1 Multimedia Cartography

William Cartwright and Michael P. Peterson

School of Mathematical and Geospatial Sciences, RMIT University, Melbourne, Australia
Department of Geography, University of Nebraska at Omaha, Omaha, USA

1.1 Introduction

The term *'multimedia'* was once used to refer to a sequential display of slides with a recorded voice-over. The concepts of *interactive multimedia* and *hypermedia* were introduced to refer to media combined with an interactive linking structure. The meaning of *multimedia* has evolved and now subsumes these newer concepts. Multimedia uses different media to convey information as text, audio, graphics, animation, and video, all done interactively. This provides 'rich media' content. It also refers to computer data storage devices, especially those used to store multimedia content. Multimedia enhances user experience and makes it easier and faster to grasp information. Multimedia *is* interaction with multiple forms of media supported by the computer. The computer is both the tool of multimedia and its medium. Without means of creation or distribution, the current interactive form of multimedia would not exist. The World Wide Web, both static and mobile, has dramatically increased the audience and use of interactive multimedia products.

Multimedia Cartography evolved from a need to present geographical information in an intuitive manner. Multimedia Cartography is best defined through the metaphor of the world atlas that revered assemblage of maps in book form that has introduced people to the world for centuries. Displayed prominently in people's homes, or stored for reference in the library or school, the atlas has been a window to the world for millions of people. It is consulted when one needs to know where something is located or something about a region of the world. The atlas forms the basis for how people conceive the world in which they live.

The atlas also has a general audience. Its use does not require any particular expertise or motivation. It is not intended for the expert user or

people from any particular educational background or for only a few, highly-trained individuals. Rather, it is an inclusive form of cartography that invites the user to explore the world through maps.

The traditional, printed atlas is not without its limitations. The maps lack interaction. It is not possible to change the scale of the maps or add detail. There is no provision to consult an underlying set of data. It is not possible to link features to other types of media, such as sound, pictures, or video. It is not possible to view cartographic animations that would depict the dynamic character of the world.

Interactive media is now commonplace and ubiquitous. Through the influence of the World Wide Web, users now expect a linking structure to be incorporated on any computer display. A display that is static is uninteresting and so it is with maps as well. The surface depiction is no longer sufficient. People want to "go into" the map, both spatially and conceptually. They want to explore at a deeper level. They want to put the pieces of information together themselves. These tendencies are not idle pursuits but can be attributed to the way we learn and structure knowledge. Interaction is the key to knowledge formation.

1.2 Visualizing geography

The general public use maps daily as a general information source, or as a tool to find specific locations when using a street directory or an atlas. They are bombarded with spatial information on television news reports, in newspapers and magazines and as part of computer packages for gaming, education and training. Technological developments have led to a wider range of different cartographic products that can be made faster and less expensively, and the interaction with visual displays in almost real-time. This has moved the emphasis from static to dynamic map use (Taylor, 1994), from discrete to distributed information provision, and from 'wired' access to 'wireless' access.

The 'real' geographical picture can be seen to be one that consists of many attributes. An efficient system for exploration would allow users to gain access to the 'picture' via a general, surface access mode or through a rigorous process of deep interrogation (Norman, 1993). At the 'viewing end' of the electronic mapping process users would be offered depiction methods which either painted a general information overview or else gave a very specific and precise graphic profile of essential user-defined geographical characteristics.

1.3 Access to geographical information

The spatial science professional is no longer the only one who should gain access to and present geographical information. Cartography has developed in two directions: the refinement of the means to represent natural points of reference; and the depiction of multiple phenomena. Therefore there exists the need to include more human-oriented elements in new media presentations and resources. There have been many comments about the needed evolution of current-day tools like GIS into one that will offer the required components for the next generation of user interaction, and it is suggested that this product should move from the 'technical elite' to the 'everyday user'. Commenting on GIS technology, Roe and Maidlow (1992) have noted that to date the vast majority of the emphasis has been placed on technical issues and that if it (GIS technology) is going to create value for the masses it is going to have to become more intuitive to use.

Many proposals have been made to rectify the shortfalls of digital mapping and GIS. Future systems were envisioned that incorporated image analysis and processing technology (Gallant, 1987); ones that included the cultural argument and information that highlighted human and social aspects, so as to reflect the basic goals of society (Chrisman, 1987); and new forms of data portrayal for the purpose of understanding, controlling and monitoring the multiple layers of space that make up the focus of human relationships (Müller, 1989). Other types of spatial data that were largely disregarded until fairly recently by the existing technology - photographs, free text, video images and sound, were seen in the future to play a greater role in decision-making than did all of traditional GIS (Lewis, 1991).

