Scientists claim new glasses-free 3D for cellphone (w/ video)

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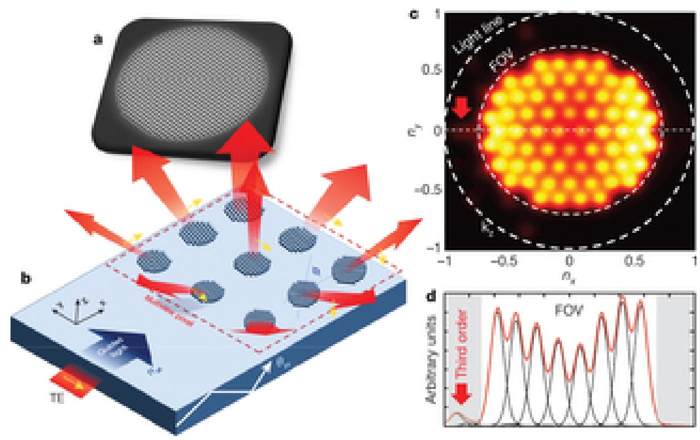


Multi-directional backlight concept. Credit: *Nature* doi:10.1038/nature11972

Fancy watching a movie on your mobile phone, where figures leap out from the screen in 3D, rather as Princess Leia did in that scene from "Star Wars"? That's the claim made by US researchers, who on Wednesday reported they had made a display which gives a three-dimensional image that can be viewed without special glasses and is intended for cellphones, tablets and watches.

Unlike the holographic projection used in George Lucas' movie fantasy, their small prototype display is flat and backlit.

It uses a technology called diffractive optics to give 3D images that can be viewed from multiple angles, even if the device is tilted.

"Unlike a lot of technology out there that only does so-called horizontal parallax, which means that you only see 3D when you move your head left and right, we actually are talking about a technology that gives 3D for full parallax," said David Fattal, who led a team at Hewlett-Packard Laboratories in Palo Alto, California.

"For example, if you were to display a 3D image of Planet Earth with the North Pole facing out from the screen, by turning your head around the display, you would actually be able to have a view of any country on the globe, you would be able to see all the way around," Fattal told journalists in a telebriefing.

Diffractive optics meet a challenge posed by the human anatomy, according to the study, published on Wednesday by the journal *Nature*.

Humans view the world stereoscopically, meaning that our two eyes see two slightly different images because they are separated by about six centimetres (two and a half inches).

2D screening provides only a single flat image, which means the two eyes both see the same picture on the screen.

3D imaging, therefore, has to present a slightly different image to each eye.

Glasses-based systems work by having two lenses that each polarise the light in different directions, or by having cheap-and-cheerful—and headache-inducing—lenses of red and green. In the first case, the display has two simultaneous images, each with different polarisation; in the second, the two images have red and green outlines.

Current glasses-free systems, including some mobiles, use thin lenses called lenticules or parallax barriers that send an image towards each eye.

But the 3D effect is limited and can only be perceived if the viewer is positioned in a narrow zone so that the correct eye gets the correct image.

The best option would be Princess Leia-style holography. But right now, this cannot be used for images displayed at a normal video rate, as the demands in pixel density are just too great.

The new "autostereoscopic multiview display" uses a backlight whose surface has been etched with tiny refractors.

Each of these microscopic deflectors send individual points of light in specific directions. These individual pixels, put together, comprise the different images sent to each eyeball.

