

MULTIMEDIA AND MAPPING: USING MULTIMEDIA DESIGN AND AUTHORING TECHNIQUES TO ASSEMBLE INTERACTIVE MAP AND ATLAS PRODUCTS

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The use of multimedia to design and produce maps and atlas products requires a different approach to that of assembling a mapping package with automated mapping systems or desktop publishing. Multimedia authoring packages allow for the assembly of an interactive atlas or map collection which can contain computer graphics, still and moving images, sound and video. These mapping elements can be cross-referenced and connected through hypertext links and pre-determined viewing routines. The authoring of multimedia products, which can be stored and distributed on CD-ROM, offers cartographers the ability to investigate and develop design strategies which can be implemented using non-conventional mapping packages. The mapping industry first used computers as "number crunchers", then to guide drawing instruments as CAD systems, then applied computer graphics to artwork production and output. Multimedia, and its associated computer-driven devices may well become part of the tools of the profession.

A growth area in employment and business opportunities at present is in the production of graphics, maps and effective reports for decision support. Multimedia is playing a bigger and bigger role in spatial decision support in both government and private sectors. The growth in the use of computer simulations and multimedia "packages" to effectively illustrate things like spatial phenomena and associations has been steady over the past few years. A much richer media environment can be made available to the user if access to geographical data can be made with the type of user interface which best suits the mapping package and the type of map use. Multimedia offers the user many different ways to interactively interrogate a mapping product, making it much easier to find the most appropriate data and to "see" that data a visual or aural images.

The author has been developing an interactive CD-ROM mapping program which is to be used to test the effectiveness of multimedia as a user interface to Geographical Information Systems (GIS). This paper outlines the methods used to produce an interactive mapping package on CD-ROM. It will outline the design philosophy used to guide the mapping package assembly, describe the authoring packages used for production of the package elements and give details about how such products can be used to enrich the media used for spatial data depiction.

1. Introduction

As computer technology now dominates map production, a major technological development which the interest of visualisation has brought to cartography has been the utilisation of new multimedia technologies, which offer the potential for map displays. [26] Multimedia is an accessible tool, both practically and economically. If multimedia is viewed as multi-media, its potential in the application of access and display interfaces to geo-spatial information in a variety of ways can be visualized. Multimedia offers a different way to view and store geo-information.

Electronic computer-generated and controlled multimedia is a relatively new tool for use with geo-spatial information. Multimedia offers more tools with which to design and assemble contemporary map products. [7] By looking beyond the map metaphor and to different multimedia methods, better and more appropriate data portrayal can result. Mapping and GIS would benefit from having a computer-based "package" which contains some elements of numerical calculations, data storage and manipulation; information assembly, evaluation and certification; and the translation of all of these component parts into spatial knowledge.

The paper discusses multimedia and maps as another way with which to present geospatial information. It then covers the design of an interactive multimedia mapping package and gives an overview of design guidelines. The production of an interactive CD-ROM using Macromedia Director is explained and the associated software packages used are described. Finally, future prospects for the delivery of interactive mapping are outlined.

2. Multimedia and Maps

Computing and computers have been used by the geo-spatial information industry in many different ways. However, the industry has been disappointed before when the predicted benefits resulting from applying computers to production of spatial tools for geographical interpretation. Computer-generated maps, orthophotomaps and microformats, either did not practically provide the products promised or were not accepted by map users, leading to eventual dismissal as a technological gimmick or something which was seen to be inferior to existing paper maps. Effective communication and education are the key elements to success with multimedia. [25]

With today's (and tomorrow's) technology tied to human endeavour and innovation maps produced using multimedia could actually be many maps - providing access to information in ways dictated by the user. The multimedia map needs to be thought of as a means by which a better "picture" of the information a user needs can be painted: a map which, as well as using traditional map and GIS metaphors, can give users access through the use of additional metaphors.

A multimedia map provides not just a picture of geographical reality, but also gives access to geographical data. It also allows users to access further data and information plus background information about how things - data systems, data suppliers and facilitators, and mapping systems, and so on, actually work.

The geographically-linked "things" which can be displayed using a multimedia map are a conglomerate of items, systems, processes and conventions.

