An Electronic Atlas Authoring System

This paper describes an electronic atlas authoring system that is being developed at the University of Arkansas. The system is a set of computer programs that aids in the construction of electronic atlases. The paper begins by examining the types of organizations that might be interested in using this system. It then offers a general description of the authoring system, including a discussion of the specific components which make up the system. The final section of the paper outlines how the system might be distributed.

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ATLAS PRODUCERS

There are two main types of organizations that have in the past shown an interest in producing electronic atlases. The first group–commercial companies–is probably the most visible. Commercial companies have published such widely sold software products as *Maps and Facts* and *Software Toolworks World Atlas*. The second group includes various governmental agencies, educational institutions, and advocacy groups. For convenience, we shall refer to this group as nonprofit organizations. Nonprofit organizations have published such atlases as the *Electronic Atlas of Arkansas*, the *Interactive Atlas of Georgia*, and the *Picture Atlas of the World*.

There are some fundamental differences between the marketing behavior of commercial software companies and that of nonprofit organizations. For example, commercial companies generally sell their electronic atlas products to the mass, or consumer, market. Their products can be found on the shelves of such stores as Wal Mart, Sears, and Radio Shack and software retailing chains such as Software Etc. and Egghead. You also can find their products in nationally distributed catalogs and in Original Equipment Manufacturer (OEM) bundles. An OEM bundle is a collection of computer programs that is offered free of charge or at a greatly reduced price when one purchases a personal computer or a CD-ROM drive. Additionally, commercial companies often sell their products to an international market and may sell foreign language versions of the same program.

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The electronic atlas market for nonprofit organizations has been more limited. Nonprofit organizations usually aim their products towards buyers with specialized interests rather than towards the more general mass market. Thus, an international agricultural organization might plan to sell their electronic atlas primarily to individuals and organizations that are working in some phase of the agriculture business and that would be interested in obtaining atlas-based information on agriculture. Often, their buyers are subscribers to their printed materials.

The potential market for such atlases is often limited in geographic scope. The *Atlas of Arkansas*, for example, has appealed mainly to a regional market. The new *Interactive Atlas of Georgia* will probably sell mostly to Georgians and buyers from the surrounding region.

In terms of the number of electronic atlases sold, commercial companies have been far more successful than nonprofit organizations. In fact, the vast majority of the electronic atlases that have been sold to date have

been sold by commercial companies. This is not surprising since most of the important factors necessary for success in the software business favor commercial companies.

The main mission of commercial companies is to develop, market, and sell computer software. The entire company, including management, is focused on this goal. Most companies have in-house, software development expertise. Their teams of software developers are experienced and are able to respond quickly to changes in technology and market conditions. It also helps that all of the large commercial software companies have more than one product to sell.

Commercial software companies that focus on the consumer market make their money by selling a large volume of relatively low cost products. Largely due to the intense competition, most of the electronic atlases found on store shelves and in catalogs today are heavily discounted and can be purchased for under $40.

In nonprofit organizations, it is rare to find in-house, electronic atlas development expertise, and the response to changes in technology and market conditions is typically slow.

In contrast, the main mission of nonprofit organizations does not include the development, marketing, and sale of software. Management is not focused on software and often does not understand the important related issues. In nonprofit organizations, it is rare to find in-house, electronic atlas development expertise, and the response to changes in technology and market conditions is typically slow. Such organizations usually set out to sell small quantities of a single atlas product at a relatively high price. For example, the *Electronic Atlas of Arkansas* sells for $99, National Geographic's multimedia *Picture Atlas of the World* sells for about $150, and the new *Interactive Atlas of Georgia* sells for $89.

In considering all of these differences, it is important to point out that commercial companies and nonprofit organizations may have different reasons for producing electronic atlases. The goal of commercial software companies is to make a profit, and they will do almost anything to realize that objective. On the other hand, the principal goal of most nonprofit organizations is to provide better service to the group of individuals (i.e., scientists, government officials, libraries, etc.) that they may serve.

Two difficult barriers stand in the path of nonprofit organizations that might wish to produce electronic atlases. The first problem is that these organizations' lack of experienced programmers inhibits their ability to create efficient, modern software. In fact, we do not know of any nonprofit organization that has a team of programmers experienced in the production of electronic atlases. The second problem is that few nonprofits have a staff of cartographers capable of producing digital maps for electronic atlases. Thus, nonprofit organizations are unable to create high quality digital maps. And it can be very expensive for them to have this work done outside the organization.

The goal of our project is to develop an electronic atlas authoring system that is designed primarily to meet the needs of nonprofit organizations. A main objective is make it feasible for nonprofits to produce electronic atlases by reducing their costs and development time. The system incorporates maximum flexibility in order to meet the needs of a variety of organizations. Very little programming will be required on the part of the atlas producer.

Atlases created on the system will permit users to view maps, to view text and tabular data, and to make two types of thematic maps on the fly. Initially, it will create atlases that run under Windows. Additional modules are planned for the future that include more features and the ability to run on different platforms.

