Applications of optical storage and interactive information technologies continue to be developed at an incredibly accelerating pace. In the past two years, technology improvements, implementation methodologies and cost-effectiveness have continued to show great gains. Thus, the impact of new interactive optical technologies has increasingly been recognized by educators, researchers, librarians and publishers alike. This paper intends to provide a quick introduction on the interactive videodisc technology. Optical videodisc technology permits high-density storage of multi-media, multi-formatted, and multi-dimensional information on a single disc, thus possessing great potential for information organization, storage, retrieval and transfer. However, with the demonstration of the spectacular interactive videodisc, entitled, "The First Emperor of China", a product of PROJECT EMPIROR-I, it is clear that the full impact of the videodisc is only realized when the disc is used with a computer in an interactive mode.

PROJECT EMPIROR-I: China's Treasure Revealed via Videodisc Technology is funded by the Humanities Project in Libraries, US National Endowment for the Humanities. Applying the most recent videodisc technology, this project presents and interprets a most significant historic/archaeological period of China's past. The site and artifacts recorded are from the First Emperor of China's lifetime. The terra-cotta figures of warriors and horses, which were found near his tomb in Xi'an are included.

PROJECT EMPIROR-I demonstrates how interactive videodisc technology has been used to transfer information and to provide better information access insensitive of time, distance, geography and other boundaries. It thus promotes better communications among people and better international relations among nations.

Since early 1985, tremendous progress has occurred in the applications of optical and interactive information technologies in information services. Technological improvements, implementation methodologies and cost-effectiveness have continued to show great gains. Thus, significant milestones were reached in both the variety and employment of these technologies, and the impact of these new interactive information technologies is increasingly being felt and recognized by educators, researchers, librarians and publishers alike.

In line with the central theme of this PIF Conference on information transfer, communications and technology, it is essential to expand on how the interactive videodisc technology can and will continue to play a significant role in information transfer and communications. It is important to note that although other laser optical technology, such as CD-ROM technology, have also revolutionized electronic publishing, libraries' mode of operations and services, as well as information transfer and communication. This paper will deal with videodisc technology only, in particular the analog one for interactive use.
INTRODUCTION

Much to many people's surprise, videodisc technology has been around longer than microcomputers. Yet, throughout the 1970s and 1980s videodiscs were employed mainly for recreational purposes. It was not until recently that the videodisc's role as a high-density, high-speed information storage and retrieval tool was identified. The rapidly growing microcomputer industry is responsible for the continued dynamic development of videodisc. For it is the marriage of the computer, especially the low-cost, high-performance microcomputer, to the videodisc which provides infinite information transfer possibilities. Divorced from the computer, the videodisc has limitations. This is revealed by the extreme popularity of micro-based videodisc technology in information services. (1)

An important role in this matching was the promotion of information communications beyond alphameric codes. In the past, this has been a hindrance for applications involving visual images. With the coupling of videodisc technology to computerized databases together with other significant advances in this technology, the possibilities for graphic image applications have mushroomed. Evidence of this is the ease at which videodisc technology, with its capabilities for large-scale information storage and retrieval, permits the quick and random use of graphic images with accomplished text and numerical information.

To facilitate better discussion on this subject, the following introductory information is abstracted from Chen (see reference 1).

Videodisc and Its Characteristics

Optical videodisc technology is unique in that it allows the union of various types of information media into one continuous and simultaneous format. For instance, still pictures, moving slides, and films or motion pictures, meaning film and videotapes, as well as dual-sound stereo audio can all be included in one videodisc.

A high-density storage medium, an analog videodisc can be on a double-sided, 12-inch disc store 108,000 images with high color resolution and one-half-hour audio. This is comparable to 1,350 carousel trays, each possessing 80 slides; at 30-frame per second, video running for one-half hour. For a digital videodisc, about 800 MB of data can be stored on a 12-inch double-sided digitized disc; approximately 10,000 to 20,000 pages of text (varying with resolution fineness); up to 75 hours of digital sound; or any combination of these.

Analog videodisc permits a single image or piece of a motion sequence to be retrieved randomly in less than three seconds. In addition, one may retrieve a combination of still images, motion sequences and audio. Digitized videodiscs also allow information to be retrieved in seconds via the Boolean search and/or the full text search by use of a specified software.