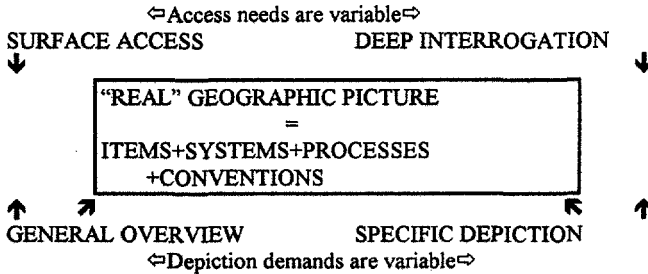


Figure 1. The "real" geographical picture is one which consists of many attributes.

What the Figure 1 attempts to depict is the fact that the "real" geographical picture is one which consists of many attributes. If access is denied to support information, that is information which supports how to get data, data standards, data systems, data providers and data and data depiction conventions then the mapping system user is denied a true picture of geographic reality. Also an efficient system would allow users to gain access to the "picture" via a general, surface access mode or through a rigorous process of deep interrogation. [19] At the "viewing end" of the electronic mapping process users would be offered depiction methods which painted a general information overview or gave a very specific and precise graphic profile of essential user-defined geographical characteristics. This may go towards satisfying what Buttenfield [4] says is needed when moving from interactive to proactive graphics - proactive involvement of the user, where the user takes some action before it is mandated by a system request.

3. Design of an Interactive Multimedia Mapping Prototype

3.1 General

A CD-ROM package has been assembled as the first part of a project to test the effectiveness of using a multimedia interface as a GIS information "browser". The concept behind the product was that in many cases users of the system "browse" the interface to "see" the types of elements about which the complete GIS database could be interrogated to elaborate and expand upon. Once the multimedia interface user has found the type of information they needed, they can then link to the GIS package "behind" the interface and interrogate the GIS system for more precise and concise database information.

The interactive package was built to test a combination of metaphors in addition to the map metaphor. These additional metaphors have been proposed as: The Storyteller; The Navigator; The Guide; The Sage; The Data Store; The Fact Book; The Gameplayer; The Theatre; and The Toolbox. [8] (Monmonier [17] says that the two most important metaphors for dynamic cartography are Navigation, to locate facts, images and other relevant information, and Narration, the introduction to new data sets through a "guided tour" using narratives of useful / interesting information.) The product is being further developed to include all of these metaphors as a means to access the database.

3.2 Assembling the Package

Design rules are still being developed for multimedia mapping packages. A sample of three design ideas are presented here.

Luther [16] classified the topology of putting together a multimedia package into six categories:

- Linear Presentation (offers the ability to control activities by keyboard, touch-screen or mouse operations and usually alternate between presentation and controlling activities).
- Data-driven Engine (used where linear presentations need to be simplified by things like reading instructions from a text file).
- Hierarchical Menu (works through the display of a menu using a presenting activity and then controlling the activity to receive a users selection).
- Information Retrieval (applications use multimedia databases, containing multimedia assets like text, audio, video, Quicktime movies and scanned photographs to access databases).
- Hypermedia (for applications where more latitude needs to be given to the user. Usually requires an engine approach through the use of commercial hypermedia authoring programs).
- Simulation (specific programs need to be written for these applications and generic structures generally cannot be applied).

Fonseca and Raper [12] proposed a design process which used:

- Animation (map sets)
- Thematic material (for "browsing" and "associative linking")
- The use of Hypertext
- Algorithms like those used on GISTutor II [23]
- A pop-up palette of commands
- A time-space diagram as an organising metaphor
- Statistical information, maps, air photos, scanned archival material and photography

Elements which should be considered when designing multimedia maps are:

- Production of storage media to accepted standards
- Imagery and Image Compression
- Authoring systems for constructing navigation strategies for "search", "locate", and "display" routines.
- Map displays - design / adaptation of individual maps.
- Image Queries and Navigational Strategies. [7]

Most developers usually concentrate firstly on the user interface as a means to develop further access to individual package components. The first step in producing the interface is to determine the parameters that are important in tuning a search to a specific user. Such parameters may include: level of detail, language used, type of information (eg: map, image, photo, text), place of interest, etc (etc or be conclusive). [2]

4. Authoring Packages

Packages used to author multimedia packages offer the ability to transform what is essentially a linear reading process with conventional atlases and "sets" of digitally-produced maps. Interactive multimedia packages have been produced to test the media and to develop access routines. Some of these are: *GISTutor* [23]; *Hypersnige* [9]; *the Scott Multimedia Project (SMP)* [24]; *Great Cities of Europe* [21]; *The Territorial Evolution of Canada* [1]; and *Athena* [20].