ATLAS AUTHORING SYSTEM

The authoring system is comprised of two parts: a builder and a viewer. The first part of the system–the builder–has several functions. The builder brings together maps and data from a variety of sources. It cross-correlates information to validate that all map and data connections are correct. It converts vector maps from AutoCAD files and raster maps from BMP files into a more efficient format. Finally, it converts all data from the data matrices into a more efficient format. These last two conversions are made so that the atlas will be smaller and will run faster. The second part of the system–the viewer–serves as the atlas interface. It is an executable file that reads a configuration file which describes the data, maps, and indexes.

Five steps are required to create an electronic atlas. These steps are: (1) design the atlas, (2) create the map component, (3) create the data component, (4) create the map / data connections, and (5) run the builder. In the first step–atlas design–the developer organization defines the atlas. This step requires a number of decisions, including the selection of an atlas title such as "Crime Atlas of the U.S." The developer must also decide which map layers to include, which data categories to include, and how to connect maps and data. For example, the organization might decide that maps will include political boundaries and major city layers; data might include demographic, crime, and population categories; map / data connections might be the U.S., States, counties, and major cities. This means that there will be maps and corresponding data for each of these four levels.

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Once the atlas has been defined, the next step is to create the map component. The organization can supply its own digital maps or use those that are provided with the system. It is planned that digital maps of U.S. States and nations of the world will be provided. User-provided maps will need to match the following specifications: vector maps must be SQL databases, and raster maps must be BMP files (BMP is the standard Windows raster format). If there are both vector and raster maps, they must have a common coordinate system.

The third step is to create the data component. The data matrices can be created using any SQL database program. Most popular database programs meet this condition. The fourth step, the creation of map / data connections, can also be accomplished using an SQL database program. The resulting file is used to verify that maps and data match and to create the atlas index. It consists of a list of places to be indexed for each map / data connection. A place ID links each place (for example, each U.S. State) to a map file and a row ID in a data matrix.

The final step is to run the atlas builder. Running the builder creates the atlas with all maps, data, and indexes. The builder prompts for: the atlas name, target directories, a list of map layers, a list of data categories, a list of map / data connections, a list of filenames of map files, a list of filenames of data matrices, and a list of filenames of map / date connections.

The resultant atlas has three main parts: an information window, a map index, and a data index. One can use the information window to examine various types of information. Information can be in the form of reference maps, thematic maps, numerical data, and textual information. Data and map screens both support scrolling. Map screens also support zooming and hot spots in the event that such capabilities are desired by the atlas developer.

The map index helps a user move from place to place in the atlas. Its primary purpose is map related, but it also works for data. For example, one could move from a map of Japan to a map of Mongolia. One also could use the map index to move from Japanese economic data to Mongolian economic data.

The data index helps atlas users move from topic to topic. For example, one could use the data index to move from Japanese economic data to Japanese health data.

The authoring system was programmed using C++. For efficiency and flexibility, programming libraries were used extensively. The most important of these used in constructing the system were *Microsoft Foundation Classes* and *Victor Image Processing Libraries*. The use of libraries gives atlases a polished, professional appearance. In this case, the look and feel is that of a conventional Windows program, with print, export, help, and other standard features. Additionally, the use of programming libraries makes the system portable to other platforms. For example, it would not be very difficult to convert the system to produce Macintosh atlases.

DISTRIBUTION

A great deal of work has been done on the system to date, and we estimate that it will be finished in early 1995. At that time, we will announce its availability through the appropriate AAG, ACSM, and ICA publications. Initially, we will make the system available through the Internet. We also hope to provide various levels of support for organizations that are using the system. We may offer telephone and on site support, and we plan to develop additional modules that will permit multimedia capabilities to be added to atlases. A price has not been established, but it will certainly cost very little compared to the $350,000 or more that it costs these days to develop a full-featured electronic atlas. Thus, the system will allow the variety of nonprofit organizations that lack expert programmers and/or funds to produce high-quality digital atlases.

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RESUMEN

Este trabajo describe un sistema electrónico de autores de atlas que está siendo desarrollado en la Universidad de Arkansas. El sistema está compuesto por un juego de programas computarizados que ayudan en la construcción de atlas electrónicos. El trabajo comienza examinando los tipos de organizaciones que pueden estar interesadas en el uso de este sistema. Después ofrece una descripción general del sistema de autores sistematizado, incluyendo una discusión de los componentes específicos del sistema. La última parte del trabajo trata sobre la distribución del sistema.

SOMMAIRE

Ce document décrit un système de génération d'atlas électroniques en cours de développement à l'Université d'Arkansas. Le système consiste en un jeu de programmes informatisés qui aident à la construction d'atlas électroniques. Le document commence par examiner les types d'institutions qui pourraient s'intéresser à ce système. Il fournit ensuite une description générale du système de génération, qui comprend une discussion des composants spécifiques constitutifs du système. La section finale du document souligne le mode de distribution que pourrait adopter le système.