ビデオペーパー：紙をインターフェイスとしたビデオの閲覧

Video Paper : A Paper-based interface for Video Browsing and Retrieval

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要　　旨

紙をインターフェイスとして，ビデオを見る方法を提案する．紙の上にはビデオから各シーン切り出した静止画，音声を全て文字に変換したテキスト，および各静止画に対応したバーコードが印字されており，各バーコードはビデオのランダムアクセスが可能である．ビデオの内容が紙に印刷されていることで，ユーザーは新聞を閲覧する感覚で，素早く全体を把握したり，斜め読みをして，関心のあるトピックを見つけ，これまで時間を費やしていたビデオ情報を効率よく活用することができる．またオフィスドキュメントのマルチメディア化などビデオの新たな活用方法も期待される．このビデオペーパーで使用している要素技術，システム構成およびアプリケーションの事例を述べる．

ABSTRACT

A paper-based interface for browsing and watching video is described. A paper document shows key frames selected from a video, a transcript for the parallel audio track, and bar codes that start a multimedia player. The paper document provides a stand-alone representation for a video recording that lets a user both understand the content of the file and replay only selected parts of the multimedia that are necessary to gain a better understanding. This approach applies the two-dimensional display characteristics of a newspaper to multimedia retrieval. By so doing, the user's browsing and search efficiency is greatly improved. This paper describes an implementation of the Video Paper system using a Pocket PC with a bar code reader as the remote control device and an archive of video recordings on the Pocket PC or an external server.

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1. Introduction

Video is difficult to browse and search because at any time we can only see a small portion of the available information. It is a challenge to visualize the surrounding context. While there are many elegant online solutions for this problem, they can be difficult to use.

As an alternative, we have been investigating how paper can be used for video browsing and searching. We wanted to provide a paper representation for a video recording that was "stand-alone" so that a reader could understand as much as possible about a video by merely glancing over the document. However, that document should also include an easy-to-use means for replaying portions of the video so that the user could see and listen to the multimedia recording whenever a more in-depth explanation was required.

Our solution for interacting with multimedia content such as a TV broadcast or a recorded video is called *Video Paper* [1, 2]. This system provides paper documents that include a text representation for the audio (we use the closed caption (CC) that accompanies many TV broadcasts). We also display key frames extracted from the video.

Fig.1 shows how Video Paper documents are created. A video signal, such as a television broadcast, is processed and the closed caption text is extracted. A key frame image is saved every second. First, the text is laid out on the page. Then, the remaining space is filled with key frames that were recorded at the same time as the text they are adjacent to. The typical Video Paper document for a news broadcast represents about six minutes of recorded video on each sheet of paper.

Bar codes are placed under each key frame that refer to corresponding points in the recorded video. Swiping a bar code causes the video to begin playing at that time. This allows users to read the paper document and view only those parts of the recording that are relevant to their needs. Given a multi-page document of this type representing, say, a one-hour TV program, a reader can quickly skim the contents of the program to see if anything relevant might be present in the text.

An example of using Video Paper for analyzing a news broadcast, like the one shown in Fig.1, would be looking for a
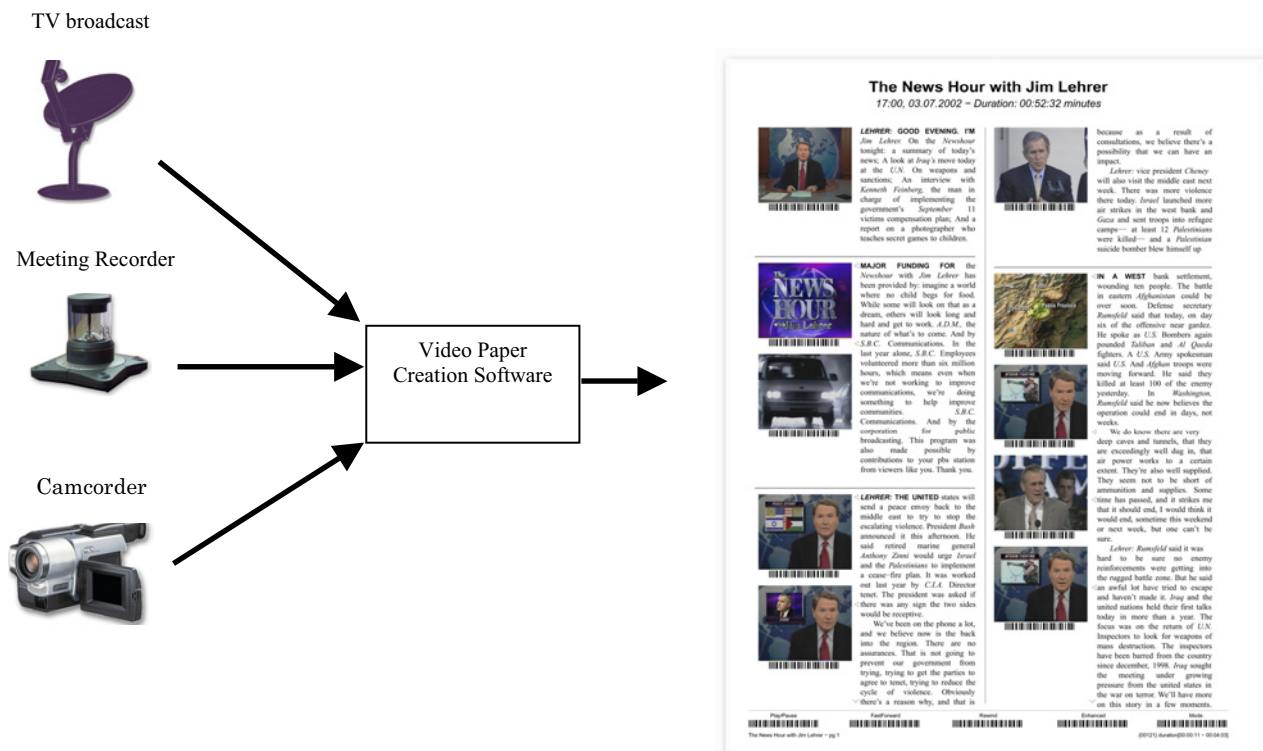