Packages available to put together interactive multimedia bundles are hyper media tools: Apple *Hypercard* and Aldus *SuperCard* for the Macintosh environment and *Matrix Layout* for the PC and authoring tools *MacroMedia Authorware Professional* (Macintosh and PC) *Assymetrix Multimedia Toolbook* (PC / Windows) and *MacroMedia Director* (Macintosh and PC / Windows). The authoring program used for the project was *Director 4.04*. It has become the pseudo-standard for authoring interactive multimedia packages in Australia and is used to produce the interactive components of other packages like *Authorware Professional*. As much developmental work has been done with *Director* in Australia, the access to authors for information about products produced with the package was invaluable.

Director, according to Moore [18], is "simply the best authoring software for putting together graphics, video and audio to create kiosk displays, interactive entertainment or educational CD-ROMS, simulations, presentations and demos." (p.53) The software can be used on both Macintosh and PC (Windows) platforms and programs authored on one platform can be ported onto the other for distribution. (A fine claim by the software vendors, but one aspect of the practical application of the software which created, and still continues to create, time-consuming de-bugging and modification tasks).

Macromedia gives a royalty-free license to release the "movie" as projectors, provided that their logo and a copyright notice is placed at the end of the projector. Most other authoring software vendors require that a royalty fee be paid for each copy of the program made for distribution. Developers are already reeling from escalating production costs and licensing fees. [3] and the development of titles using many proprietary authoring software packages require that the author pays a licence or royalty to distribute copies of the interactive program. Whilst this is usually quite a small fee for companies which develop titles for mass distribution, and the sheer volume of numbers produced reduce the unit cost of royalty fees to an acceptable amount, short runs, which may be needed for specific mapping applications, will attract a sizeable levy..

Authoring is done using icons and timeline metaphors. Audio file formats which can be used are .AIFF, .SND, Soundedit and Windows .WAV (only .AIFF for the Macintosh). *Video for Windows* .AVI and *Quicktime* .MOV digital video is supported (only .MOV on the Macintosh). Animation formats are FLC, FLI, MMM and PICS. Devices which can be used under software "control" are MCI-compliant CD and MIDI devices and videodisc. All popular image formats can be used.

Figure 2 illustrates the essential components of *Director*. The Score (the TIME element which is the essential component of putting together a *Director* movie, and then controlling

how the user can progress through the movie, "jump" to other frames and move to specific frames in other movies); The CAST (imported images, sounds, digital video and graphics from which the program is composed and individual "scenes" are constructed); The CONTROLLER (allows the developer to move about the composition with VCR-type icons); and The STAGE (in which objects are able to "enter" and "exit" on cue and to be located according to a pre-determined hierarchy of importance, allowing a reasonable figure-ground relationship to be designed).

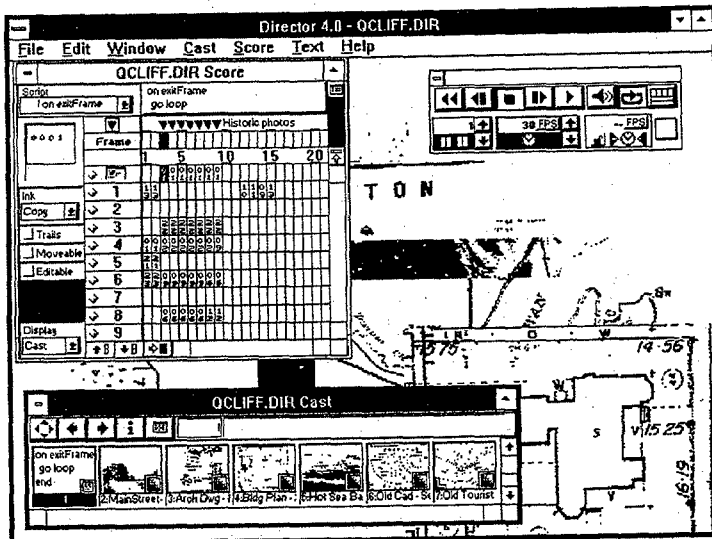


Figure 2. The Director authoring screen with Score, Cast, Controller and Stage (background)

