The camera never lies, but the computer does

David Fox looks at the BBC's new 3D Virtual Studio and the innovative technology at work behind the scenes.

Television is nothing but a lot of overexcited electrons flashing on a screen; and now so are the studios it is broadcast from. The BBC launches its first 3D Virtual Studio today, where actors, presenters and the cameras can move around a bare studio, which will instantly be filled with sets created by powerful graphics computers.

The corporation has been using virtual sets since 1992. All its main news bulletins use prerendered 2D sets, as do sports programmes such as *Match of the Day*. What is different with the new 3D system is that instead of being limited to static shots (or preplanned animations), our view of the sets will change as the camera moves.

To do this live requires a huge amount of computer power, which is why each camera is linked to a Silicon Graphics Onyx supercomputer. The dedicated studio opening today can have up to three cameras, with a further Onyx being used to create a virtual actor or live action cartoon character. A larger virtual studio will open in two months, but "a lot of virtual productions don't need a huge studio. That's the point, you can do a lot in a small area," says Danny Popkin, technical development manager at the BBC.

Among the first programmes lined up for the studio are a children's drama, complete with a live cartoon character, a magazine programme and a music show.

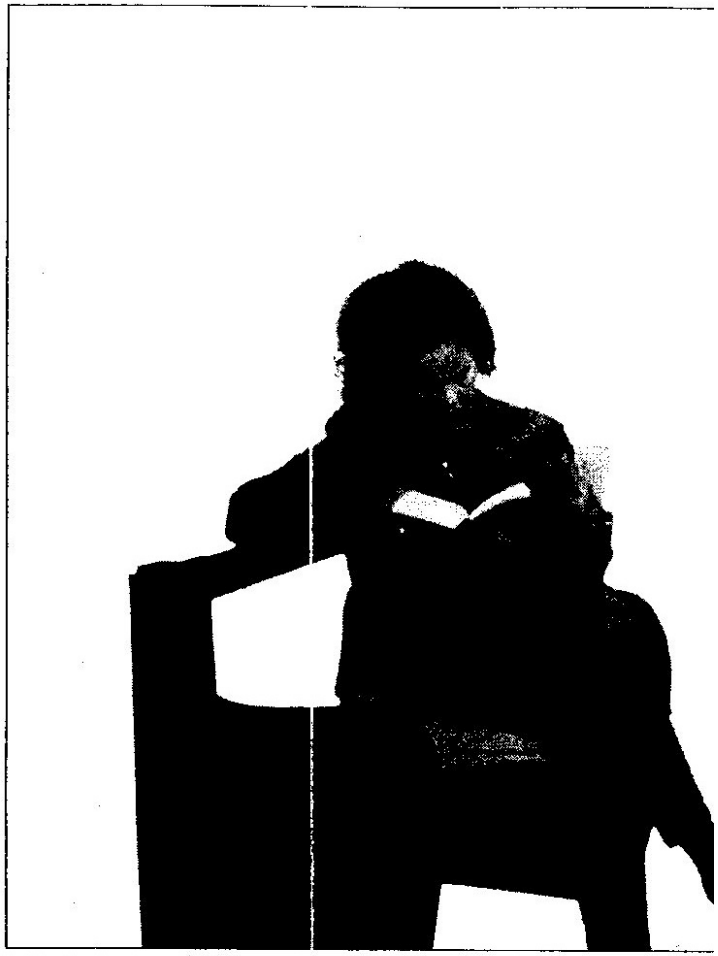
Virtual studios can cost £1m to £2m because of the computing power needed, but Popkin believes future systems will cut costs by using a hybrid 2D/3D system. "A 3D system is only required for around 5 per cent of camera shots, so a system that links the camera to a 2D background manipulator fed via a shared 3D system makes sense," he says.

