graphical user interface consists of a hypervideo player applet and a server-side generated visualization of the hyperstructure and annotations displayed in a standard web browser. The hypervideo applet makes use of the cross-platform Java Media Framework. Embedding the client into a web browser allows the presentation of any media type supported by today's browsers including HTML, image formats, PDF, Office Files, etc. The web-based client allows the generation of document-style summaries of the hypervideo structure in PDF and RTF including screenshots of the movie, graphical representations in 2D and 3D. Further, more complex clients allow the communication with the server using protocols based on the eXtensible Markup Language (XML, SOAP).

Figure 2 shows the system architecture concept of the collaborative hypervideo system. Besides the presentation of annotated videos, additional information, and communica-

Figure 3: Example of web-based graphical user interface

tion content a navigation view is provided in order to support orientation within the hypervideo, which can be rather complex.

Interacting with Hypervideo

The interaction concept is based on four separate ways of accessing the hypervideo structure. In the graphical user interface, these perspectives are reflected by different views as depicted in figure 3 showing the web client:

- The *video view* shows the video either in its original form or displays the sensitive regions as rectangular shapes with enhanced contrast. This view offers the most natural timeline perspective of the video.
- The *hyper structure view* gives a linear or alternatively hierarchical perspective of all sensitive regions and annotation information linked to each region. This view allows the quick access and search of the hyper structure. Alternative visualizations in 2 or 3D have been developed.
- The *annotation view* gives a detailed perspective of the annotation data. This can be used to read the additional information linked to the video.

The visualization of the sensitive regions can be controlled by the user, deciding either to display the rectangular shapes or watch the movie without any augmentation. In this way learning can focus on the original media without any distraction by linked information, which might be necessary in some situations. It is important to note that the video itself is not being modified but annotation is generated at runtime from the data retrieved from the database.

The exploration of the hyper structure works in a similar fashion to common hypertext metaphors. However, while hypertext today only knows single-destination links, hypervideo allows to link many annotations to one sensitive region, each of which can be selected by simple mouse interaction or the context menu. Different types of contributions can be classified as either video information, generic information of other media types, and discussion threads.

Adding new regions or annotation links has been designed to be easily and intuitively accessible. Sensitive regions are just drawn into the video by marking rectangular regions. The context menu opens a dialogue allowing to upload any file from local hard drives, to add links to external resources, or to edit rich text.

Empirical Evidence

The system has been discussed as an authoring environment for collaborative hypervideo design projects in educational contexts. In a number of empirical studies the system has been evaluated in cooperation with the universities of Münster and Tübingen. The feedback from these studies has motivated several redesigns and improvements of the system to date. The system has for instance been employed by students in an instructional program based on courses of hypermedia writing making use of the hypervideo application in a collaborative setting. The results of the evaluations approve the overall design concept of the collaborative hypervideo system and show high potential for hypervideo as a new media form for group-based communication regarding audio-visual information content.

Outlook

The areas of application for the hypervideo system comprise a great number of industrial and educational scenarios. The modular architecture of the system allows an easy integration of new components and the development of new applications to be put on top of the existing system. Fully functional application prototypes have been developed in the context of several national and international projects (e.g. *http://www.mummy-project.org*). Contact and licensing information can be obtained on the ADIVI web site (*http://www.adivi.de*).

Points of Contact

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