This technology-elaborated map could actually be many maps and provide access to information in ways dictated by the user. This would have the benefit of providing a map that is not just a picture of geographical reality, but also a search engine which, as well as giving access to geographical data and a means of data selection and display, also allows users to access further data and information plus a background on how things, data systems, data suppliers and facilitators, and mapping systems, and so on actually work. The geographically linked 'things' are a conglomerate of items, systems, processes and conventions.

1.4 A *Different* map

What multimedia offers is the ability to create a different map. By different map, what is meant is not merely something that is an 'electronic page turner', but a product which really extends the technology and allows for a

different way of presenting geographic information to change geographical information access. A multimedia-based mapping product is seen as a real alternative to conventional mapping (including those maps now being produced electronically). Most electronically-produced are still not really that different to the maps produced when the printing press harnessed cartographers to think in terms of page sizes, print-derived specifications and products which had to be technically correct the very first time they came off the press. For example, topographic maps design, and the efficient uses to which these maps can be put, owes much to eighteenth century generals and nineteenth century engineers (Raper, 1996). They served their purpose as a tool for the accurate depiction of hills, roads, streams and other strategic terrain elements for military strategy, but the advent of the aircraft made the importance of high ground less prominent. Similarly, engineers required accurate, large-scale representations of landforms to enable the planning and conduction of their Victorian age buildings. The role that these types of maps were used for, and the depiction methods used, served particular functions. The 'print mindset' has been extended into some areas of automated mapping, GIS maps, applied computer graphics-generated maps (like those in contemporary printed products and those used as support devices for television news and weather services) and even to digital data stored on CD-ROM. Peterson (1995, p. 12) speaks of a 'paper-thinking' that still pervades how we think about maps and the process of producing them. The print mindset has 'harnessed' map designers to the idea that computer-generated maps should mimic printed maps (Cartwright, 1994).

Multimedia is intended to expand the channels of information available to the user. Users should then be able to thread their way through a database query in ways not anticipated by the system designers. Multimedia is an accessible tool, both practically and economically, even though it has been 'hijacked' by the 'glossy' nature of many multimedia products. But, if multimedia is viewed as multi-media, then its potential in the application of access and display interfaces to geographical information in a variety of ways can be seen. Multimedia offers a different way to view data that has been generated and stored by the many existing spatial resources packages.

In the real world some things can appear to be something that they are not. How things appear on the surface of an interactive multimedia product is not representative of what is happening with the human part of the interaction. Designers of multimedia geographical information products are undertaking work to ensure that the media allows for individual mental maps or virtual worlds to be composed and thus making available artifacts that allow geographical information and the real world to be better understood. Users must be encouraged to include their own experience in the 'reading'

of the presented data. Multimedia allows the virtual world to be unfolded, scene by scene, where each unfolding offers a further unfolding.

1.5 Multimedia as an information interface

The traditional map form can be seen as a form of multimedia, whereby lines, colours, text, rendering, symbols, diagrams and carefully chosen content, were used to impart a 'story' about reality. Everyone is a product of their past training, and the limitations of the printed graphic map are still embedded in our thoughts and habits (Morrison, 1994). Those involved in the art and science of map-making should be content that these devices, paper or digital, accurately portray the phenomena that has been selected. However, the traditional delivery mediums cannot be viewed as an isolated entity in the digital electronic age, an age where arrays of information resources can be output in many different ways. This will restrict the possibilities for offering a package of information-enhanced map products. The multimedia revolution should be exploited to augment the capabilities of existing methods of geographical information processing (Groom and Kemp, 1995) and extend the use of the map as an isolated display device by adding extra data and information depiction methods. Interactive maps, using hot-spots and buttons to give access to the underlying data and metadata would allow for the map display to link to other information offering an enhanced spatial information resource.

Contemporary mapping, although providing timely and accurate products, may be still using formats which disallow them to be fully utilised. If one was to make a very general observation, the conclusion could be made that the formats and types of presentations used for the depiction of spatial data do not fully exploit the plethora of other information delivery devices in common usage. Telephones, television, faxes, computers, email, Web browsers, radio, newspapers, magazines, films and interactive mediums are all used to keep us informed in our own everyday lives. Maps can also adapt these other devices to enhance the communication of spatial information.

