

# virtual reality

## this house would abandon school and study in a virtual classroom

### virtual reality

You've probably played a computer game where you are in battle or going on a dangerous quest. Making that virtual world look and feel realistic is one of the great challenges for scientists and engineers - and not just to create good computer games and virtual worlds for your enjoyment. They have many other uses from medicine to education.

Virtual reality is an illusion - created by clever use of computing power, physics and maths to give users the impression of being somewhere else. Research has shown that when people do get immersed in well-made virtual scenes they respond as they would in the real world. For example, when seemingly on the edge of a cliff - their heart rate goes up.

Some very good systems have already been developed, like simulators to train pilots or astronauts. Manufacturers can now test out a new design without having to build a prototype; or put a virtual human at the controls of a virtual machine to see how easy it is to handle. But we are long way off creating a virtual world where the interaction between human and computers isn't intrusive: where we don't need headsets or clunky controls or wires and gloves. The challenges show just how amazing the human brain is.



NASA Astronaut training  
(photo NASA/James Blair)

### making virtual worlds seem real

Making a virtual world look realistic with shadows and reflections, for example, as they would be in the real world is one challenge for scientists; the other is making sure that things change in real time depending on what you and others do. Both need much faster computers and graphics processors than we have now. Realistic images take a long time for programmers to create. A mathematical model of an object is 'rendered' - a process of applying light and shading (for example) which can take as long as a day for very realistic images. It is a very computing power-hungry process.



A lone house, image made using Blender 3D  
(photo Michael Otto/Mayqel)

Sometimes models are built up from real world images, sometimes they are created by the developer. Software has been developed to allow modeling of human movement so images of people on screen move realistically. To create a realistic virtual environment scientists need to be able to model how sound and light travel; how smells disperse and taste develops. You might also want to be able to touch the environment, to make it a truly 'real' experience. That's a lot of physics and maths to do.

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## how real is realistic?

Scientists at Warwick University are trying to work out how 'real' the virtual world needs to be. They are looking at how much information we take in about the world around us. They find, depending on what you are looking at or doing, that you only concentrate on 10-15% of your surroundings, so if you can get the physics right for that 10-15% you can cut the amount of computing needed. They call this 'Real Virtuality'. For example, if you are reading a book, you're not taking in the rest of your surroundings so they don't have to be highly realistic.

What you are concentrating on depends on who you are. In a computer game the environment can be faked but that's no good if you are training pilots: they need to know exactly how the instrument panel looks when the sun is shining into the cockpit.

Researchers at Birmingham University are building virtual Afghan villages to test the skills of bomb disposal squads and teams who have to search for the improvised explosive devices that kill and injure many soldiers today. Here, they need to get every detail right: there's even virtual rain. But the one thing that's defeated them is trying to re-create smell.



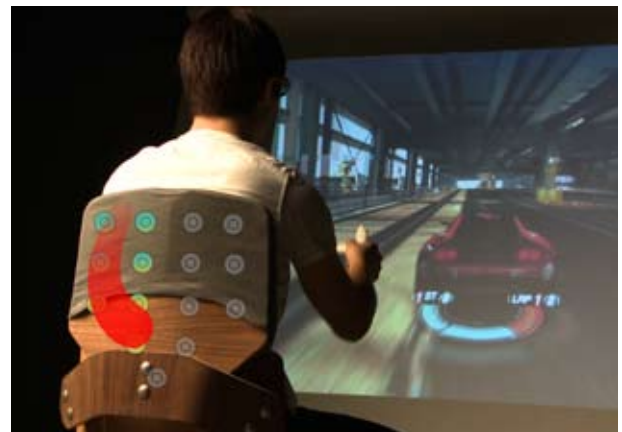
Randolph Air Force Base, Texas. The T-38C Talon trainer's "glass cockpit" features the digital instrument displays in aircraft and virtual reality views of realistic flight environments.  
(U.S. Air Force photo by Javier Garcia)

## can you smell, taste or touch the virtual world?

A lot of effort has been made to get good quality visuals and sound. Touch, smell and taste are proving harder. Scientists have found that smell and taste are incredibly important for learning, so they are working on modeling how smell wafts across a room, for example.

