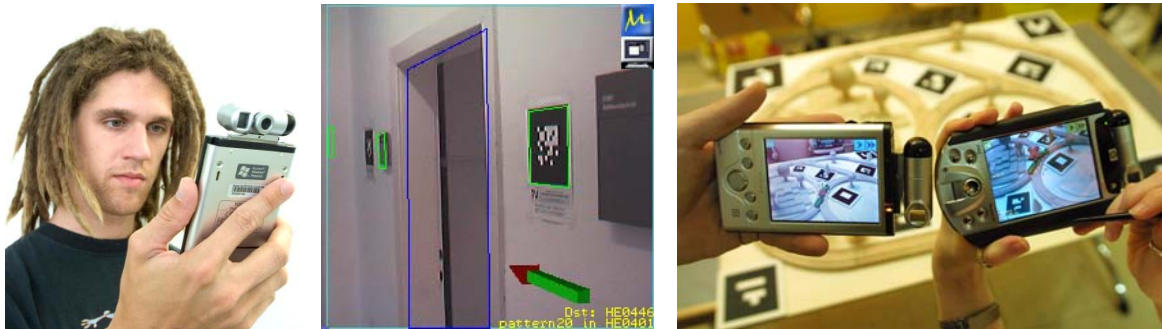# A Handheld Augmented Reality Museum Guide

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Left: User with handheld AR device. Middle: Navigation video overlay showing way to next exit. Right: The Invisible train, a multi-user handheld augmented reality game first shown at SIGGRAPH '04

We report on an ongoing project with the aim of developing an electronic tour guide for museums based on a self-contained, inexpensive PDA, that delivers a fully interactive 3D Augmented Reality (AR) to a group of visitors. Previously, it was believed that AR is technically too difficult to render services for museum users. Clearly, regular PCs or notebooks are not feasible for everyday use, and PDAs were believed to be not powerful enough. In the past two years, we have developed a platform for AR on unmodified commercial PocketPC devices, which performs real-time optical fiducial tracking and 3D graphics video overlays at interactive frame rates (typically ~20Hz overall). No server infrastructure is required, except for mediating wireless communication among a group of users and for database access.

The new PDA-based approach introduces very low costs per device and high scalability which allows for the first time the realization of applications for many concurrent users as required for an appealing museum installation. Our work on the "Invisible Train" [1] has proven that such an approach is indeed feasible.

The main objective of this project is to enhance museums by an extra dimension of knowledge transfer using AR. The museum is augmented with a physically continuous information space, which is aligned with the real interior of a museum. Every real exhibit is augmented by its virtual counterpart. The information space embeds all exhibits into a story and provides game mechanisms to carry visitors along in an exciting way. Storytelling is an important component of a modern learning environment, directly affecting its quality.

Visitors use a mobile, hand-held, personal guide showing a 3D Augmented Reality image of the surrounding that combines real and virtual elements. The guide knows the position of its user and provides context relevant information. The guide thus becomes a kind of "magic lens" capable of visualising the otherwise hidden virtual objects anchored in the real world space. By looking at the guide's display, visitors see visualizations and animations superimposed onto real exhibits. The guide displays multimedia content, but also acts as an intelligent assistant – the modern day replacement for a guide book. As a consequence, the whole museum becomes an interactive exhibition.

While the clients operate completely self-contained, the system incorporates a database server for the information space, providing the live 3D content on demand, in a timely fashion, potentially scaling to a very large number of museum visitors. The geometric database links the real museum space to the cyberspace. Its design must accommodate the real museum geometry and properties, including navigation, exhibit dimensions, etc. It incorporates both the raw geometric information (measurements) as well as a sufficient amount of semantic information (such as the subject of a specific exhibit and its position in a guided tour).

A massive multi-user communication system is built for interaction between groups of visitors, in particular multi-user location based games. Our previous work on multi-user AR has concentrated on fully synchronous collaboration, using same-time and same-place distribution of information. In this new approach, we are extending the communication to include different-place and different-time sharing of information, so that a number of new collaborative interactions are enabled, for example sharing "collected items" between separated users, or "guided tour replay" at a different time.

The AR tour is delivered in the form of a team-oriented game. Two teams of visitors (target age 10-14) are casted into the role of investigators trying to uncover a mysterious criminal case. In that capacity, they are given a number of puzzles to solve that involve finding specific exhibits in the museum and manipulating the 3D cyberspace that surrounds the exhibit. Successful completion of a puzzle leads to the revelation of another part of the story. Video sequences shown on a large monitor to the assembled group of young investigators will move the story forward. An interesting aspect of our project is also that it will for the first time involve the creation of massive amounts of professional and didactically relevant content for an AR application.

Reference

[1] T. Pintaric, D. Wagner, F. Ledermann, D. Schmalstieg: Towards Massively Multi-User Augmented Reality on Handheld Devices. Proceedings of the 3rd International Conference on Pervasive Computing (PERVASIVE 2005), Munich, Germany, May 8-13, 2005.