Reconfigurable Video

Russell Sasnett, Research Affiliate
MIT Media laboratory
Gerstein/Sasnett Associates

Abstract

The problem of efficient access to full-motion video resource materials in an educational context is explored. Reconfigurable Video™ is a software technology designed to assist in the organization and delivery of visual databases on optical videodisc. A prototype project is described which integrates a relational database of documentary video, audio transcripts, and expert analysis into a multi-media educational research tool for the humanities and social sciences. "Marital Fracture," a case study of a divorce by Dr. Rosalyn Gerstein, serves as a model for future interactive video resources. Specialized software allows for the creation of electronic pages which incorporate video "footnotes", and the synchronization of text to video. A graphical user-interface for editing and restructuring the movie materials is presented.

Introduction to the Problem

The last decade has seen a tremendous increase in the use of video materials in curriculum, with few corresponding developments in technologies which allow simple and effective management of video resources by the people who use them. At universities all over the country, case-study videotape is becoming the preferred mode of teaching the complexities of decision-making and behavior: in medicine, business, law, and psychology. Paper case-studies are hindered by the layers of interpretation that separate students from the situation being examined. The language used to present the paper case-study is already layered with judgments that students must accept at face value; analysis becomes a game of manipulating words and abstract concepts. The critical phase of translating one's own perceptions into a personally insightful viewpoint is undermined. In contrast, video presentation is capable of simulating or actually documenting the characters and situations in a case study, in a way that allows students to extract information using their own senses, and to arrive at judgments using their own mental processes. This is not to say that video is an "objective" medium, only richer and more realistic than printed materials.

Unfortunately, videotape is found lacking in several areas. Chief among these complaints is that viewer's simply can't get what they want when they want it. Videotape as a medium consists of the serial delivery of information; programs never divulge their agenda to their viewers because direct access to content isn't possible, preventing individual exploration and access. It is impossible to provide a 'table of contents" for a videotape, due to the lack of addressing capability on all but the most expensive professional equipment. Hence the viewer can neither browse nor annotate, but must passively receive the information in the order in which it was originally assembled.

Another difficulty is the inability to render high-density supplementary textual information in limited NTSC video resolution. Videotape also deteriorates rapidly with use, requiring special care to maintain archival quality. Finally, videotape presentations are incapable of being rearranged even slightly without a complete reconstruction.

Yet the teaching power of moving video is undeniable, especially in applications which require students to perceive phenomena directly and develop their own interpretations. Professionals and academics have responded enthusiastically to the innovative quality of Dr. Rosalyn Gerstein's work with documentary video case studies.

> The power of video comes from its ability to render actual people and situations, so that we realize that these aren't just raw statistics we're talking about, that these are complicated decisions in which there are rarely any easy answers… [In mediation] for example, I find the body language of negotiating parties to be an invaluable clue to their emotional state, and you just can't get that kind of richness out of a paper case-study.
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> Attorney Michael Wheeler
> MIT Department of Urban Studies

Dr. Gerstein's interests in visual ethnography and the social application of media technology led her to document a couple's marital separation, and edit a portion of the ethnography for interactive videodisc in 1982. It was the perception of the potential of these video case studies that led the author to collaborate with Dr. Gerstein in 1983 on a 2-year project at the MIT Media Laboratory, exploring alternative technologies to overcome the limitations of the videotape medium for case-study curricula. The product of this effort is **Marital Fracture: A Moral Tale**.

> As I continued to work with pictures and words, I realized that videodisc was πthe ideal distribution medium which combined television and text. Although it had never been used for portraiture or documentary before, I was excited by the application to my own material… Documentary creates a vivid record which appears to capture all one needs to re-explore meanings. The contribution of this work is in the [provision] of sufficient material (and means of access) so that viewers can study the construction and better understand the influences which make up a visual account.
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> Dr. Rosalyn Gerstein
> PhD, Communication Technology and Culture

A Model Solution

The combined technologies of computer-controlled videodiscs and high-quality graphic displays are capable of solving the problems inherent in videotape curricula, and providing the sort of flexible teaching and research tools that these applications demand. The best solutions will not be designed by isolated technologists, however. Attention

must be paid to the careful combination of film aesthetics, information systems, and the fundamentals of graphic design. Above all, any proposed solution must take into account the current methods of educators and researchers, and foresee how they can be adapted for new electronic media. Previous models for interactive video in university settings have suffered from high single-use development costs and limited adaptability of the videodisc content. The strength of the Gerstein/Sasnett model is its focus on the provision of substantial amounts of both video and textual resources, and the means to mold these raw materials into courseware at the delivery site. Faculty are given the ability to structure new presentations in response to their own classroom requirements. This avoids the problems inherent in having a programmer mediate between faculty needs and computer-enforced constraints.

Implementation

More than a year of software development has gone into the creation of a prototype. The backbone of the effort is a relational database describing the individual video segments and their content. Ashton-Tate's dbase III was chosen for its simplicity, power, and general availability. Interface routines to the database manager were developed in C on an IBM-PC, and linked to a 1' video editing system controller. This allowed the database to be constructed automatically as the pre-master tape was being edited. The SMPTE time code addresses are eventually converted to videodisc frame numbers at the time of playback. An intelligent software package manages video control commands regardless of format 9tape or videodisc), making possible some simulated branching prior to actual disc pressing. Video segments may be located by theme or textual description, as determined by the database designer. This makes possible one of the main goals of the project, the provision of a complete Table of Contents for the videodisc being produced.

The relational database stores descriptive information about each video segment, including in- and out-frames, enabled tracks, and the name of the data file containing an optional digitized sample frame. All other fields are optional, and entirely up to the designer's discretion. If desired, an industry-standard CMX Edit Decision List (EDL) may be converted to the relational database format. The sample frame is chosen by the editor during pre-mastering, then digitized in a true-color frame buffer, and saved as an 8-bit picture icon at 64x64 pel resolution. This icon serves as a handle for the graphical user interface, which represents the database as a deck of 4-by- cards, with a picture icon "stapled" to the upper left corner of each. Operations are provided to give the user control over all the basic editing functions. Splicing one piece of video to another becomes a simple matter of moving a representative frame of the new shot onto a filmstrip symbolizing a larger sequence. Picking a new order for a scene is as easy as shuffling a stack of postcards.

There is also an associative network database called the VideoFile™, which creates links between the video segment records and other descriptive data. Links can be made between video and audio segments and blocks of text. Text segments are defined with a mouse by visually "clicking" at the in- and out-points, similar to the Macintosh™ convention. An outline processor was constructed which converts a standard text file in

outline form into a hierarchal tree-structure. Any number of text or video segments may then be attached to each node in the outline tree. Viewers may traverse up and down the tree, applying display functions to the current node and/or all of its descendants. Alternatively, users may search for additional information in the database and attach new segments to the current node. A dictionary of each text file is created, allowing for fast searches by keyword in text or video segments. This becomes very useful when a full transcript of the video material has been entered into the system.

The final software module is an electronic page formatter, which interprets commands embedded in normal text files. This allows for the creation of high-quality anti-aliased text output, as well as the placement of certain graphic primitives. Special display hardware enables the superimposition of live subsampled videodisc imagery onto the computer graphic output, creating the effect of "moving' illustrations in an electronic book. The initial software, developed for an experimental frame buffer on an IBM-PC, is now being ported to off-the-shelf equipment, including the Commodore Amiga™.