Tools like word processors and drawing programs are now commonplace. Users work with many tools on one computer and, increasingly, computer-based tools are used for communication with other people. Interactive systems are becoming gateways to communities and endless information spaces (Rijken, 1996). Hybrid tools, like the use of television for shopping and the use of metaphors to navigate through fairly complex data sets, have been developed. The choice of an ‘ideal’ tool is becoming com-

plicated as we move from the simple one-user, one-device to computer-supported collaborative work and the design of interfaces for entire organisations (Rijken, 1996).

Maps themselves have been designed for purposes that are far more intimate than the plethora of uses to which contemporary maps are put. If the types of graphic representations provided with contemporary spatial information products are looked at critically it could be said that the depiction methods used are still not that dissimilar to those that have developed from the specifications provided by military and engineering authors. Multimedia offers the tools for depicting spatial information through the use of many media tools. To limit depictions afforded by multimedia to just maps and plans does not exploit the rich forms of media that are available. Multimedia allows many other ways of presenting data sets and the results of analysis.

Multimedia is a new form of visual and aural presentation and expression. As a new communication form it has taken on its own grammar and made its own rules. The grammar is developing and (script)writers are only beginning to master it. The rules are new and already being broken, as new forms of multimedia are explored and other means of exploiting this conveyor of 'rich media' are tried, tested and developed. Multimedia has much to offer users of GIS in improving access to data and facilitating displays of that data in formats most compatible with an individual user's preferences for aiding their journey through a virtual world.

1.6 Visualizing Multimedia Cartography

Multimedia Cartography can be viewed as sphere that may moved by the user across and into a plane of geographical reality (see Figure 1). The Plane of Geographical Reality is composed of levels of abstraction. The user controls the sphere and can move down these levels. Moving the sphere across the surface affects a variety of other interrelated aspects of the display, such as scale and perspective. Critical in the use of multimedia

