Artificial eyeball does away with distorted images

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NewScientist.com news service
Kurt Kleiner

Mimicking the curves of a human retina has enabled a digital image sensor to take wide-angle pictures without distortion. This is possible thanks to an improved method of transferring silicon sensors onto a curved surface.

The electronic eyeball design can allow small cameras to capture wide-angle views with low distortion. That could be useful in a range of situations, from policing, to attaching cameras to wildlife.

Conventional film and digital cameras use a flat surface to capture an image and as a result are unable to capture a wide field of view without distortion. Optics designed to correct such distortions can be complex and expensive.

The concave retina of your eye is able to capture a wider field of view without distortion. But building similarly curved electronic image sensors is difficult. Silicon doesn't bend easily and can't be forced into a hemispherical form without creases appearing in the material.

John Rogers at the University of Illinois at Urbana-Champaign and colleagues have now worked out a way around those problems, using conventional chip manufacturing technology.

Flexible form

They built their hemispherical electronic eye by first using conventional photolithography to build silicon photodiodes 500 micrometers square and 1 micrometer thick. These were then wired into a flexible 16-by-16 array using chromium and gold.

Separately, they created a 1-cm-wide hemisphere out of a stretchy plastic, and stretched it into a flat surface. That stretched surface, or "drumhead", was then pressed against the photodiode array.

The silicon squares stuck to the stretched plastic thanks to van der Waals forces, which was then allowed to spring back to its original hemispherical shape. As the array took its new form, the photodiodes packed together tightly and the connecting wi arced away from the surface, but the array was undamage

The reformed array was then glued to a curved glass surface, and a conventional lens attached. It now resembled a human eye in construction, with light entering the lens from the front, and passing to the curved "retina" containing the matrix of photodiodes behind.

Army eyes

Although the camera they created has only 256 pixels and is therefore relatively low-resolution, Rogers says that the same technique could be used to make wide-angle megapixel cameras.

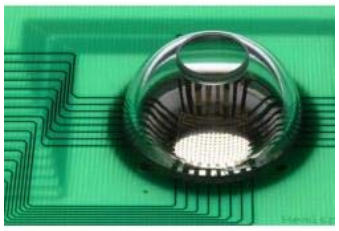
He says the most likely application for the new camera is for military surveillance, since it could result in a camera that can clearly see a wide field of view in a smaller, lighter device.

But the technique could also eventually have medical applications, as a way to imprint sensors onto curved surfaces of the human body, he says. For instance, it may become possible to give the curved surface of a human retina a coat of digital sensors, helping blind people see again.

Max Lagally, a physicist at the University of Wisconsin-Madison, says that the new approach is useful because it allows the use of conventional technology to create the circuits.

"What's elegant about this is you can use silicon. The technology is well developed," he says.

Journal reference: *Nature* (DOI: 10.1038/nature07113)



Enlarge image
By assembling an array of photodiodes bound flexibly with wire, researchers have managed to create curved image sensors that mimic a biological retina (Image: University of Illinois)

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' - - Does Away With Distortion' ?? VIEW THREAD >>

By Go Figure
Wed Aug 06 22:25:17 BST 2008

Nice development, and I'm not knocking it; BUT, with tongue firmly in cheek, and to provoke discussion:

How do you define 'distortion' in this context? Seems to me it's a bit subjective, like 'weeds' or 'congestion'. When IS a plant a 'weed'; how much traffic constitutes 'congestion'. A 2-dimensional image of a 3-dimensional reality is an artefact of how it's produced, so is as 'valid' as another; so surely any one image could be branded 'distorted' RELATIVE TO any other?

The image perceived by our eyes is the artificial product of our optical system as 'seen' through our brain. Does a fish 'see' the same ('corrected' by ITS brain); or is its world that as 'distorted' (in OUR eyes) by a fish-eye lens?

So - - does this new development produce an image 'less distorted' relative to human perception, or relative to some 'neutral' objectively-defined standard of what constitutes undistorted?

REPORT | REPLY

> **' - - Does Away With Distortion' ??**
>
> By Bdan
> Wed Aug 06 22:57:39 BST 2008
>
> I think it is undistorted relative to an objectively-defined standard. Consider: if you project an image of a scene onto a flat surface, objects towards the edge of the scene will not appear the same size as objects near the center of the scene, even if they are the same distance away and the same size in real life. It's similar to what happens when you project an image of the Earth onto a flat map; the only undistorted map is a globe. If you project the image of the scene onto a sphere, as this technology does, everything will be the right size relative to everything else.
>
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Here's A Tip For Them VIEW THREAD >>

By Nick Sharratt
Wed Aug 06 23:21:05 BST 2008

Don't bother trying to make a perfect regular grid of sensors at all, but then "train" the eye using software to cope with the non-regular/perfect placement or even 'failed' sensors by pointing it at a variety of test images to identify the irregularities and build compensation into the output. E.g. Copying what nature does in the eye even further.

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By Terry Schuster
Thu Aug 07 03:24:18 BST 2008

Sorry, but as a U of Illinois graduate ('76), I have to insist that Urbana-Champaign be spelled correctly. It is French for "plain" - and anyone from the University will attest to the extreme flatness of the landscape. Sorry - not the bubbly wine.

- still, I remain an avid reader of NewScientist.com. Thanks!

REPORT | REPLY

> **Spelling**
>
> By Michael Marshall
> Fri Aug 08 12:12:12 BST 2008
>
> Sorry Terry, that one must have escaped our editors. It's fixed now. :)
>
> **REPORT | REPLY**

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