

The Video Paper Multimedia Analysis System

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ABSTRACT

Video Paper is a prototype system for multimedia browsing, analysis, and replay. Key frames extracted from a video recording are printed on paper together with bar codes that allow for random access and replay. A transcript for the audio track can also be shown so that users can read what was said, thus making the document a stand-alone representation for the contents of the multimedia recording. The Video Paper system has been used for several applications, including the analysis of recorded meetings, broadcast news, oral histories and personal recordings. This demonstration will show how the Video Paper system was applied to these domains and the various replay systems that were developed, including a self-contained portable implementation on a PDA and a fixed implementation on desktop PC.

Keywords

Paper-based multimedia browsing, retrieval, access, and replay.

1. INTRODUCTION

The analysis of multimedia recordings is a challenging task, largely because the obvious solution of watching the recording from the beginning, perhaps taking notes along the way, requires as much time as the length of the recording. Essentially, this explains why so much multimedia content is never used -- it is just too difficult to browse. Over the years, researchers have addressed this problem with online interfaces (e.g., [5]) that display key frames from the video and provide random access as well as the ability to search the transcript. Other work has exploited features of the original recording to improve the utility of an online interface. Video Manga is one example that varied the size of key frames based on an importance measure [6].

Video Paper is an alternative solution for multimedia skimming and retrieval [1]. Text from the closed caption (or a transcript) is displayed together with key frames extracted from the video. A bar code is printed underneath each key frame that replays the video from the corresponding point in time. This allows users to read the paper document and view only those parts of the video

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that are relevant to their needs. Given a multi-page Video Paper document representing an hour-long meeting or TV program, a reader can quickly skim the content and determine whether there is anything worth listening to in the multimedia recording.

This demonstration will show several novel aspects of the Video Paper system, including how we're using it for reviewing multimedia meeting recordings. A complete working system will be installed that the visitor can operate.

2. SYSTEM DESIGN & APPLICATIONS

The Video Paper system includes a digital multimedia recording process and a postprocessing step that produces the paper document. Users can access the multimedia data on a local area network with a PDA. The PDA decodes bar codes and sends commands to the server that control replay of the video on a television attached to a video rendering card on the server. In addition to the bar codes associated with key frames, meta bar codes are included on the Video Paper document that pause the replay, rewind, fast forward, or display the closed caption text on a television.

We also developed a portable version of the Video Paper system in which the video data is written on a PCMCIA disk drive that is interfaced to a PDA together with a bar code reader. A modified version of the control software invokes the video replay on the PDA instead of on a separate television. This allows the Video Paper system to be used in places where there's no network connection, such as on a train.

A version of the Video Paper system specialized for multimedia meeting recordings is illustrated in Figure 1. A video camera with a 360-degree lens captures everything that happens during a meeting. This is combined with a four-microphone audio localization system that identifies where each speaker was positioned with respect to the camera. A presentation recorder captures a separate set of key frames from the slides that were shown on a projector [3].

Postprocessing software chooses key frames from the video and presentation streams to fill the space near the text transcript. Presentation slides that were shown for more than a minimum duration are guaranteed placement on the page. The rest of the space is filled by randomly sampling the sound localization output. This shows not only who spoke during a meeting but approximately the amount of time they used. This contributes to making the document a stand-alone representation for a meeting. An example of a document created by this process is shown in Figure 2.

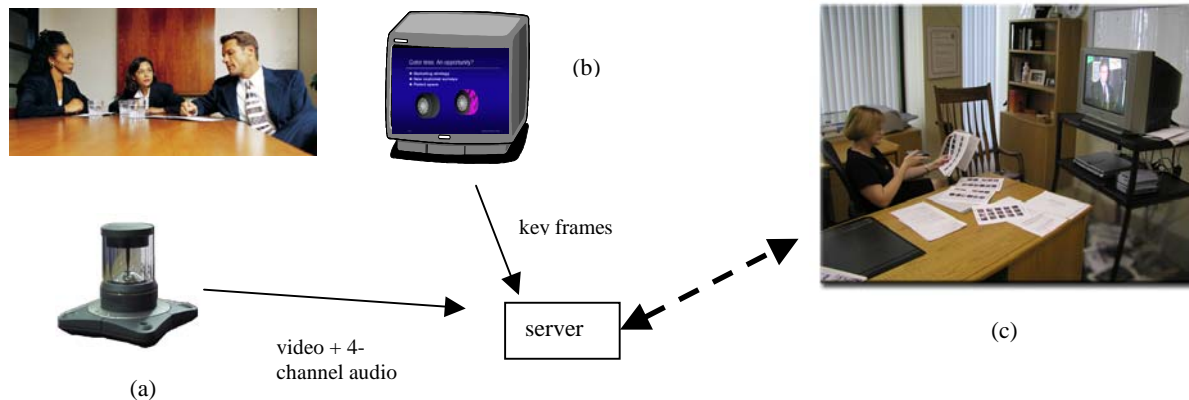


Figure 1. The meeting recorder (a) captures video and four-channel audio. The presentation recorder (b) saves key frames from the video shown on a projector. A networked server supports Video Paper access to the recorded data (c).

The Video Paper system has also been tested in our laboratory for other applications, including the analysis of broadcast news, where we observed that the paper representation was similar to a newspaper in the sense that a user could understand what had been presented by skimming the document, selectively reading only the sections that were needed to improve ones' understanding. This result was extended in an application to oral histories [4] which showed that Video Paper improved the efficiency of researchers by letting them read-ahead while listening to another section of the recording. It also provided a convenient means for accessing multimedia recordings that previously required the user to load a VHS tape into a VCR and manually fast-forward to a given time-stamp. Now the same work

is accomplished by scanning a bar code.

3. CONCLUSIONS

Video Paper has proven to be an efficient and easy-to-use method for multimedia skimming, access, and retrieval. This demonstration will show the visitor how the system works and will let them operate the retrieval interface themselves.

4. REFERENCES

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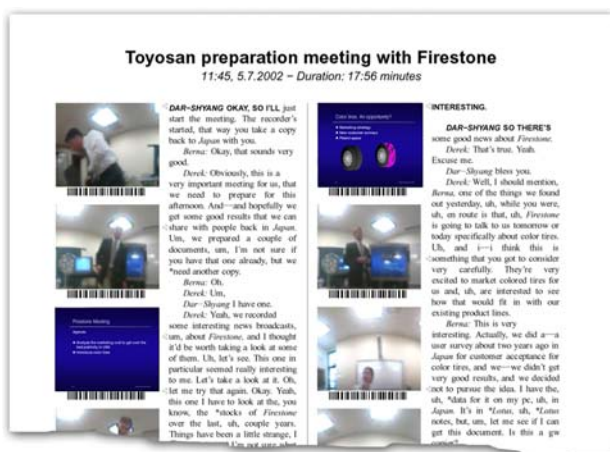


Figure 2. A Video Paper representation for a recorded meeting.