The BBC has already cut costs through two inventions that look set to be adopted by broadcasters and film-makers around the world: Free-d and Truematte. In order to match the virtual set to each camera shot, the computers need to know precisely where each camera is. This is usually achieved by fixing the cameras to expensive robotic pedestals, which is creatively stifling as the actors have to play to the slow-moving cameras rather than having the camera react to them. Instead, the BBC's new Free-d system allows any camera, even handheld, to be used by fixing a tiny camera to the studio camera body, pointing upwards at targets on the lighting grid. The targets are unique circular bar-codes, which were used "because you don't know at what angle it will be viewed. Also, with a circular object it makes the measurement of the exact centre easier," says Richard Russell, senior BBC R&D engineer, who developed Free-d's software.

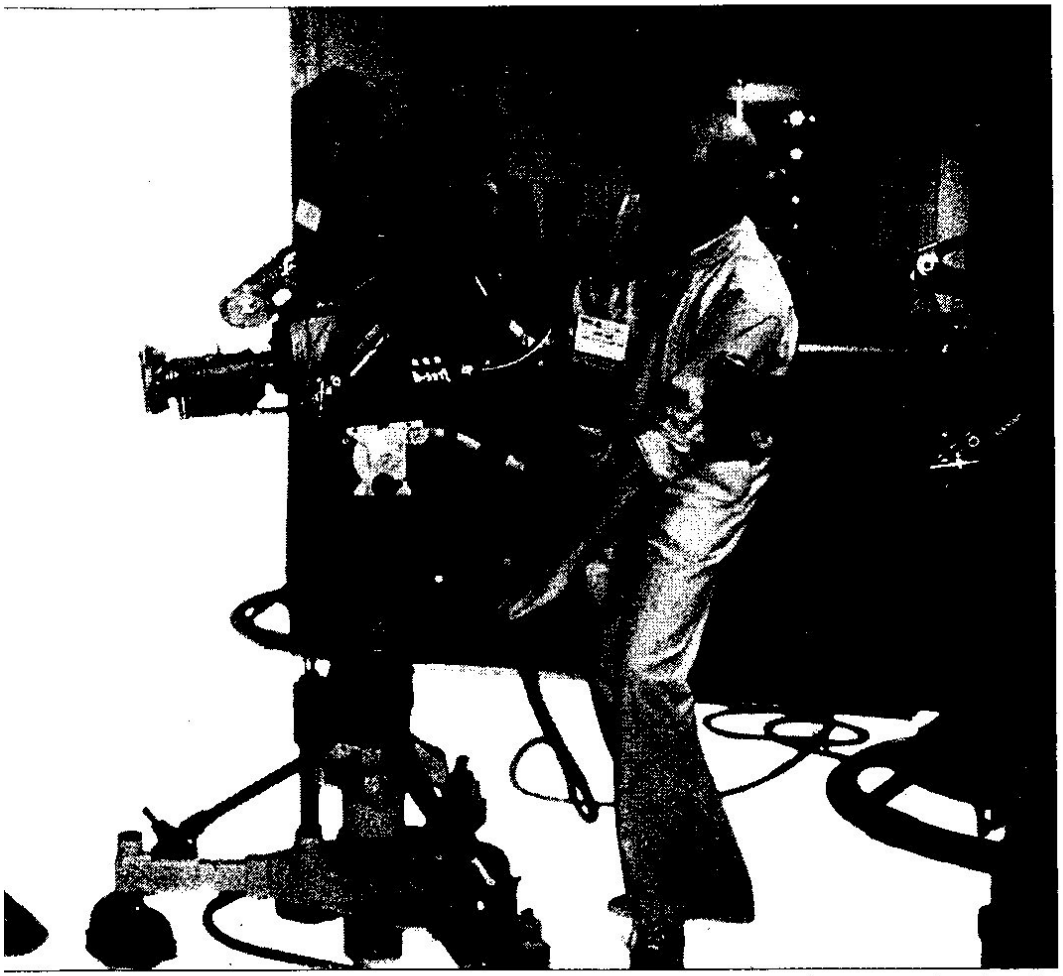
They use a cheap monochrome camera, surrounded by a ring of low-power yellow LEDs to light the highly reflective tape used to make the bar-codes. The targets are positioned at different heights so the system can distinguish between whether the camera is tracking or tilting but don't have to be a set distance apart, which allows for lights and other equipment hanging down. As long as it can see at least four targets at once it can locate itself correctly.