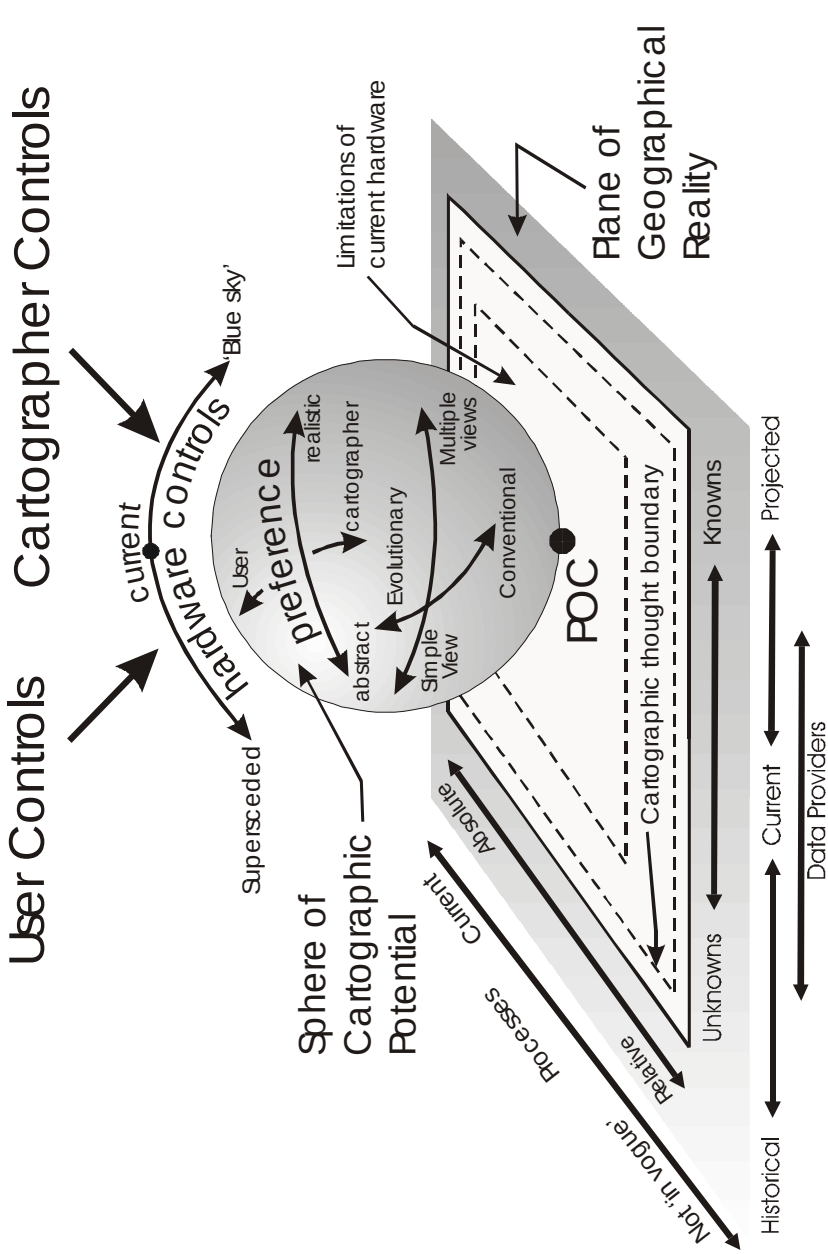

Fig. 1. The Sphere of Cartographic Potential and the Plane of Geographical Reality.

cartography is the Point Of Contact (POC) – the 'ideal' method for data/ information/ knowledge transfer/ understanding.

The POC is where the Sphere of Cartographic Potential (the best method of enabling the user to fully exploit a multimedia package according to cartographic allowances and hardware/software affordances) comes into contact with the Plane of Geographical Reality (the geographical 'window' through which the real world is viewed). The Sphere of Cartographic potential is controlled both by the user, who can choose a particular presentational method according to their ability and psychomotor skills, and the cartographer, who can apply their own biases or *depiction preferences* (and thus add *weight patches* to the Sphere and dictate, to some extent, its attitude and thus the relationship with the Plane of Geographical Reality.

The Sphere of Cartographic Potential is positioned according to controls that are within and outside of the sphere. The major external force are the hardware controls that can range from the need to use outdated equipment if, say, archival data located on a laserdisc needs to be viewed, to developing a product that needs 'blue sky' hardware that does not currently exist, or is cost exclusive, but will be available or economically accessible when a multimedia project is completed over some considerable time. The Sphere can be controlled by both user and cartographer to make display settings that will provide displays that range from the abstract to the realistic, from simple views to realistic views, and from the conventional to evolutionary displays.

The Plane of Geographical Reality is restricted by several factors. Firstly limitations of current hardware will disallow certain parts of the real world to be depicted. This limitation can be seen to be a movable feast and in the ever-changing scene that depicts today's computer hardware industry, what is currently impossible can be tomorrow's standard method of operation. The Cartographic Thought Boundary is the theoretical constraints of what could be depicted as can be conceived by cartographers. This perception of what can actually be done is a function of what is possible with contemporary cartographic visualization tools. The Plane of Geographical Reality is positioned also by the desire to view either relative or absolute information or whether knowns or unknowns (in terms of geographical information) need to be depicted. Processes that can be undertaken to take raw data and convert it into cartographic visualizations can be selected from the methods currently in use and even past methodologies that are not 'in vogue', but may be chosen to ensure that all possible procedural strategies are explored. Finally, what can sometimes override the best laid plans for delineating the Plane of Geographical Reality, the access to data, will affect its position and thus where the POC is made. Data

providers can make available data to underwrite depictions of historical, current or projected scenarios.

1.7 About this book

Multimedia Cartography is complex and the factors influencing its design and operation many. Much experimental work has been undertaken to explore the possibilities that Multimedia Cartography offers. Lessons learnt from the application of this multimedia data depiction tool can be used to guide future enterprises in the display of geographical information.

This book includes a number of chapters from Edition 1, as the topics covered are still relevant for providing a complete 'picture' of what Multimedia Cartography is – discrete, distributed, mobile and 'at location' geographical information provision. Chapters that follow cover all of these areas of cartographic endeavour. It is a truly international effort, and it brings-together contributions from academics, researchers and producers.

The first section of the book provides the underpinning concepts of interactive multimedia and its application to cartography – 'Multimedia Cartography'. Then multimedia atlas applications on CD-ROM and the Web are covered. This is followed by chapters on Virtual Environments and Virtual landscapes, and it includes an application on how this might be applied to cartographic education. Then chapters are provided on animation and dynamic maps. Chapters then cover the use of computer games technology for displaying geographical information in new ways. Mobile applications are discussed next, and the section provides chapters on research into this form of cartographic information provision as well as practical implementation. The Web, Web standards and Web applications then contribute to knowledge about how the Web can be best used as a geographical information conduit. Users are considered next, with chapters on usability and adaptability. The last section of the book examines future directions for Multimedia Cartography and then sumarises the book's contributions.

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