A laser is the mechanism by which optical videodisc technology records and/or reads. The laser has the accuracy of one micro or one millionth degree of a meter. Because of this accuracy, a 12-inch disc possesses information with a phenomenally high-density inscription. Over 10-billion microscopic spiralling pits compose each side of the videodisc's information surface. The disc spins at a rate of 1800 revolutions per minute or 30 revolutions per second. As it spins, the laser beam's reflected light focuses on the disc's surface and a photo-detector collects it. When the beam hits a pit, its light is diffracted away from the detector. The different lengths of the pits cause a variation of light intensity. The formation of video and audio signals is in the result. Thus, the laser beam reads the information on each disc without actual contact. Furthermore, a protective layer of plastic on the videodisc's metallic surface forms the protective cover, which yields the information burned on the disc nearly indestructible. It is one of the reasons why the videodisc has been considered as an archival preservation or conservation medium.

The above summarizes the versatility of the videodisc, as revealed through the following characteristics:

- High storage capacity
- Multi-type information integration
- High resolution and sharp color images
- Ideal medium for archival and preservation purposes
- Fast random access
- Interactive capability with computer systems

The Interactive Videodisc

Though highly praised for all these traits, the videodisc's ultimate power is only completely divulged in an interactive mode. What is an interactive videodisc?

An interactive system is one in which both the user and the system enter into a simultaneous and reciprocal interchange. An excellent example of such a system is a human conversation.

Simultaneity and interactivity are the significant qualities. As in our mode of conversation, an interactive optical videodisc system allows a viewer to be an intimate part of the system and to be actively involved in both the viewing and learning processes. The coupling of the analog disc with a computer system, most commonly a micro-based computer system, yields this effect.

The ability to easily access information on a videodisc, together with the availability of sophisticated authoring software, allows the development and/or composition of computer programs on a variety of coursesware. Thus, a user has a convenient array of alternatives, via the selection from the supposedly user-friendly, menu-driven screens on the system, to retrieve needed information, found both on the disc and/or in the computer. To demonstrate both the characteristics of an interactive videodisc and how this technology has been used to provide information access insensitive of time, distance, geographical and other boundaries, a product of PROJECT EMPEROR-1 has been used.

PROJECT EMPEROR-1

PROJECT EMPEROR-1: China's Treasure Revealed via Videodisc Technology is funded by the Humanities Project in Libraries. US National Endowment for the Humanities. This project applies the most recent in videodisc technology. Its aim is to not only present, but also provide an interpretation of a difficult but most interesting humanities-related subject -- a major historical and archaeological find of China's past, the First Emperor of China's terra-cotta figures of warriors and horses. During the Emperor's brief 15-year reign, the Qin Dynasty, there were many significant achievements. For instance, the institution of unified written scripts, the completion of the Great Wall, the unification of warring states, and the construction of his magnificent tomb near Xian. This most spectacular and archaeologically significant discovery, which includes the 7,000 life-size terra-cotta figures of warriors and horses found near the First Emperor's grave, has captivated people throughout the world. Empowering an interactive videodisc, PROJECT EMPEROR-1 captures and interprets these incredible and most intricate subjects.

The Project Objectives

PROJECT EMPEROR-1 illustrates the valuable role of videodiscs for information storage, processing and retrieval. It also attempts to bond new communication technologies with the transfer of humanities-related information most of which
Introducing a revolutionary interactive educational and learning tool, in addition to the provision of multi-media, multi-formatted and multi-dimensional, visual, audio, and textual information, PROJECT EMPEROR-1 also offers interactive micro-based coursework to enable systems users to learn about the subject at their own pace and as desired.

PROJECT EMPEROR-1 Products

1. "The First Emperor of China" Videodiscs

Two double-sided 12 inch NISCAV videodiscs, entitled "The First Emperor of China: Qin Shi Huang Di" are the primary products of PROJECT EMPEROR-1. Most of the historical interludes and 100,000 frames of visual images make up each disc. Also, recorded in both Chinese and English is one full hour of narration and/or interviews.

