

Mainstreaming Augmented Reality

Advancements in computer vision, object recognition, and related technologies are leading to new levels of sophistication in augmented-reality applications and presenting new ways for humans to relate to the natural world.

SINCE THE EMERGENCE of the first augmented-reality applications 20 years ago, the field has drawn a great deal of interest and enthusiasm, not only from researchers working in computer science at the cutting edge of graphics technologies, but also from leaders in aerospace, medicine, the military, and a wide range of other industries and government sectors. In augmented reality (AR), a real-world setting or set of objects is augmented by a computer-generated overlay. Advancements in computer vision, object recognition, and related technologies are increasing the level of sophistication of that overlay, and presenting entirely new ways for humans to relate to the natural world.

While a great deal of research is being conducted in this area, given the promise of the technology to have a major impact in industrial and consumer applications, significant challenges remain, such as the accuracy of Global Positioning System- (GPS-)

Augmented-reality applications are increasingly compact and powerful, and many of them require nothing more than a current-generation smartphone.



An augmented reality game called ARhrrrr! developed at Georgia Tech and the Savannah College of Art and Design. In the game, the graphics are tightly registered to a physical game board using an image-based feature tracker developed at Graz University.

or compass-based AR applications, the bulkiness of head-mounted displays, and other issues endemic to the sciences and systems upon which AR technologies rely. Still, researchers developing AR systems continue to build increasingly compact and powerful applications, many of which require nothing more than a current-generation smartphone.

Examples of mobile AR applications include Layar, a “reality browser” that retrieves point-of-interest data on the basis of GPS, compass, and camera view, and GraffitiGeo, an application that lets users read and write virtual Twitter-style comments on the walls of restaurants, movie theaters, and cafes. Both applications are available for the iPhone platform. Another example is Goggles, a Google-created application that allows users to search the Web on Android phones simply by capturing photos of landmarks or oth-

er objects. The technology also allows users to point the phone’s camera at local storefronts to retrieve business information automatically with GPS and compass data.

While the number of such mobile applications is increasing rapidly, AR evangelists say a killer app will be needed to make AR technologies truly catch on in the consumer space. Given the enormous popularity of Web-based social networking, for example, one killer app might come in the form of a mobile facial-recognition application that can automatically link the humans to their social-network profiles. One company, The Astonishing Tribe, has demonstrated an AR interface concept, called Recognizr, to show the possibilities of doing just that.

Another approach to mainstreaming AR is in gaming. One researcher working in this area is Blair MacIntyre, who directs the Augmented Environ-

ments Lab at the Georgia Institute of Technology. MacIntyre says his current work in AR is driven mainly by the desire to understand how to create compelling AR experiences, interfaces, and tools. To that end, he and his team build games and study them, focusing on everything from interactivity and visualization techniques to the feel of game mechanics to the social experiences they foster.

"I'm very driven to create tools and platforms that will give a broad range of people the ability to experiment with the technology," says MacIntyre. "Just as we didn't know what the Web would be used for until people with real problem- and design-driven goals started trying to create applications, the same will be true for AR."

Tightly Registered AR Games

For now, MacIntyre is focusing on what he calls tightly registered AR games, in which the graphics appear to be locked onto the real world. In the *ARhrrrr!* game, for example, a handheld device's graphics are aligned with the physical game board using an image tracker to determine where the camera on the handheld is located, relative to the board. The system pulls video from the camera, runs it through a vision library, and returns an estimate about the game

The mainstreaming of augmented reality now largely depends on the ability to manufacture and sell the technology profitably, says Steven K. Feiner.

board's relative position. Using that information, the handheld draws graphics in the camera's view of the board. Those graphics remain locked in place over a wide range of movement by the player.

"We found that if the graphics are unambiguously aligned with features in the world, game players treat the combined physical-virtual view as one merged space," he says. "As a result, they can refer to virtual content smoothly and unambiguously, and can collaborate or compete as they would on a physical board game."

MacIntyre says the biggest challenge he faces is with the limitations

of the vision-based tracking technology that signals to the phone what the camera's relation is to the world. "We are constantly struggling with the tension between what we want the games to do and what is technically possible to know about the world and to track and interact with," he says. Because accuracy is directly related to the quality of the inputs, MacIntyre and his team use vision-based tracking technology instead of less-accurate alternatives such as handheld-based GPS, compass, and accelerometer sensors, which might work for large-scale AR applications but lack the precision needed for tightly registered games.

Another researcher working in this area is Steven K. Feiner, director of the Computer Graphics and User Interfaces Laboratory at Columbia University. Feiner began his work in AR by exploring how the technology might be used to assist in maintenance and repair, and has directed projects ranging in focus from restaurant guides and gaming to integrating technical instructions directly into a task domain. "Our overarching goal is to design user interfaces that help people be better at whatever they do," Feiner says, noting that his general approach in these AR projects is to build dynamic virtual worlds that are overlaid on and geo-

Employment

U.S.'s Bright CS Job Forecast

The job outlook for U.S. college students majoring in computer science is very favorable, according to *The Market For Computing Careers*, a report by Joel Adams, a professor of computer science at Calvin College. Adams' report contains an analysis of data from the U.S. Bureau of Labor Statistics, Computing Research Association's Taulbee Survey, and *U.S. News & World Report*.

"The U.S. Bureau of Labor Statistics predicts that computing will be one of the fastest-growing U.S. job markets in science, technology, engineering, and mathematics (STEM) for the foreseeable future," according to the report, with "nearly three out of four

new science or engineering jobs in the U.S. going to be in computing." Of these new computing jobs, 27% will be in software engineering, 21% in computing networking, and 10% in systems analysis.

The "demand for software engineers, network administrators, systems analysts, and other computing-related professionals is exploding, but fewer and fewer students are choosing to study what is needed to get these jobs," the report says. The U.S. Bureau of Labor Statistics, for example, predicts, nearly 140,000 new job openings in computing per year through 2018, with less than 50,000 CS graduates vying for those jobs.

Meanwhile, as fewer students enter CS, the salaries for software engineers, network administrators, and systems analysts "are climbing." According to *U.S. News & World Report*, the median salary for a software engineer ranged from \$85,000-\$92,000 in 2008, with the best-paid 10% of software engineers earning more than \$136,000.

"I think the most surprising thing [in the report] is that the U.S. Bureau of Labor Statistics is projecting more than four times as many new jobs in computing than in all the traditional (non-software) engineering areas combined," Adams said in an email interview. "A second surprise was their projection of

more than twice as many new computing jobs per year than there are computing graduates at present. The third surprise was that computing is the only STEM discipline where the demand for graduates outstrips the supply.

"Calvin College is in Michigan, which has, I believe, the highest unemployment of any state, but we are already seeing the effects of this imbalance," says Adams. "This past semester, we received an average of three requests per week from local businesses seeking students with significant computing skills. We don't have nearly enough students to meet such demand."

—Jack Rosenberger

