25

Optical disc storage: another can of worms?

Roger Martlew
Department of Archaeology, University of Leicester

25.1 Introduction

The University Grants Committee and the Computer Board have funded 139 projects in British Universities as part of their *Computers in Teaching Initiative*. Two projects have been accepted in archaeology, a joint Southampton/York project on simulating an excavation, and an investigation at Leicester into the use of interactive videodiscs for teaching archaeology to undergraduates.

This paper introduces the work which has just started at Leicester University, in the wider context of the potential application of optical storage devices in archaeology. The paper is also an invitation to submit databases of visual material, on any archaeological subject, for possible inclusion on the videodisc which is being produced as part of the project.

25.2 How optical storage technology works

Videodiscs are one manifestation of optical storage technology. The basic principle of these systems is that digital data are stored as microscopic pits in the reflective surface of a disc, in either concentric tracks or in a spiral track as on a record. When a low-powered laser is directed along these tracks on a spinning disc, the pits interrupt the reflection from the disc surface allowing the data to be read. The commonest example of optical disc storage is the compact audio disc, known as CD-Audio: the digital data read from the disc are converted into music. If this conversion stage is omitted, data from the disc can be read straight into a computer. The disc then provides a high-density storage medium, and is known as CD-ROM (Compact Disc Read Only Memory).

Videodiscs use the same basic technology to record video images. Research on videodiscs began as long ago as 1939, but the idea of using discs was superseded by video tape, which enjoyed the advantages of mass production for the home entertainment market. Videodiscs are like CD-Audio in that the digital data are converted into an analogue signal, in this case for output to a television monitor. This means that the image itself can not be accessed by the computer. Indexing details need to be provided, with pointers to the relevant frames, for random access to the information. For example, a page from the Domesday book displayed by videodisc would have to have all the words listed separately on the computer if full-text searching of the page contents was to be achieved: the computer would not be able to 'read' the words on the page itself.

Under computer control, though, the videodisc provides a large store of visual information with full random access: images can be still frames or moving video, or stills from a section of

moving video. There are two parallel sound tracks which can be used for voice-over narration, background music, or computer data; graphics produced by the computer can be superimposed on the video image from the disc.

25.3 Capacity

Recent years have seen a steady increase in the capacity of magnetic media to store data, with a consequent decline in the cost of storing information. Optical storage devices have brought about a sudden leap in cost-efficiency, but with attendant limitations imposed by the technology itself. In approximate terms, a six-inch diameter CD-ROM disc can store the equivalent of 200,000 A4 pages of text, 3000 colour images, or 650 Megabytes of binary data.

A fourteen-inch diameter videodisc can store the equivalent of a million pages of text, 108,000 colour images, or four Gigabytes of data, in addition to one hour of hi-fidelity sound on each of two tracks.

The most serious limitation of optical storage devices at the moment is that they can not be overwritten: once data have been stored on a disc, they can not be erased or edited. Videodiscs suffer the added disadvantage of an expensive production process: with CD-ROM, the mass-production of CD-Audio has brought down the initial costs of disc pressing, because the same machinery can be used for both types of compact disc. A drive is also available which allows data from a computer be written to a compact disc, without having to be sent away for pressing: the device is known as a WORM (Write Once Read Many times) or DRAW (Direct Read After Write) drive, and can store in the region of 115 Megabytes, ten times the storage density of a standard magnetic Winchester hard disk.

25.4 Costs

The costs of disc players reflect the fact that in commercial terms optical discs are still breaking into new markets: late 1986/early 1987 prices for the same CD-ROM drive varied from $2800 in France to between $680 and $900 in America (Collier 1987). Videodisc players vary in price depending on the degree of interactivity supported: the Philips VP415 used with the BBC Domesday disc is at the top of the range (it can handle binary data stored on the disc in addition to the video images), at a cost of about £2600. Once a master videodisc has been pressed, at a cost (after mastering) of around £3,000 per side, multiple copies can be run off for around £35 for 10 to 25 copies, reducing to £10 for 500 to 1000 copies. Although these costs are likely to come down as mass-production increases, they have considerable implications for the ways in which optical discs are likely to be used in archaeology.

25.5 Applications

Outside archaeology, CD-ROM is increasingly being used for electronic publishing, particularly by online database hosts. It is cheaper for their customers to receive monthly updates of a large database on CD-ROM for in-house searching, rather to pay expensive online charges. ERIC, the American educational resources database, is available on CD-ROM from at least two online hosts; British Books in Print has 920,000 titles on CD-ROM, each record containing fifteen fields; the Post Office now has every one of the 23.5 million addresses in Britain on CD-ROM.

