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Augmented Reality: Another (Virtual) Brick in the Wall

Michelle Delio February 15, 2005

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Imagine wandering through a southern Victorian-era cemetery shaded by ancient oaks dripping with Spanish moss, seeing images of the people who are buried under the crumbling stones appear and listening as they tell you their stories.

<< Click here to see how Augmented Reality works

Georgia Institute of Technology's Augmented Environments Lab has developed an "Augmented Reality" tour that allows visitors to do just that at Atlanta's Oakland cemetery.

During a recent trial run, users carried small laptops in backpacks and used game console controllers to navigate through the cemetery. As they approached specific graves they listened to the "voices" of the first person buried in Oakland, a child who lived through the Battle of Atlanta during the Civil War, and a local historian who died in 2000. The audio, with information culled from personal documents, was piped in via a wireless network.

The Georgia Institute of Technology team is working on adding the appropriate ghostly images to the tour, which users will view through a head-mounted display unit. The ghosts' appearances will probably be activated by RFID tags on the graves.

Unlike Virtual Reality, which immerses users in a new digital environment, Augmented Reality (AR) -- a broad class of user interface techniques intended to enhance a persons perception of the world around them with computer generated information -- aims to enhance the analog world.

Users, via wearable display screens, see the non-virtual world around them with digital information superimposed into their surroundings. But since each person experiences the world differently, AR developers face some tricky programming and design problems.

"Making AR systems that allow us to feel truly present in the experience is a big deal to me," says Blair MacIntyre, director of Georgia Institute of Technology's Augmented Environments Lab. "The challenge is to create a seamless interface between the digital information, each individual user, and the physical environment. We aren't quite there yet, but we're on our way."

Developing AR material that responds in a seemingly intuitive manner to user reactions and interests primarily involves putting a lot of information into an AR offering so that users get the impression that the experience has been tailored just for them.

Macintyre says the question he's most often asked about the Voices of Oakland is "what's the big deal, don't they do this stuff in most museums now?"

And, on a basic level, this is true. There are two types of audio tours: Linear where the story that's being told has a strict order and Random Access which uses RFID to tell what object a user is near.

The AR tour, though, blends the best of both, a linear story with a random access system that lets users dig deeply into whatever fascinates them, giving them access to what feels like seemingly unlimited information.

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On The Web:

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- Columbia University's Computer Graphics and User Interface Lab
- A good introduction to Augmented Reality
- More info on Wizard of Oz Techniques

Sort of Open Source:

The DART is, according to Blair MacIntyre, director of Georgia Tech's Augmented Environments Lab, "more or less" open source. It's free, and anyone can download it here.

The system is two pieces: the Xtra (extension to Director) which brings the AR technology into Macromedia Director, and Scripts to simplify DART's use. The Xtra is currently not distributed in source form, but the code for the scripts (written in Lingo, Director's scripting language) is available.

"But so far, nobody has actually gone beyond talking to us about the possibility and has actually asked for (the source code" notes MacIntyre.

False Reality:

Steven Feiner thinks there are two main misconceptions about AR.

"People tell me that they feel that that the ability to overlay information on top of what people see and hear will overwhelm us with a ceaseless barrage of information that we can't control. The easy, and definitely too pat, answer here is an "off switch."

The second misconception is that AV will, of necessity, somehow compromise privacy, as if the process of presenting information actually did the data gathering itself. Feiner adds that it is possible -- though not essential -- to combine data gathering with AR, especially with regard to vision-based and other sensor-based tracking technologies.

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"Random Access tours like Seattle's Experience Music Project do have some linearity because the exhibit is laid out in a purposeful way but the multimedia content is fragmented and cannot tell a cohesive story because each segment is independent," says Macintyre. "Voices of Oakland has many possible stories but each builds into a cohesive narrative and at the same time allows users to dig deeper into any grave in the story as well as wander off and explore independently."

The other key to providing a realistic AR experience is to develop programs that can make smart assumptions about what users want to do next. AR researchers often use "Wizard of Oz" techniques -- a testing method where users are unknowingly interacting with humans instead of computers -- to fine-tune their programs and predict user actions.

The AR developers talk a lot about "perfect registration" -- the flawless alignment of real and virtual objects -- because it's hard to line up digital data with ever-changing real world input. In fact, some believe that problem will keep AR from ever past the cool prototype point.

