Audio Augmented Reality: A Prototype Automated Tour Guide

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ABSTRACT
Augmented reality (or computer augmented environments as it is sometimes called) uses computers to enhance the richness of the real world. It differs from virtual reality in that it doesn't attempt to replace the real world. Our prototype automated tour guide superimposes audio on the world based on where a user is located. We propose this technique for use as an automated tour guide in museums and expect it will enhance the social aspects of museum visits, compared to taped tour guides.

INTRODUCTION

For many types of information retrieval, social interaction is critical to the experience. For instance, why do people go to live music concerts instead of listening to compact discs at home? Partly because of the different quality of sound, but it is also largely due to the social experience of being at the live show, being with your friends, and being part of the audience.

Many people believe that computation enhances our everyday lives. But many of the forms in which computers aid us also work to isolate us. Perhaps the most glaring example of this is *virtual reality*, where the main point is to take us out of the physical world by replacing our senses with computer-generated ones.

Augmented reality, on the other hand, is an attempt to combine our real world interactions with the richness of computational information without isolating people from each other. The basic idea is to superimpose computer generated data on top of the real world, as the person moves within it. This idea was originally described by Myron Krueger [4], but now a number of groups are beginning to experiment with it (see [2] for a collection of several research articles, or [1] for a survey).

MUSEUM TOURS

One place a low-tech version of augmented reality has long been in the marketplace is museums. It is quite common for museums to rent audio-tape tour guides that viewers carry around with them as they tour the exhibits.

While this technology works reasonably well, many people using it become frustrated because it seems to obstruct some of their social purposes in attending the museum. As with music, part of the reason many people go to museums is to socialize, to be with friends and to discuss the exhibit as they experience it. Taped tour guides conflict with these goals because the tapes are linear, preplanned, and go at their own pace. This makes it hard to stay with friends because if one person turns off their tape temporarily, it is very difficult to get synchronized again.

In addition, the taped tours typically describe only a relatively small subset of the pieces on exhibit. The pieces described on tape may not be the ones a particular viewer is interested in hearing. But because the tape must be accessed linearly, it is impossible to skip over or access descriptions out of order.

AUDIO AUGMENTED REALITY PROTOTYPE

A more technologically sophisticated tour guide, on the other hand, can offer the benefits of automation without the social conflicts caused by the taped tour guide.

We have built a prototype audio augmented reality-based tour guide. This system replaces analog audio tapes with random access digital audio. In addition, it adds a microcomputer and an invisible spatial locating device that allow much more freedom for the participant.

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The idea is to allow visitors to hear descriptions of pieces just by walking up to them. Descriptions may be heard in any order, and can be cut short by walking away. Friends visiting together can stay in sync very naturally just by walking up to a piece at the same time. When they walk away from a piece the description will stop and they may talk amongst themselves.

Because the digital storage device can hold two and a half hours of audio, the tour planner can describe many more pieces in the exhibit than any viewer will likely see. This gives much more control to the viewer since they can hear descriptions of pieces they want to hear about.

This prototype consists of a few devices that the viewer carries with them: a random-access digital audio source (modified Sony MiniDisc™ player), a microprocessor (Motorola M68332), and a custom infrared receiver that tells the computer where the viewer is. A very small infrared transmitter is placed in the ceiling above each piece to be described. It transmits a unique identifying number that the computer uses to identify the location of the viewer. As the viewer walks around, the computer simply controls the audio source to play or stop playing pre-recorded descriptions. See Figure 1 for a schematic diagram of the system.

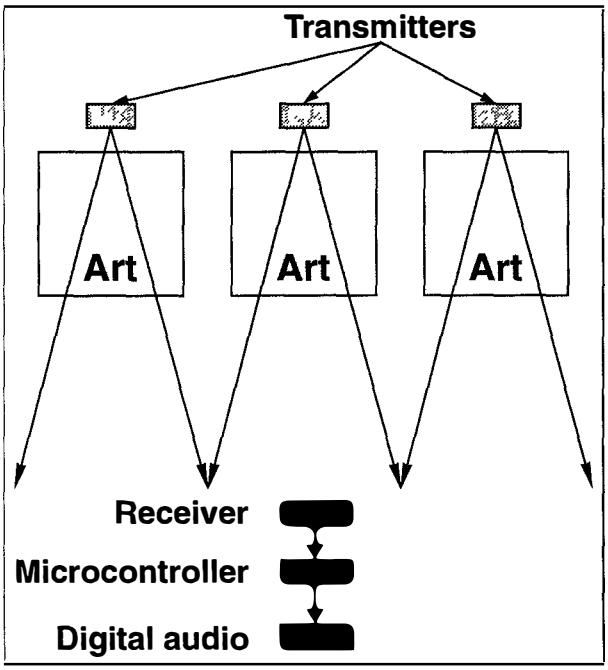

Figure 1: Schematic of automated tour guide prototype.

This type of technology offers the possibility of modifying the descriptions of pieces based on the particular interaction history of this viewer with the exhibit. This notion, more generally referred to as *history-enriched digital objects* is described in [3]. For example, if the computer noticed that the viewer had looked at several pieces by one artist, it could offer extra background information on that artist. Or it could relate pieces currently being viewed to particular pieces that this viewer recently saw. There could even be a "restroom button" on the device which would give the viewer directions to the nearest restroom.

One group [5] has created a similar technology, but in reverse, to identify the locations of individuals to a centralized computer system. In this system, people carry around small infrared transmitters, and there is a single receiver in the ceiling of each room.

Some museums have begun experimenting with new guide technologies, but they still have some limitations. One popular approach is to have some local audio broadcast technology so that each piece broadcasts a description of itself in continuous cycles. The disadvantage of this approach is that participants often walk up to a piece mid-way through a description. In this case, they hear the second half first, and then the description starts over again. It is vital that the user carry the audio source with them so the descriptions can be heard on the user's time schedule.

CONCLUSION

Augmenting rather than replacing the external world can take advantage of computation without conflicting with social concerns. We introduce a prototype museum tour guide based on augmented reality which shows that more appropriate technology can enrich our experiences without interfering with our social interactions as much.

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