To use Director to develop the prototype "movie" an Apple Power PC 8100/80AV with 64mb RAM and 2gb of hard disk, two graphics screens and one video screen, a 16 bit sound card and a CD-ROM reader was used. Once complete, the program was transferred to a 486 DX-2 PC with 20mb RAM and 500mb hard disk, with Soundblaster sound card and CD-ROM reader for production of the Windows version. Director "movies" can be run on a less powerful computer, like a 386P PC with 4mb RAM and an 8 bit sound card. "Projectors" can be created from Director "movies", which enables the completed projector to be played on computers without the need to have Director software available.

5. Production of an Interactive Mapping Package on CD-ROM

Authoring the package involved two distinct steps - capturing and assembling images and writing the "score".

5.1 Capturing images

Images were available on videodisc, captured during trials of multimedia and videodisc for historic property records. [5, 6] A Sony Lasermax LDP3600 was used to capture images from the PAL videodisc. "Videodisc Stack" software was used to control access to individual frames on the disc. This allowed quite rapid viewing of images. Images were captured with a frame grabber and then exported to Adobe *Photoshop*. *Photoshop* was used to manipulate the images by cropping and enhancing - by adjusting contrast and brightness and applying a sharpening filter.

Digital video movies were produced using *Premiere 4.0*, from Adobe Systems. *Premiere* can be used to import video from tape or videodisc and produce *QuickTime* movies, which can be compressed and stored to hard disc. The package also allows for individual frames to be combined into a *QuickTime* movie and stored on disc or output directly to videotape. For this project video was output from the videodisc at 30 frames per second (fps) and digital video made at 15 fps at a 240 x 180 pixel resolution, compressed and written to the hard disc. It was found that producing movies at a larger resolution did not produce more suitable products, just bigger ones which took up more storage space and were slower to run. Each movie was compressed for storage using MPEG. Compression of a 2 minute video took approximately 20 minutes.

Digital movies produced for the interactive package had to be playable on both PC and Macintosh platforms using *Quicktime* on the Mac or *Windows with Quicktime for Windows* on the PC. As the movies were processed on the Macintosh platform, they had to be "flattened" to enable them to be played on either platform. This was done using *MediaGrabber* (to compress the movies and save them at 15 frames per second) and *Movie Player 2.0* to transform the movie so that it was self-contained and playable on non-Apple PCs