But MacIntyre warns that it's easy to go overboard in tailoring the user experience. So, he devised an ingenious solution to the registration problem: ignore it.

"My idea is let's ignore the goal of perfect registration between the virtual and physical world, which seems to be the goal of many AR researchers, and instead figure out what is needed to support the creation of usable, rather than perfectly registered, systems," says MacIntyre.

MacIntyre sees AR as a new artistic medium that even the non-technically inclined can work with. To further that idea, his team developed DART -- The Designers Augmented Reality Toolkit -- a set of software tools for Macromedia Director that support the design and implementation of augmented reality experiences and applications.

DART, released in November and available for free, has been downloaded by people connecting from military, industrial, banking, design schools and advertising firm domains.

"For me the real excitement of the DART project is enabling creative people who don't know how to program to easily work with very sophisticated technology," says MacIntyre. "Other free AR tools largely shut out creative professionals if they can't program in Java, C, C++, or whatever. But I believe these folks will be the ones who find the killer AR apps and really push the medium.".

Henrik Hedegaard and Johanne Kortbk from the Aarhus University in Denmark and Kika Kjrside from the School of Architecture in Aarhus are just the kind of people MacIntyre hoped would use the system.

The trio is using DART for a project called ARDressCode, developed as part of an AR course offered at the University of Aarhus. ARDressCode will allow users to select clothing items in a shop and then try the clothes on virtually in front of an augmented mirror, which displays the user wearing a 3D version of the chosen clothing.

"Basically the application is about moving AR out into the wild," says Hedegaard. "We believe the application will enhance the opportunities to do a lot more experimenting with sampling new and very different kinds of clothes, since the users are not required to try it on to see how it fits them -- physically and aesthetically."

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A Little History:

The idea of placing computer-generated information directly in the world can be traced back to Ivan Sutherland in the late 1960s. But AR research didn't really heat up until the early 1990s, when computers became sufficiently powerful, and trackers and head-worn displays became available.

Steven Feiner, director of Columbia University's Computer Graphics and User Interface Lab, started working on augmented environments in 1990, when he built a monocular see-through head-worn display using a Reflection Technology Private Eye, and a mirror beam splitter, inspired by Sutherland's work.

In 1991, he started experimenting with how augmented reality could integrate maintenance and repair information with the user's view of a piece of equipment (a laser printer), rather than requiring that they look at a separate manual.

Feiner continues to work on ways to provide vital information quickly to people by avoiding the need to continually switch and reestablish visual context, from looking at the world to looking at documentation describing it.

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The AR tools aren't just for cool museum tours and ecommerce. MacIntyre is working with the Georgia Institute of Technology Food Processing Technology Division to develop ways of using AR to improve poultry inspection. Currently FDA inspectors and workers are positioned right beside each other, so communication is verbal and gestural -- people get the information they need by asking each other questions directly.

But the industry wants to increase automation, and to do that workers will need to be repositioned along the line, which will make it more difficult for them to communicate.

"It's a hard problem; this is a "wet" environment, the workers need their hands free, and it's noisy so audio won't work," says MacIntyre. "So we're working on multiple approaches to using AR including head-mounted and non-head-mounted projection-based systems to superimpose information on the shackle line.

And Georgia Institute of Technology's "Everyday Computing" lab is working to develop an AR interface that would allow office workers to use the walls of their cubicles as a type of adjunct brain. The walls would project images of documents, tasks and commutations workers had previously had with others, to help people remember what they have done and to provide a sort of subconscious cue cards that would prompt the brain to quickly recall needed information.

But most AR researchers, including MacIntyre, believe that entertaining AR experiences will be deployed long before more practical AR programs for industrial, medical or military use.

Steven Feiner, director of Columbia University's Computer Graphics and User Interface Lab points out that it's easier to create something that many people will use for a very limited period of time during a specific experience.

That generally means video games, which are a likely application area for augmented environments.

Feiner's lab has received funding from Microsoft Research to develop an environment for building augmented reality games. He is especially interested in exploring how tracked head-worn and hand-held, see-through displays can be used within an environment populated by large numbers of other displays and interaction devices, creating what he refers to as "hybrid user interfaces."

"I really believe that systems that mix physical and virtual worlds in novel and interesting ways can completely revolutionize how we think about these worlds," says MacIntyre.

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