'Virtuality' gets real

12 August 2008

(PhysOrg.com) -- Up to now virtual reality has proved cumbersome as a design tool, but European researchers are finalising a system that brings ‘virtuality’ to the wider world.

Virtual reality (VR) is a powerful tool, but its true potential remains unrealised. Applications mixing the virtual and real worlds, called mixed or augmented reality (AR), are weak. There are few, reliable systems, and what exists are very expensive. Collaboration is limited and still relatively unsophisticated. And the state of the art is anchored to the desktop or multi-tiled, or multi-screen, displays. Both are fixed solutions.

But VR and AR could do so much more. They could enable onsite sketching of a proposed building design, to reveal the real-world impact on the cityscape, or allow teams to review, annotate and amend proposed and existing car designs. The technology could enable engineers and designers to collaborate with other, distant teams. And it could pave the way even for consumers to contribute to production of better, more successful products.

There are bottlenecks, however, and the IMPROVE project began life with the remit to break through them. “We worked on head-mounted displays, improved tiled displays, rendering and streaming software, colour calibration techniques, collaboration and networking, and novel interaction systems,” notes Pedro Santos, coordinator of the EU-funded project. It was quite a broad research agenda for a STREP project, he admits.

High-performance, head-mounted displays

The IMPROVE project really created a series of hardware and software innovations that, once combined, offer a full-specification VR and AR platform. But all of these individual innovations are useful on their own, and could be potentially commercialised as standalone products.

The Head Mounted Display (HMD), for example, offers a see-through lens that can overlay virtual images onto a real object or landscape, like a building or car.

The project developed three prototypes – two wearable and one handheld – that offer good resolution.

“Better yet, the handheld model can also block out daylight, so you don’t get the usual problem of sunlight washing out the image. It is a breakthrough, and the daylight-blocking HMD will feature this month at Siggraph 2008 in Los Angeles,” Santos remarks. Siggraph is the industry conference for computer graphics and interactive technologies.

IMPROVE also developed breakthrough video-streaming technology that offers high-quality stereoscopic streaming across a mobile network. “It takes a lot of processing power to render a virtual image onto a real landscape, mobile device CPUs cannot really cope. We developed a video-streaming protocol that allows a desktop to perform the rendering, but then streams a compressed signal across wireless networks,” explains Santos.

Rendering software

The platform’s rendering software itself marked another breakthrough. It takes images from high-dynamic range cameras, which offer a range of exposures on a single image, to calculate realistic reflections, shadows and light-intensity levels. It allows visualisation of a model from any direction in real time, after pre-processing.

“We are already in discussion with some companies about commercial opportunities for the rendering platform,” Santos reveals.

The team also developed marker and marker-less tracking systems. The first uses reflective markers to compute the position of real objects in a fixed reference frame. It allows the system to plot the shape of an object accurately.

Marker-less tracking is even cleverer. “In contrast to marker-based tracking, where we track labels with patterns on it, in marker-less tracking we detect feature points in real scenes and compare current images from a camera to calibrated reference images of the same scene to calculate the current position of a user,” explains Santos.

IMPROVE also developed innovative interaction systems for working with AR and VR. IMMIVIEW supports multi-modal, multi-user interaction, while IVIEW is a collaborative system for design sessions.

Finally, a colour-calibration technique developed by the IMPROVE team helps ensure that tiled banks of high-definition screens are all rendering colours faithfully. “You get big calibration problems with projectors on multi-tiled displays, because projectors vary, or projector bulbs deteriorate at different rates. It affects image quality, but our calibration-tool ensures faithful colour across the multiple screens.”

Design-intensive applications

Together, these components make up a complete VR and AR platform that enable functional applications required in the real world. The project performed studies with end-users to see what those applications should be.

The project chose two design-intensive domains to test their platform, architecture and automotive design. The two are a good fit. Car manufacturers can afford very expensive equipment and are quick to adopt improved systems, while architectural companies could really use VR and AR systems more widely, but have much tighter budgets.

“The mix of applications meant we had to develop low-cost but high-performance systems. The tests were successful, and the system performed well,” says Santos. (See follow-up story: ‘Virtual applications reach out to real world’.)

It is an impressive list of achievements, and some of the work will be continued in two follow-on projects, Maximus and Cinespace. Many of the components developed within the project are already on their way to commercialisation.

“It is unlikely that the platform will be commercialised as one product, but most of the components will have direct commercial potential and many of them are a real advance on what is currently available,” notes Santos.

The rendering software, the video streaming solution and the head-mounted displays all offer immediate solutions to existing problems, as does the tiled screen calibration and the collaboration tools.

The combined influence of all the components will mean that, finally, virtual reality is ready for the real world.

Provided by ICT Results