EVALUATING THE ELECTRONIC WALL MAP

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Abstract

Printed on a sturdy material and rolled for storage, the wall map has persisted well into the computer age. Changes in the world over the past decade have made the major limitation of the wall map very apparent — while these maps are made to last many years, the information that they depict goes out-of-date very quickly. The static display of the wall map also makes it difficult to show movement or dynamic processes directly. The ability to zoom onto an area or quickly switch between maps is also impossible. The electronic wall map can facilitate many of these dynamic forms of map presentation. It is characterized by the use of a projection device that displays onto a screen as large as several meters in diagonal measure. Electronic wall maps displayed from different video and computer sources have been tested in classes with up to 120 students. The major problems that were encountered were map legibility and response time. An adequate video source and projector are needed to assure a legible display. Slow display times make it difficult to display maps directly from the computer. It was found that the display of small paper maps through a vertically-aligned video camera proved to be the most versatile and effective version of the electronic wall map. The zoom feature of the camera allowed parts of maps to be examined more closely. The ease in switching between maps and the ability to point to different parts of the map was another advantage of this form of map display.

1 Introduction

The wall map holds an especially revered place in the front of the classroom where it is often used to focus the attention of students. The ability to indicate the location of places and emphasize broad patterns are principal advantages of this form of map display. Designed for the simultaneous use by a group of people, it is a type of map to which most people are exposed.

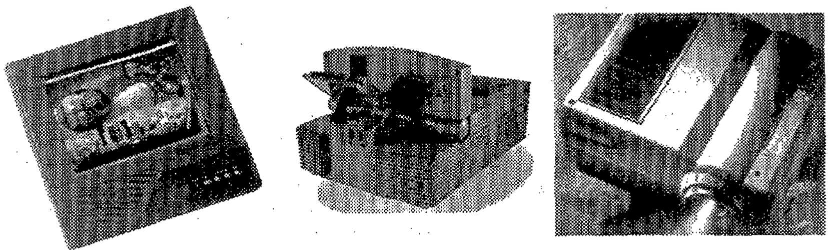
A number of problems can be identified with wall maps. First, while these maps are intended for group use, the actual number of simultaneous users is fairly limited. They are best used with small groups of less than ten people. Secondly, while the wall map is printed on a sturdy material and designed to last many years, the information that they depict often goes out of date very quickly. It is safe to assume that most wall maps in use today are more than a decade old and are referred to more for their historical content rather than as an accurate reflection of the current situation. This is particulary true of maps that show political boundaries or demographic data. The third problem, related to the previous, is the high cost of wall maps. With an average price of about US $500 many institutions are precluded from buying these maps on a regular basis. Finally, the wall map has all of the limitations associated with the printed map (Peterson 1995). It is a static display that makes it difficult to show movement or dynamic processes. The ability to zoom onto an area and depict it at a larger scale or quickly switch between maps is also not possible.

The use of video and computer projection devices as an alternative to the traditional wall map is examined here. First, the current video and computer sources and display devices are presented. Then, their use in a classroom is examined. Finally, some recommendations are made about the use of this technology.

2 Forms of the Electronic Wall Map

The electronic wall map is characterized by the use of a large monitor or projection device that creates an image on a screen that can be up to several meters in diagonal measure. It consists of two components — the output device that displays the image and the input device that generates the image. The output or display device may be a large-screen monitor, computer monitor, a video wall (consisting of a series of adjacent large-screen monitors), a projection panel, or a video projector. The input device may be a computer, a laserdisc, a VCR, or a video visualizer (a video camera designed for the display of documents). Each of these input and output devices have certain advantages and disadvantages. We begin by examining the display devices.

Display Devices. Display or output devices use two major technologies — the cathode ray tube (CRT) and the liquid crystal display (LCD). The large-screen monitor, computer monitor, and video wall all use a CRT to display an image. The first two differ in the resolution of the image that is displayable. Although large-screen television monitors are available in sizes over 50″ (1.26 m), they are limited to the display of about 525 video lines. The computer monitor, designed for the display digital images, has a much higher resolution display. Large computer monitors, available at sizes up to 29″ (73.66 cm), can be used as a display for small groups, especially if the monitor is set to display at a larger size. A video wall, on the other hand, consists of a series of large-screen monitors that are placed side-by-side. A special hardware controller divides the video source to be shown into sub-segments so that the image is displayed over several monitors. A disadvantage of this method is that the display is discontinuous because of the separation between the monitors. The use of rear-projection television monitors can reduce the size of gap between adjacent monitors. The use of adjacently placed CRTs without intervening gap has been investigated but it was found that the images did not align properly between displays and that even a slight misalignment was perceptible.



(a) (b) (c)

Figure 1 (a) Projection panel. (b) Video projector with mirror display system. (c) Direct display video projector.