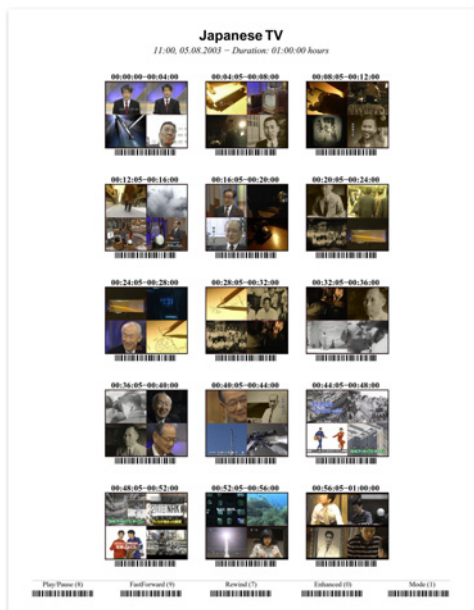Fig.1　Video Paper creation process.

Fig.2　Video Paper for a TV program without closed caption and a DVD cover for a home video.

story about Idaho. A quick glance over that page lets a user to see the map on the right side and focuses his attention on that section, thus eliminating the need to look elsewhere in the document.

Video Paper can also be used for recordings that do not have a closed caption. Fig.2 shows an example document that contains just key frames and bar codes. A cover sheet for a DVD is also displayed that could be created by the software people use to transfer home videos to DVD disks. The cover sheet can also be used together with an appropriately modified DVD player to control playing the contents of the DVD.

2.　System Architecture

Two alternative versions of the Video Paper system architecture are shown in Fig.3. A remote control device is comprised of a PDA (e.g., Compaq iPAQ) with a bar code reader and a wireless interface (e.g., 802.11b). The PDA decodes bar codes and sends commands to the server that control replay of the video on a television attached to the video rendering card on the server. In addition to the bar codes associated with key frames, meta bar codes are included that pause the replay, rewind, fast forward, or display the closed caption on the television.

We also developed a portable version of the Video Paper system in which the video data is written on a media card. A modified version of the remote 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 is no network connection, such as on a train, a plane, etc.

3.　Experimental Results and Applications

A complete working prototype of the video paper system has been developed that includes a PC server that stores recorded videos and *automatically* generates video paper. Running on a 2 GHz Windows 2000 system, less than one minute of run-time is required to produce a video paper PDF file for a one-hour recording. The MPEG2 video file can also be trans-coded to a low bit-rate version for the portable system. These files typically require about 100 MB per hour of recorded data. Thus, up to 50 hours of video can be saved on a 5GB media card.

The remote control shown in Fig.3 is connected to our WiFi LAN and allows users to replay any of the Video Paper documents on demand. We also developed a version of Video Paper for our Meeting Recorder [3]. This system captures 360-

degree panoramic video and presentation slides while they are being displayed in our conference room. The Video Paper representation includes key frames from both sources and a transcript for the audio track.

4. Conclusions

A solution for video browsing and retrieval was proposed that uses a paper-based representation to provide an efficient and easy-to-use method for finding information in videos. Recent results with news broadcasts and recorded meetings confirm the intuition of the system's developers that Video Paper is an ideal interface for browsing and selectively accessing recorded video.

References

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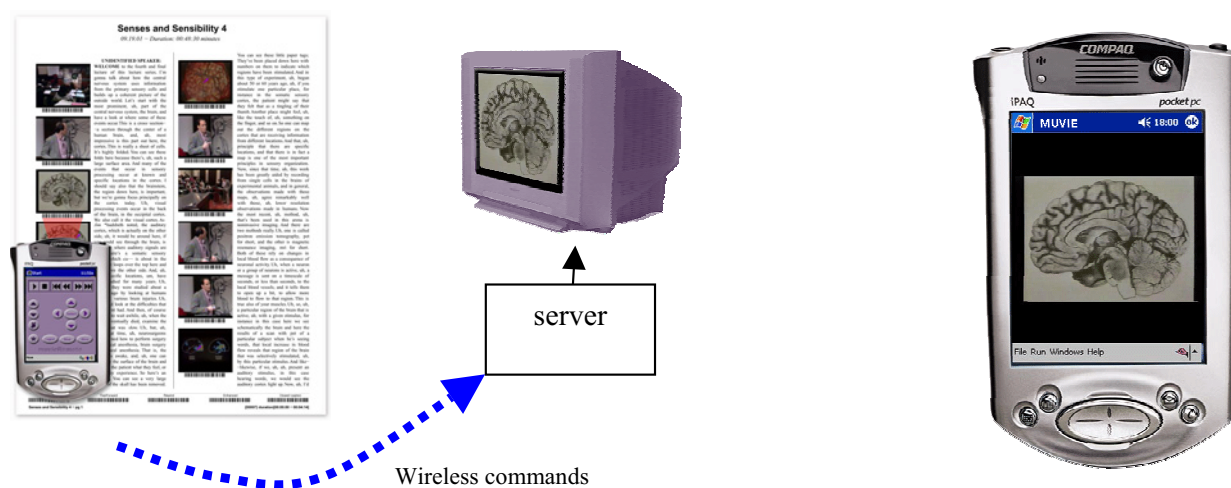
Fig.3   Video Paper System Architectures: A server version and a portable version.