The BBC developed Free-d because other systems weren't suitable for large studios. It is accurate to 1mm in its x, y and z positioning and to less than 1/100th of a degree in lens alignment, which is better than can be achieved by robotic cameras. Because of its low cost, the BBC hopes Free-d will be attractive for other applications, such as precisely locating robots in manufacturing plants. Unlike other systems, it only has to be set up once, taking just 30 minutes to calibrate.

It is controlled by a dedicated single chip Digital Signal Processor (roughly equivalent to a 486 processor), which works out where the camera is in relation to the targets. They could have used a PC, but opted to develop the dedicated rack unit because "it saves money, is more reliable and it gives you something to sell – it's much easier to copy software than copy hardware", says Russell.



The other big issue is matting or placing the actors or presenter into the virtual set. This requires the computer to extract them from the real background, which is usually blue (to be different from skin or hair). However, even in a small studio, lighting a blue screen takes about 12 kilowatts of power and



Virtual presenter: the actors or presenters are later extracted by computer from the real, bare set to be placed in the virtual set

getting that light evenly spread is tricky. Instead, the BBC invented Truematte, a highly reflective grey cloth which needs a maximum of 6 watts (3 watts in a small studio) to light it. Unusually, the light comes from a ring of blue LEDs fitted around each camera's lens.

This means the studio can be lit for the actors, rather than the bluescreen. The LEDs can throw a blue cast on the actor, but only when the camera is a lot closer than it usually needs to be. It is also easier to set up as there is no need to worry about creases, or corners, or even scuff marks on the floor, all of which would cause problems with standard blue screen. It only needs to be swept where a blue floor usually has to be repainted each time as scuff marks show through the signal.

Popkin believes the new studio will be attractive to producers, who will be able to create sets impossible in any other way. Although earlier systems have had a cartoony feel, he says "the quality of the sets is now almost good enough for drama, and we can create very realistic lighting effects", thanks to Truematte.

The BBC isn't allowed to sell the system as its own product, but it will be licensing it to a manufacturer and getting royalties from any sales. These will join other BBC inventions such as the Nicam stereo sound system, now licensed to almost all TV set and VCR makers, and the 2D Virtual Scenario set system made by Radamec.

FEEDBACK

Women and technology

With reference to Melanie McGrath's article "Are women turned off by technology?" (10 March), I would like to point to an example where women are leading the way.

I work for Poptel, a co-operatively run Internet service provider, where over 50 per cent of the staff are female, and 50 per cent of the management are also female. This could be because, as a co-operative, we have a more relaxed management structure relying on teamwork, or because we deal primarily with charities and non-profit organisations – traditionally female-dominated sectors. However, I do feel that our company is a good example of the changing trend towards women being more interested in IT and being good at it.

Poptel recognises the ability that women have to communicate efficiently, and how valuable these skills are in today's world of "cyberspace". Let's hope other IT companies will follow suit.

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I read Melanie McGrath's article on women and technology with interest and doubt whether women really are being left behind. There may be more men than women linked to the Internet, but for what purpose?

When I weave my way through the wired world, I meet a lot of women. This is not so surprising as my main area of interest is embroidery. What I do find surprising is the low level of participation by men. Many men enjoy canvaswork, particularly in retirement, and others chart patterns for wives to embroider, yet few of them take advantage of the information available.

While a man may feel diffident about joining a room full of women at a local craft group, cyberspace offers an environment where gender and age are irrelevant. I am membership secretary of the Computer Textile Design Group and find our male members are few. Women and men need to shake off these illogical stereotypes and make the most of the opportunities new technology has to offer.

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