PHOTO:IRA AWASTHI; DIGITAL IMAGING: NEETA

A deeper PERSPECTIVE

Who among us has not yearned, at some time or the other, for realistic 3D display on our monitors? Researchers around the world are working hard to make your wish come true...

Unleashed upon unsuspecting viewers more than a decade ago, *Chota Chetan* might have been a relatively clumsy attempt at 3D movie-making, but it still had visual imagery which grabbed viewers' eyeballs, pulled them out of the sockets, and stamped them all over the floors of assorted cinema-halls across the country. Cynics, who believed that 3-dimensional viewing would never be possible on a conventional two-dimensional screen, came away, bleary of eye, and tweaked of nose.

Dilemma of three dimensions

Three-dimensional cinematic experience is unforgettable. And yet, 3D displays have not really taken off. Why?

Technology, for one. Even though 3D displays have been in existence since the 1950s, they required viewers to don clunky red-and-blue cellophane (or plastic) glasses to actually perceive the simulated third dimension. The image quality was poor, and for some, the glasses also resulted in severe eye-strain. For many years, 3D displays were dismissed as nothing more than a gimmick.

Technologists of that era are not to be blamed, though—producing realistic 3D imagery on the screen can be more difficult than most people would imagine. Stereoscopic image-processing by the human brain is complex. The pupils in our right and left eyes being about two-and-a-half inches apart, the eyes perceive slightly different images and those images are co-interpreted in the brain, to produce tangible three-dimensional vision, that gives us the sense of depth.

When a picture is being displayed on a monitor, however, this effect becomes difficult to replicate, because the display 'fakes' spatial expansion of objects, and both eyes see the same picture at once. Even while working with 3D modelling packages, all you see are two-dimensional representations of 3D renderings. Which are convincing enough—until you see the surrealistic, hologram-like, stereoscopic displays that allow a user to perceive true 'depth'.

In deference to the human eye, stereoscopic displays create, and then merge, two slightly different views of an object. Both the representations of the same image are displayed on the screen, and in most cases the viewer has to wear special glasses, which make sure that each eye sees only the image representation meant for it. The eyes convey this combination of two flat images to the brain, which then interprets 'depth'.

Out of the lab, into your living room?

Manufacturers like VRex, StereoGraphics, and NuVision Technologies already sell 3D display systems, but cost and complexity are two issues which mainstream manufacturers are yet to contend with.

There are broadly two categories which most stereoscopic displays fall into—'Active' and 'Passive' systems. With the former, the eyewear shuts out the display, alternating between the eyes, showing each eye only one image at a time. In a StereoGraphics display system for example, the eyewear consists of liquid-crystal shutters, which juggle the images meant for both the eyes at very high speed. When the left-eye image is on the screen, the left lens remains clear, and the right one darkens, and the reverse happens when the right eye image is being displayed. The result is that the brain 'sees' images hovering in front of the eyes, in all the glory of SGI Octane-simulated depth.

In 'Passive' systems like NuVision's, the display itself is field-sequential—showing one complete left-eye image followed by one complete right-eye image. The polarised glasses ensure that the eyes see only the images meant for them, and the result is that you find all those dinosaurs staring at you in the face, with fright-inducing realism. Other passive systems, like VRex, use interleaved field-sequential technology, which displays all even lines and odd lines in very fast sequence. One eye sees only the odd lines, and the other, only the even. The result is similar to that in the other passive technology-based systems.

The Next Wave

Users of stereoscopic displays find wearing special eyewear irksome, and want systems that do not require the viewer to wear special glasses. Researchers from the Heinrich Hertz Institute for News Technology in Berlin, developers at the Philips Research in the Netherlands, and a team from the Technical University in Dresden have developed different kinds of LCD monitors which do not require the viewer to wear special glasses to see in 3D.

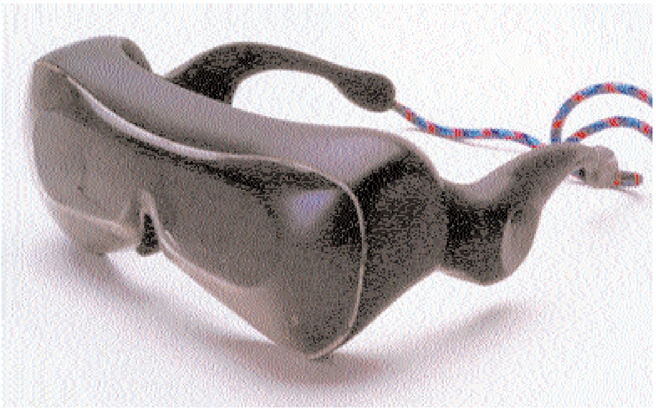
To do this, Philips uses special lenses (called Fresnel lenses) at an angle of 9.5 degrees diagonally inclined through the 3.5 screen lines respectively. Normal collective lenses