Many people have Ipods and touch screen phones - so touch has become a very important part of our interaction with computers but we're still not able to 'feel' what we see on screen.

It would be very useful to be able to 'feel' a fabric before buying an item of clothing on-line. That was the impetus behind the European HAPTEX project. Researchers developed a system to enable you to 'feel' a collection of virtual fabrics. Details of the physical characteristics of a piece of fabric (eg. surface friction, and how it stretched) were fed into a computer to create models of the fabric as a whole, and locally where it was touched with a fingertip. A user would put their hand into a mechanical 'glove' which they could move across the image of the fabric. Scientists at Exeter University have refined this so that as you move your finger over a graphics tablet you can get the 'feel' of the fabric. This system has been tried in the Museum of Scotland to allow you to touch artifacts which are too delicate or precious to be handled.



The user feels his virtual car as he drives it  
(photo Surround haptics, Disney Research)

In the United States, scientists at Disney's labs have invented a system that fools users into thinking something is moving against their skin. You can imagine how effective that could be in the cinema or when playing a scary computer game. The system is called Tactile Brush and creates the illusion of being touched by anything from a raindrop to a crawling insect. They use an array of 12 vibrating points on a foam pad fixed to a chair. The system works by exploiting the fact that if two points close together vibrate one after the other on our skin, our brain interprets this as something having moved across our skin. Using the vibrating chair with a driving simulation game, they've been able to create a sense of the air rushing past, bumps in the road and the car skidding, for example.

# stem cells

## fast facts

- Huge advances in computing power have made virtual reality possible. More transistors can be packed into each chip, allowing many more functions. Transistors have got smaller so computer performance has improved: they use less power and have become more affordable. The sort of computers being used to develop today's virtual training systems would once have cost hundreds of thousands of pounds. Now they can be run on a laptop.

- Virtual reality already has many uses: designing better buildings and vehicles; training surgeons and emergency response teams; treating phobias like a fear of spiders; rehabilitating injured soldiers or stroke victims: and in education - you are much more likely to take in details of a Shakespeare play if you visit the Globe theatre in 'Shakespeare's time'.

- For training virtual reality is cheaper than having to recreate a situation in real life; and it allows dangerous or rare situations to be tested safely

- Scientists in Birmingham are developing a system to re-create the sights and sounds of the sea, to help physically and mentally traumatised soldiers recover.

- Work on visual reality systems is highly multidisciplinary: physicists, engineers, computer scientists, psychologists, mathematicians, and neuroscientists are all involved.

- Avatar: a computer user's virtual self.

## questions to ask

- What makes a virtual world seem real?
- How can virtual reality systems be used?
- Should we be concerned about spending too much time in a virtual world?
- Could virtual reality be used to combat climate change, so we could all be virtual tourists?

## find out more

<http://electronics.howstuffworks.com/>  
type in "virtual reality" in the search window to find a variety of articles from the history of virtual reality to its applications.

<http://www.disneyresearch.com/research/index.htm>  
see how scientists at Disney's labs are tackling computer vision, virtual reality and more.

Ted Talks has a fascinating series of talks. Search for virtual reality

<http://www.ted.com/>

[http://www.ted.com/talks/daniel\\_wolpert\\_the\\_real\\_reason\\_for\\_brains.html](http://www.ted.com/talks/daniel_wolpert_the_real_reason_for_brains.html)

## virtual reality in fiction

*Dangerous Reality*

Marjorie Blackman

*Feed*

MT Anderson

*Virtual War*

Gloria Skurzynski

*Locked Inside*

Nancy Werlin

## alternative motions: this house...

...believes social networking leads to social isolation

...believes that a life led in a virtual world is less fulfilling