The BBC's Domesday videodiscs have attracted a lot of attention recently, and there are visual databases on a wide range of subjects including the planets and Fine Art collections. Videodiscs

are widely used in industrial and medical training, with video sequences of unrepeatable events such as surgical operations or personnel interviews. Not only can the trainee go through the same material any number of times, they can also interact with the video sequences through the computer. Touch-screens and light-pens are used to identify objects on the screen, and continuation of the video sequence is dependent on, for example, identifying an organ correctly during an operation. The trainee can also be offered choices during a sequence, and the computer branches to a different sequence on the disc depending on the response.

25.6 Archaeological applications: CD-ROM

The combination of simple graphics and fully-searchable text makes CD-ROM an interesting medium for electronic publishing. Much has been said and written on the subject of the computer-based publishing of archaeological reports, and CD-ROM is yet another "black box" to be included in the arguments. It is far superior to the current practice of combining printed text and microfiche, since everything is in the same medium; hard-copy can easily be obtained from the device which is displaying the data; it can allow full-text searching, and it is cheaper to produce than print on paper. However, it shares with microfiche the problem of requiring a special machine to read the information: the commercial investment in CD-Audio will continue to ensure that costs are kept to a minimum, and the problem of standardisation is being addressed in a rational way by the industry (Schwerin *et al.* 1986).

There is so much space on one CD-ROM disc, though, that several traditional Level III reports, complete with full specialist reports, data listings and the software to search and display them, could be distributed on one disc. Not only is there a potential for archaeologists to use WORM discs for on-site mass storage of excavation data—as is already being done by Dominic Powlesland at West Heslerton—there is also a potential for a fully machine-readable archaeological journal on compact disc: such a disc could well encompass, for example, the entire annual collection of archaeological journals currently published in this country. With capacity such as this readily available, the distinction between Level II and Level III archives becomes blurred. Archaeologists must again consider how the information they generate is used, in order to decide on the most appropriate methods of storage and dissemination.

25.7 Archaeological applications: videodiscs

Videodiscs have an advantage over CD-ROM not only in their greater capacity, but also in the fact that they can store high-quality images more efficiently. Digitised drawings are acceptable on CD-ROM, but photographs take up a disproportionate amount of space on the disc. This is not a problem if only a few images are involved, but videodiscs offer a solution to the prohibitive traditional costs of publishing an artefact corpus, which requires a large number of photograph-quality images. The use of moving video means that complicated objects, such as sculpture or ornately decorated pottery, can be seen from every angle. Computer graphics can be used for information which may need updating, such as site distributions, and these can be used in conjunction with a database of maps on videodisc. Video footage of archaeological work in progress, either in the field or in the laboratory, can be used to train students in basic skills—although this should not be a substitute for experiencing the real thing. These applications will be investigated using the Leicester videodisc.

25.8 An archaeological application: Project Emperor-I

A project which is nearing completion in America has already realised some of the potential of these applications, and has also highlighted the important rôle which videodiscs can play in presenting archaeology to the public (Chen 1987 and *pers. comm.*). Project Emperor-I has produced two videodiscs on the tomb of Qin Shi Huang Di, the first emperor of China who ruled from 221 to 206 BC. A major leader in the unification of China, the Emperor was buried with an army of over 7,000 full-sized terra cotta figures, including soldiers, horses and bronze chariots. The first videodisc contains 200 segments of video and 4,000 slides, with narration in both English and Chinese. The second disc contains interviews with leading authorities on the period, describing current research and providing the sort of information which one could gain by meeting people at conferences, and not by reading their publications.

Each frame on the first disc has been indexed, and a computer database gives rapid access to any of the images on a range of search criteria. In addition to material from the tomb itself, important objects from the period contained in museum collections in China give background information which is not otherwise available outside the country. The computer allows access to the data on several different levels: sections of video can be selected and viewed as a continuous sequence; different frames can be linked by a variety of themes (such as styles of dress and armour or conservation techniques used by the excavators) to guide students through specific course work; or individual frames can be called up by someone wanting to locate information for their own research.

The tomb of the First Emperor is obviously an attractive subject to people with only a general interest in either archaeology or China. The power and flexibility of interactive videodiscs allows material of general interest to subsidise directly the production of databases for education and serious research. This is just one of the challenges which optical disc technology offers to archaeologists.

References

CHEN, C. 1987. 'Interactive videodisc technology and microcomputers: a case presentation on Project Emperor-I', *in* K. Lehmann & H. Strohl-Goebel, (eds.), *The Application of Microcomputers in Information, Documentation and Libraries*, pp. 657–661, Elsevier Science Publishers BV. (North-Holland).

COLLIER, H. 1987. 'CD-ROM price war', *Information World Review*, 12.

SCHWERIN, J., H. KAIKOW, C. BAILEY, & P. LIGHTBOWN 1986. *CD-ROM Standards: The Book*, Learned Information (Europe) Ltd, Oxford.