The major development in large screen display over the last few years has been the introduction of two types of LCD (liquid crystal display) projection devices — the LCD projection panel and the LCD video projector (see Figure 1). The LCD projection panel is placed on top of a overhead projector. Light passes through the panel to display the image on the screen. Projection panels require an overhead projector with a higher than normal light output. In contrast, LCD projectors incorporate a small projection panel and a light source in a single unit (see Figure 1). The advantage of these units is that they can generate lighter images and can be used with room lights. LCD panels and projectors generally display a 640x480 image with up to 16.7 million colors. Some models are available that display an image up to 1,024 x 768 but these generally display less than 16.7 million colors (NewMedia 1995, p. 90). Most of these models display material from both computer and video sources and some also incorporate audio output. Table 1 summarizes the major characteristics of both CRT and LCD display devices.

LCD Projection The most promising projection technology is the LCD. The LCD works essentially as a light shutter. The liquid crystal consists of an oily substance

Output	Size of Audience	Resolution	Ease of Use	Display of Cartographic Animations
large screen TV monitor	<10	poor	good	yes
video wall (series of large-screen monitors)	<50	poor/ fair	requires additional hardware	yes
overhead projection panel				
passive matrix	<50	good	good	poor
active matrix	<50	good	good	good
video projector	100+	good	very good	yes
large screen computer monitor	<10	excellent	very good	no

Table 1 Comparison of output devices for the electronic wall map.

containing rod-like molecules (cyanobiphenyls) that respond to electrical fields by reorienting (polarizing) themselves along electrical-field lines. This polarization causes light to be passed or blocked. The most common type of panel is the 90° twisted-nematic field-effect LCD (TN-LCD). When no voltage is applied to a given pixel, the rod-like molecules of the crystal are aligned at 0°. As a voltage is applied, the molecules rotate continuously to 90°. Full-color LCDs use red, green, and blue filters to produce the primary additive RGB colors. A 3x3 array of subpixels are used to create a single color, with each array having pixels of a certain color. The range of color intensities generated by an LCD will vary depending on modulation techniques, frame rate, and the characteristics of the display controller (Peddie 1994, p. 194).

The TN-LCDs, also known as passive-matrix LCDs, are slow because the liquid crystal that it uses requires 100 to 200 milliseconds to respond to the electrical fields that are applied to it. This results in the ghosting or blurring of fast motion or changing images. This ghosting is easily observable by moving the cursor across the screen. Passive-matrix LCDs are not suited to the display of moving images.

Active-matrix LCDs use a faster response liquid crystal and can effectively display video images without blurring. These LCDs also produce a brighter display because a separate transistor is used for each pixel allowing them to stay on longer. An active-matrix panel is essentially a giant IC (integrated chip) with up to millions of thin-film transistors or diode switches fabricated onto a glass plate (Peddie 1994, p. 199). Active-matrix LCDs are more expensive than passive-matrix LCDs but the use of the latter is rapidly declining.

There are a number of advantages to using LCD technology for projection display. LCDs require less energy and have a longer longevity than CRTs. Energy consumption for the LCD itself averages between 1 and 300 microwatts per square centimeter (Perez 1988, p. 212) compared with 75 watts for a 13" color CRT and 300 watts for a 19" display (Perez 1988, p 95). However, LCD panels and projectors require a backlight and this can be much in excess of 300 watts depending upon the projection display. A CRT has an effective lifetime of 10,000 hours (Perez 1988, p. 106) whereas a LCD is rated at over 50,000 hours of constant use. This amounts to five years of 24 hours a day operation. In normal 8 hour per day use, the LCD will last over 15 years (Perez 1988, p. 223). Colors on CRTs also tend to fade over time while this is not the case with an LCD display. The LCDs that are used within projectors are also smaller and less expensive to produce. A common approach to LCD projectors is to use three monochrome AM-LCD panels with respective red, green, and blue filters and a very bright backlight (Peddie 1994, p. 192).

Input Devices. Table 2 lists possible input devices that are used for the electronic wall map. Each device varies in its resolution, its degree of interactiveness, how it accesses maps, the ability to point to features on the display, and its ability to effectively display cartographic animations.