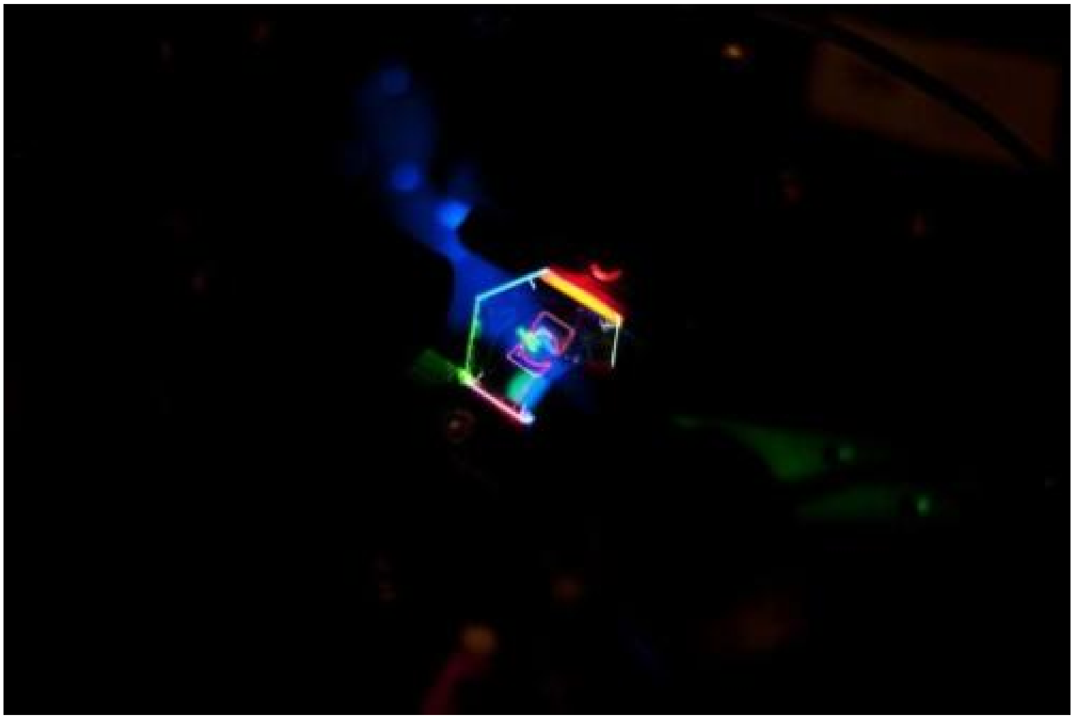
The demonstration models can send light in 14 distinct viewing directions, providing the 3D effect in an angle of 90 degrees at a distance of up to a metre (3.25 feet). Tests have been carried out with images or footage, at 30 frames per second, of flowers, a turtle or a corporate logo.

The scientists said the design can be ramped up to produce up to 64 directions, further widening the viewing zone.

Using glass of high refractive index, the field of view could be "close to 180 degrees," they add.

"This current prototype is completely transparent and we think that even using a modulating device to achieve video rates, we can still retain most of the transparency," said Fattal.

In commentary also carried by Nature, University of Cambridge computer specialist Neil Dodgson said major challenges lay ahead before the exploit would be commercially viable.



This photo, obtained on March 20, 2013 from *Nature*, shows a 3D image of an Hewlett Packard logo in RGB, from a completely transparent substrate. US researchers reported they made a display which gives a three-dimensional image that can be viewed without special glasses and is intended for cellphones, tablets and watches.

The new illumination system has much smaller pixels than mobile devices today, so more work has to be done to ensure that picture quality—which depends on pixel density—is not lost.

Another hurdle is to have the device manufactured "reliably, robustly and in quantity," which may take years, said Dodgson, who also pointed to the expense of providing content filmed in 3D in order to provide the multiple images.

"The more nebulous question... (is) whether humans want or need 3D displays," he noted. "Time will tell."

More information: A multi-directional backlight for a wide-angle, glasses-free three-dimensional display, *Nature* 495, 348–351 (21 March 2013) doi:10.1038/nature11972

Abstract
Multiview three-dimensional (3D) displays can project the correct perspectives of a 3D image in many spatial directions simultaneously. They provide a 3D stereoscopic experience to many viewers at the same time with full motion parallax and do not require special glasses or eye tracking. None of the leading multiview 3D solutions is particularly well suited to mobile devices (watches, mobile phones or tablets), which require the combination of a thin, portable form factor, a high spatial resolution and a wide full-parallax view zone (for short viewing distance from potentially steep angles). Here we introduce a multi-directional diffractive backlight technology that permits the rendering of high-resolution, full-parallax 3D images in a very wide view zone (up to 180 degrees in principle) at an observation distance of up to a metre. The key to our design is a guided-wave illumination technique based on light-emitting diodes that produces wide-angle multiview images in colour from a thin planar transparent lightguide. Pixels associated with different views or colours are spatially multiplexed and can be independently addressed and modulated at video rate using an external shutter plane. To illustrate the capabilities of this technology, we use simple ink masks or a high-resolution commercial liquid-crystal display unit to demonstrate passive and active (30 frames per second) modulation of a 64-view backlight, producing 3D images with a spatial resolution of 88 pixels per inch and full-motion parallax in an unprecedented view zone of 90

degrees. We also present several transparent hand-held prototypes showing animated sequences of up to six different 200-view images at a resolution of 127 pixels per inch.