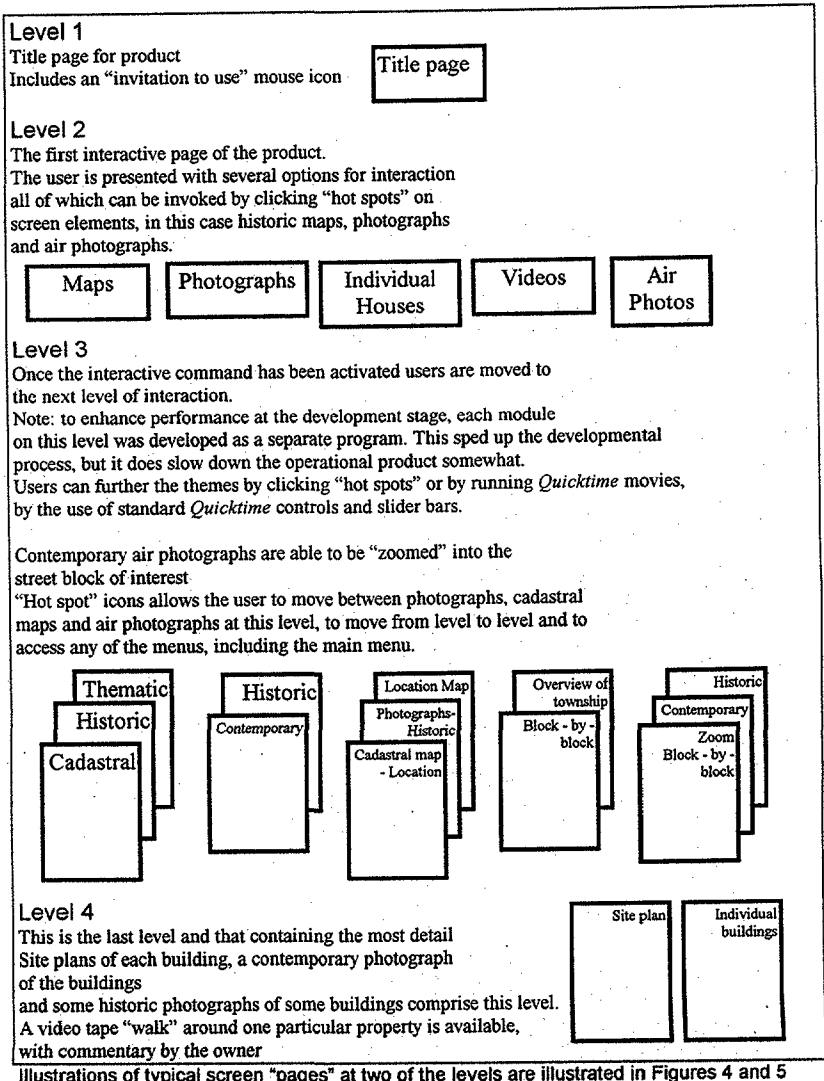
5.2 The Score

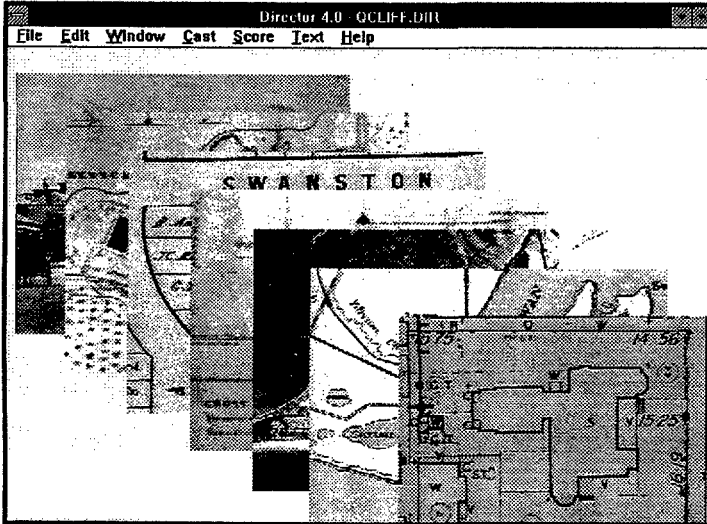
Writing the score is similar to scoring any movie script. A timeline is built and each frame assembled in a pre-determined order. Hypertext links allow the user to move from theme to theme and location to location. The score is constructed by "dragging" the appropriate cast members from the cast window into the required frame on the score matrix. The score matrix allows images to be "stacked" on many levels, allowing for the final stage to present information at various levels. The score can be likened to the assembly of a movie script, with the timeline used to "tell the story".

5.3 Further development.

Stage 2 of the project involves scripting in the *Director* "Lingo" language to enable links to be made to a GIS, MapInfo. Once a particular property or property type was found on the CD-ROM multimedia "browser" a unique file number is output from the multimedia package to a file. The GIS package then retrieves the unique number and links the image(s) on the screen to a particular property or property type.

Figure 3, below, illustrates the levels of information contained in the multimedia prototype:





Above: Figure 4. Level 1 - the user selects to move to either site plans of individual properties, maps, air photographs, historic artefacts, cadastral plans, historical maps and historical photographs. This is done by clicking "hot spots" on the screen. Below: Figure 5.