A working prototype of 3D-display monitor developed by Philips

The polarised glasses ensure that the eyes see only the images meant for them, and the result is that you find all those dinosaurs staring at you in the face, with fright-inducing realism

bundle light rays and direct them to a point. The Fresnel lenses break up the incoming light rays and refract them in the right and left eye of the observer through a precisely calculated lens cut. Two object perspectives penetrate their common lens, without being combined into a complete picture. That function is completed in the brain.

The Dresden researchers' solution resembles the Heinrich Hertz Display, but a prism mask is used instead of the lenses. Made of glass or a light permeable polymer, the prisms run vertical, alternating right and left inclined and cover a screen column. In every screen row of the liquid crystal monitor used, the various perspectives appear alternately which would direct the right and the left eye in natural surroundings. Even display columns include the right field, odd columns the left field. The prism mask refracts the light rays respectively to the right or left eye of the observer. The rays will not be refracted crosswise. For instance, the even LCD columns are located on the right side of the column group and contain the right field, which is directed to the right eye from the prism.



The glasses you need to put on for 3D viewing–from VRex

Finder) emphasises the position of the eyes, and the information is finally used to mechanically shift the prism masks or in a second method developed in Dresden, to electronically shift the object on the screen.

In electronic tracking, the prism masks do not move. Instead, the pixels 'walk' in the sub-pixel area. The pixel colours, addressed separately by a thin film transistor each, are aligned in vertical stripe form for this purpose. The pixels for red, green and blue are located next to each other in a triangle-like form. If the object is shifted on the screen, the blue sub-pixel (for example) dissolves on the right

Looking towards a 3D future

Those who cannot wait to buy the latest in technology have a rather limited choice at present. You can buy the VR Surfer (from VRex) which, at Rs 5,000 (approximate cost in the US), comes with wireless eyewear, and all the software required to make it work with TV as well as PC monitors. NuVision's 3D-Spex also cost the same, and have the same capabilities as the VRex product. Those looking for a hi-end product have the option of going in for the CrystalEyes (from StereoGraphics) which costs about Rs 40,000 (in the US), but offers much better display quality than the systems from VRex or NuVision. However, if you want to buy 3D displays that do not require you to wear special glasses, you have only one problem. You cannot. Glass-less stereoscopic displays are still under development, and even though most companies involved in the development do have working prototypes (Sharp and Sanyo, for example), they are not available to the general public. The costs, when these displays do become available, are expected to be formidable.

Researchers see computer

Glass-less stereoscopic displays are still under development, and even though many companies have working prototypes, the costs are expected to be formidable

The combination of LCD and lenses or prism mask channels better perspective than the shuttering systems described before.

Doing the PixelWalk

In all the above-mentioned 3D processes, the observer has to always look at the monitor from the same angle, which becomes rather uncomfortable after a while. When the viewer changes position, picture parts meant for one eye become visible to the other, and this interferes with the display. This disturbance, called speak-over, can be very irritating, and produces disorientation. Therefore, methods were developed to track the eye and head movements of the observer. A camera integrated on the top of the display (Eye

border of a pixel. For this, the blue of the adjacent pixel lights up on the left side. The pixel is complete even if in another place.

The Philips 3D prototype functions in a slightly different way. The Fresnel lenses, if arranged cylindrically on a display, offer a large observation angle, and several observers can simultaneously view the 3D display. No head/eye tracking is required in this case. But there is a flip side to this. Though up to seven views of an object can be calculated and simultaneously channelled by the Philips system, the actual resolution of the screen is reduced by a factor of 7. The 3D monitor from Philips might be less suitable for demanding applications.

gaming as the driving force behind each 3D development, but CAD specialists, surgeons, architects, and landscape architects are also standing in queue. Passive stereoscopic displays like the CrystalEyes is already being used by scientists at NASA's Jet Propulsion Lab, to record and interpret photographic data from the Mars Pathfinder. Companies like Boeing and General Motors use 3D displays for mechanical CAD applications, which actually helps them bypass a few steps in the conventional design process. From Molecular modelling to Endoscopic surgery, and to 3D gaming and entertainment to CAD and CG Animation, professionals at the cutting edge of technology can expect to work in 3D in the times to come.

SAMEER KUMAR