The VCR, S-video VCR, and laser disc player (see Figure 2a) are all analog devices and therefore have a limited spatial resolution. However, all of these devices can be used for the display of cartographic animations. The standard VCR displays about 250 horizontal lines. S-video VCRs and laser disc display about 400 lines but with sharper colors. The VCR is a sequential access device making it time-consuming to find a

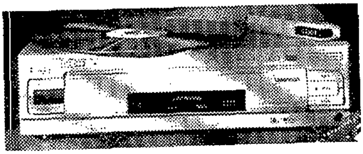
Input	Resolution	Level of Interaction	Access Sequential/ Random	Ability to Point	Display of Cartographic Animations
VCR	poor	poor	seq.	poor	yes
S-Video VCR	fair	poor	seq.	poor	yes
Laser Disc	fair	good	random	poor	yes
Computer	good/ exc.	good/exc.	random	good	yes
Video Visualizer	fair	excellent	manually random	exc.	no

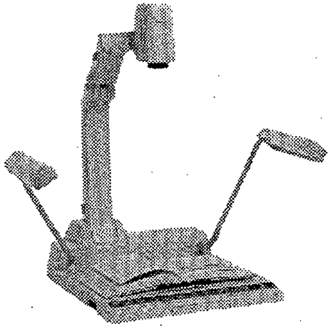
Table 2 Comparison of input devices for the electronic wall map.

particular part of the tape. In constrast, the laser disc is random access with contents being numerically coded. This makes it possible to quickly display a particular frame or sequence of frames. All three of these devices also play sound.

The computer is the most versatile display medium. It can be used for the display of individual pictures, vector drawings, animations, or video sequences. However, the disk storage requirements of this material can be extensive. One solution has been to place the material on CD-ROM — a relatively inexpensive, but slow, storage medium. Another solution is to access the material through a network. For classroom use, it is best to have the material stored on the local hard disk.

The video visualizer is a vertically aligned video camera that displays material that is illuminated from two lights on either side of the camera (Figure 2b). The advantage of





(a) (b)

Figure 2 Input Sources for the Electronic Map. (a) Laser disc. (b) Video visualizer.

this form of display is the ability of the video camera to zoom on parts of the document. If the camera outputs in S-video, the resolution is adequate for most purposes. However, the material that is to be displayed may not be too large or very detailed.

3 Analysis of the Electronic Wall Map

Electronic wall maps displayed from all of these video source have been tested in geography and cartography classes with up to 120 students. The laserdisc and VCR were used mainly for the display of cartographic animations. The computer was used for the display of thematic maps that were created at the time of instruction and for the display of material from CD-ROM. The video visualizer was used for the display of paper maps from atlases and textbooks.

It was found that the display of cartographic animations is very successful with the VCR and laserdisc. The laserdisc is preferred because it has a higher resolution although VCR tapes in the S-Video (SVHS) format are also acceptable. Another use of the laserdisc that was not investigated here is the display of individual frames. The laserdisc is capable of displaying up to 54,000 individual video images, however, access times are about three seconds per selection.

Accessing material on the computer for interactive display can be difficult in a classroom environment. One needs a way of finding the material quickly, especially in a lecture setting. One solution is the use of a bar-coding system and appropriate software. Here, each frame or map is identified with a unique bar code. The user passes a pencil-like device over the bar-code to display the requested material. The advantage of this approach is that the instructor is freed from the keyboard and mouse.

The display of maps interactively with the computer can be done with computer mapping programs that update maps quickly on the screen. A choropleth mapping program, written by the author, was successfully used to display black and white maps. Maps were updated on the screen in under three seconds. The program and data files were all on the local hard drive.

While the CD-ROM is used for the display of maps in personal multimedia (as a part of encyclopedias and other reference material), their use in the classroom is problematic because of the slow access speeds. A solution is to copy the contents of the CD-ROM onto the hard-drive of the computer and display the maps from this source. Copy protection schemes makes this type of copying impossible in many cases. In general, the display of maps by CD-ROM in the classroom is generally too slow for normal lecture use, even with a quad-speed CD-ROM drive.

The video visualizer, displaying material that is placed onto a lighted surface beneath a vertically-aligned video camera, proved to be the most versatile and effective version of the electronic wall map. The zoom feature of the camera allows parts of maps to be examined more closely. The ease in switching between maps was also noted. In general, only a small amount of focus adjustment was needed. The colors were also displayed accurately. The ability to point to different parts of the map was another advantage of this display device.

4 Conclusion

The electronic map will become more feasible when computers can display maps more quickly and the user interface is improved to the point that the selection of maps does not interfere with teaching. Even the process of selecting the map for display through the video camera visualizer may be too time-consuming. One can envision a central computer server that would store an atlas of maps and cartographic animations that can be easily selected and quickly displayed. In the meantime, the electronic wall map is best created by displaying a smaller paper map. In either case, maps need to be specifically designed for display in a large format.

5 References

Multimedia Tools. (1995). **New Media.** San Mateo, CA: Hypermedia Communications.

Peddie, Jon. (1994). **High-Resolution Graphics Display Systems.** New York: Windcrest/McGraw-Hill.

Perez, Richard A. (1988). **Electronic Display Devices.** Blue Ridge Summit, PA: Tab Books.

Peterson, Michael P. (1995). **Interactive and Animated Cartography.** Englewood Cliffs, NJ: Prentice Hall.