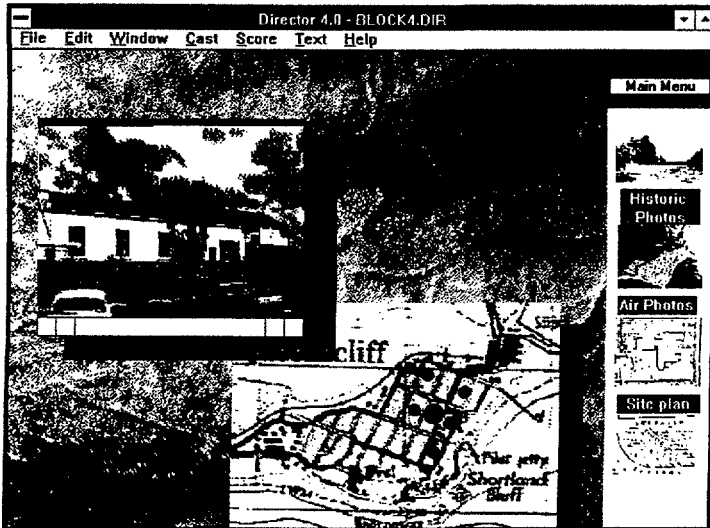


Figure 5 illustrates a Level 4 video "block-by-block" coverage of streets indicated on the accompanying map. Videos can be controlled by buttons and slide bars, fast-forward, fast rewind and pauses. The video package uses standard *Quicktime* controllers.

6. Future

The present state of the IT industry has been described as in a state of LOCAS - Lots of Confusing Acronyms and Standards. [14] However, there are a few developments which will impact on how interactive mapping packages might be developed.

6.1 Authoring Packages

The future of software packages for multimedia development will be in their ability to run on any, or the most widely accepted platforms. Script X from Kaleida Labs is a device-independent multimedia programming language, produced as a joint venture between Apple and IBM. [22] Such joint software developments illustrate that cross-platform development is now possible. This may go a long way to eradicate incompatibilities between software and hardware, as the slightest incompatibility between software and hardware can cause disaster. Script X allows the creation of a single file which runs on multiple platforms, instead of having to create multiple run-time versions.[3] Initially set to ship in October 1994, Script X was released in early 1995.

6.2 Video

Future multimedia will rely heavily on *Quicktime* and Microsoft's *Video for Windows*. [10] *Quicktime* provides both a software layer of integration between multimedia applications and multimedia hardware resources such as Digital Signal Processing (DSP), audio, and videoboard, and synchronises independent audio, video, still image, animation, and voiceover data tracks within its "movie" data files. Macintosh platforms are the preferred option for multimedia developers, by a ratio of about 20 to 1. [13] Digital video could well be the 'killer multimedia enabling platforms' for merging audio and video - bringing DSP into the mainstream of personal computing. However even though DSP PCs are on the way, higher levels of integration are still years away. It is predicted that inexpensive MPEG 2 boards will be available somewhere between late 1995 and 1998. [13] The Holy Grail of multimedia is seen to be collaboration via desktop videoconferencing [15] in the business world and digital compression and television for the home consumer. [11]

7. Conclusion

Things like maps, if used and presented properly in, say a multimedia system which is made available through "hard" devices like CD-ROM or "soft" devices like the Internet and the World Wide Web, can be seen as expressed by Donald Norman as, metarepresentations: a representation of a representation. [19] Maps, and other devices which articulate four-dimensional spatial information can be seen as cognitive artefacts, or tools - cognitive tools. How these tools interact with the mind and what results they deliver depend upon how they are used.

This paper has attempted to show how interactive multimedia can be designed and produced to offer a richer way to present geospatial information. Authoring packages are available, computer platforms are priced to make powerful devices affordable and image capture and transformation is easily made. But there remains the uncertainty about how the public will

use these products - as stand-alone CD-ROM based facilities, as networked resources or distributed multimedia via television or the Internet and the World Wide Web?

How will new multimedia maps be used? As Norman [19] says about the future and new technology"

"Even when the technology was predicted properly, it is rare that anyone truly understands its real impact, how it will be used." (p. 186) "Computers are part communication device, linked across the world, part television set. Computers will replace books, maybe." (p. 190)

Whichever way interactive mapping eventually establishes itself, the lessons learnt in developing interactive multimedia mapping packages on the plethora of software packages, computers and computer peripherals, will be investments in future mapping innovations.

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