Compact 'eyeball' camera stretches to zoom

27 January 2011 by **James Urquhart**
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A CAMERA inspired by the operation of the human eye can "zoom" without the need for bulky lenses, making it more compact than conventional cameras.

The device builds on a non-zooming eyeball camera developed in 2008 by John Rogers of the University of Illinois, Urbana-Champaign. Now he has given the technology a twist by building in a stretchable lens and a flexible photodetector whose shape alters as the magnification of the lens changes. This produces a camera with a 3.5× optical zoom.

Traditional cameras capture their images on a flat surface, formerly photographic film but now usually a digital photodetector. In a conventional camera, extra lenses are required to flatten the image before it hits the detector, otherwise it appears blurry or uneven.

The eyeball camera does away with the need for these extra, movable lenses, and reshapes the sensor instead. Rather than adjusting the image to suit a flat surface, it flexes the sensor to match the curvature of the image and the lens.

To achieve this, Rogers has mounted an array of silicon photodetectors on an elastic membrane, which in turn forms the surface of a fluid-filled chamber (*Proceedings of the National Academy of Sciences*, DOI: 10.1073/pnas.1015440108). Using hydraulic actuators to adjust the amount of fluid in the chamber, the membrane can be flexed to take up convex or concave shapes.

The lens is formed by fluid held in a gap between a glass window and an elastic membrane whose shape can also be adjusted hydraulically.

The eyeball technology could be used in night-vision cameras that now typically use bulky and expensive lenses to capture infrared images. Another application would be endoscopes, where very tiny cameras with a wide field of view are required, Rogers says.

Corin Gawith, an optoelectronics researcher at the University of Southampton, UK, says the device is an elegant solution to the problem of making lens systems less bulky. "In an endoscope you can see how it would be very useful because you've got a very small lens and what you are trying to do is take an image of quite a wide area," he says. "Same again in the security camera. What they are offering is a very compact way of achieving that."

For now, Rogers's camera can only produce images with an effective resolution of a few thousand pixels, but that could be dramatically improved. "There's no law of physics that needs to be broken in order to go from where we are now to a 5-megapixel camera," Rogers says.

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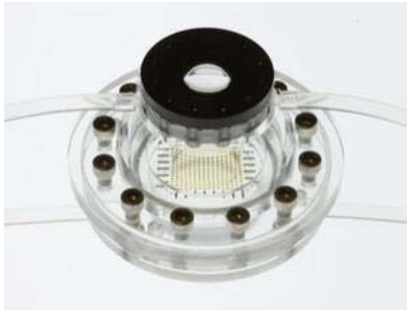

Stretching to see further (Image: John Rogers)

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