Head trip

Forget scientists losing touch with reality. Joshua Gliddon joins some South Australian boffins who are augmenting research into virtual worlds with mind-spinning results.

The man you see is not *The Wizard of Oz*'s Tin Man doing a Marcel Marceau impression. Wayne Piekarski, a PhD candidate at the University of South Australia's Centre for Advanced Computing Research, is wearing a bleeding-edge augmented reality pack. The fellow behind him is Associate Professor Bruce Thomas. He might not be wearing the suit, but he is driving the centre's efforts into building interfaces for 3D virtual worlds.

These 3D worlds are thrown up into head-mounted displays, overlaying the "real" world with additional information. What you end up with is reality that's been augmented by the virtual world.

Around the world universities and government organisations are spending big on building augmented reality packages. Some are looking into making better hardware. Others are trying to combine hardware and software. In Australia, UniSA's group, in conjunction with the Defence Science Technology Organisation, knows where its limited budget is best spent. Others can design and build specialist hardware, says Thomas. His group wants to build better 3D models and improve the interfaces to let someone interact with those models.

The big question is why?

Piekarski throws us back to September 11, and the aftermath of the destruction of the World Trade Center in New York. "You'd watch video, and you would see the destruction, but it was really hard to get a feel for where it was, what angle the film was taken from, and what sort of scale it was on." For a casual television viewer those things probably aren't going to be a problem. The sheer magnitude of the event was enough to burn certain images into our minds forever.

But video footage isn't good enough for emergency services or for armies fighting street battles in unfamiliar terrain. They need to know exactly where something is in real space, and how the environment has changed. Video will show you a picture – computer maps and GPS data show the reality.

The UniSA team is fond of using Darwin's Cyclone Tracy disaster as an example of how augmented reality could help emergency services planners during a crisis. Imagine that another cyclone wipes out large sections of Darwin, removing telecommunications infrastructure, felling power lines and destroying buildings. If there was a basic model of Darwin – and it need only be streets and simple representations of buildings – team members wearing augmented reality suits could go to investigate the actual scene on the ground.

Their head-mounted displays would show simple images of what should be there, according to a map stored in a belt or backpack-mounted computer. If the team came across a destroyed building, they could "carve" the virtual building away using hand gestures that would be read by the computer.

Unreal: overlaying a site with a virtual building

The challenge is to get the maps done in the first place. There are lots of fancy ways to build maps, but they're time consuming and can be inaccurate if, say, a tree is blocking the mapping laser. The way they've got around this is to construct simple 3D models that just outline the shape of an object – such as a building, a car or even a table in a park. A GPS system constantly logs the location of the object, while head-mounted motion sensors help adjust the head-mounted display.

"When you create an object [such as the virtual building] with GPS data, you can then accurately locate it in the real world," Thomas says. "You could give the co-ordinates to anyone, and they would find the object you're referring to."

In the case of the Darwin emergency, the data and co-ordinates could be relayed back to the command centre and displayed on a map of the city. The updated map would reflect reality and enable emergency services to deploy their forces more effectively.

The UniSA team has forged a partnership with the Defence Science Technology Organisation, which is located just up the road from the university's Mawson Lakes Campus. The DSTO made the augmented reality backpack using off-the-shelf products, including a powerful Dell notebook computer, GPS receiver and a battery with a two-hour lifespan. The whole unit weighs about 15kg – and you can really feel it.

We wandered out of the AR team's pokey workshop into the university's main quad, the backpack strapped to my back, goggles on my head. Thomas and Piekarski fire up the computer and I'm plunged into a dank, dim environment. They've hacked the first-person shoot-'em-up game Quake so that you can play it outdoors, with the game's environment projected into the goggles.

It's quite strange because you can also see (real) trees and the union building, so the two worlds don't quite mesh. Thomas says they've got another version that maps the game straight into the university environment. Monsters hide behind the real buildings and killing them means sneaking up on them, peering around corners and firing before they take a chunk out of you.

There's a human problem with overlaying a virtual environment onto the

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Suits you: Wayne Piekarski in headgear and Associate Professor Bruce Thomas

real world: you tend to forget that you're outside. Thomas says the sensation is called "tunnelling," and I almost walk into a (real) tree before one of the team grabs my arm and steers me away. It's enough distraction, however, to get me killed in the virtual world.

However, it's a good demonstration of how the perspective changes when you move your head, or walk forwards and backwards. When I look up I see the roof of the virtual environment (which looks strange, overlaid onto the sky). Looking down shows the floor and if I am fast enough I can turn and see the monsters before they kill me.

The challenge for the team is refining the interface shown inside the goggles. Simply taking a Windows desktop with its icons and menus won't work because it's too cumbersome to use without a mouse and keyboard. "Some groups have tried using a normal desktop system," says Piekarski. "You have to pull down menus. But 2D doesn't work in a 3D world."

What they've done is to create gloves where four fingers on each hand correspond to a menu selection. It's a bit like sign language. The gloves also have little markers so that when you wave them around, the computer can track the movements and gauge where you're pointing, while the head motion sensors can tell what you're looking at.

However, even the glove sensors are limited, and the team plans to use voice recognition on a future version.

The DSTO's interest is, obviously, in defence applications. Rudy Vernik, research leader for future command and intelligent environments, says that in a battle soldiers could wear augmented reality gear to help them identify targets and landmarks. A soldier in an unfamiliar urban environment could have directions, street signs or buildings labelled.

However, don't expect our soldiers to have augmented reality as part of their standard kit for a while. Vernik says that it will be at least 10 years before the technology appears on the battlefield. But it's not the hardware that presents the challenges. "If Sony or someone wanted to, they could take all this," says Piekarski, gesturing at the backpack, "and make it small and light enough to wear. Battery power could be an issue, though."

The real challenges are mapping and interfaces. Jim Warren, head of the Advanced Computing Research Centre, says that the augmented reality team are truly doing world-class work. Vernik adds that although funding is limited, the interest is not. "We want to encourage as many students and institutions to get involved as possible," he says. □

- *Videos of augmented reality in action can be found at Wayne Piekarski's web site,* www.tinmith.net