In such the same format of an electronic book, the visual information is organized with reference to appropriate bilingual narrations, which are then classified into "chapters" each of which can be searched and retrieved just in the same way as any one frame of the visual images. While the videodiscs are not meant to be stand-alone discs, the first one does consist of a few stand-alone introductory programs, such as "The Introduction on the First Emperor of China", "The Great Wall", and "The Qin Terra-Cotta Museum of Warriors and Horses". In addition, the first disc contains also over 200 segments of motion video and over 4,000 still frame pictures.

An oral history presentation of videotaped interviews is located on the second double-sided disc. Segments from over 60 hours of videotapes consisting of interviews of the field's top experts were critically edited and reorganized into the format of questions asked of and responded to by each expert. To enhance quick retrieval, the answers provided by each expert to the questions asked are also arranged in chapters.

2. Electronic Database

For the visual images which are most significant, a detailed database is being developed on a micro-based system. Each database record consists of 12 fields, such as disc side number, frame number, type of object, date of object, date of discovery, size of object, material of object, site where discovered, current location of object, information source, publication sources, and comments. Almost all fields are expected to be retrievable for both visual and textual information.

3. Courseware

A hardware grant from the Digital Equipment Corporation led to the employment of a DEC IVIS (Interactive Video and Information System), together with the videodisc to create a variety of computer-assisted instructional coursework. In response to meeting the needs of users with different levels of expertise in Chinese art history and/or archaeology, three levels of coursework have been developed. The levels are the intelligent layman including school students, college students and researchers including graduate students in the field. For each level, computer assisted instructional lessons are being developed currently by using Videologic's authoring software, DIRECTOR.

Making selections on menus and sub-menus will be the method by which a system user will interactively choose options. In this manner, the user will progress through each lesson or part of it. Simultaneously, the user will be able to select visual, audio and textual information in any desired combinations. The
main menu is composed of the following alternatives:
- Topical -- choices for various subject matters at different levels of sophistication. Sub-topical menus are also available (see Figure 2 for the topical menu selection).
- Exploration -- choices to view three-dimensional pictures or to browse the slide collection by going forward, backward, zooming in, zooming out, etc.
- Reference -- selection for checking in the "glossary" file or for viewing the "bibliography" file. Some items included in the bibliography can also be retrieved and viewed in full-text form.
- Announcements or messages for the system user(s).

The intent is to make these courseware also compatible with IBM and IBM-compatible micro-based systems. Aside from the use of the DIRECTOR authoring software, options are open for experimenting with various other kinds of authoring software as well.

Figure 2: A topical menu of a sample courseware

CONCLUSION

A key element in the success of the objectives of PROJECT EMPEROR-I is its humanities focus. This orientation permits laypersons and field specialists alike to grasp the benefits of this technology. Videodisc technology permits the simultaneous retrieval of the multi-media information sources and spectacular visual images of this magnificent Chinese treasure. Thus, many can view this find in an even grander fashion than if they were personally on site. It also brings to those who may never in their lifetime travel to China, a mouth-watering taste of this spectacular archaeological discovery. For it provides them with the opportunity to experience this thrilling period of Chinese history. PROJECT EMPEROR-I allows our technological advances in information technology to enhance our appreciation of something very ancient and far away. Its cross-cultural orientation promotes international information transfer and communications.

Just as importantly, PROJECT EMPEROR-I has revealed itself as a perfect research and development project. It spectacularly promotes the tremendously exciting opportunities which the interactive videodisc can provide in education, research and training.

Generally speaking, videodisc technology also can be a universal tool for all of us and should have a very positive influence in the future of information provision and communications. It can provide information access incentive of time limitation, distance volume or complexity in a way not possible for us to contemplate before. This is the kind of dynamic and aggressive information provision which we as information professionals in this information age should develop and strive for.

PROJECT EMPEROR-I is one attempt to promote the development of a new frontier, a frontier which uses the most current information technology for information transfer and communications. While the process and tasks involved have been difficult and at times frustrating, the experience and results have been most exciting and gratifying.

REFERENCE


* This project has been widely covered in media, publications and conferences. For more information about the project and a complete and up-to-date listing of publications, contact: Dr. Ching-Chih Chen, Professor and Associate Dean, Principal Investigator and Project Director, PROJECT EMPEROR-I, Simmons College, 300 The Fenway, Boston, Massachusetts 02115, USA.