Scientists develop flexible sensor to allow simple zoom

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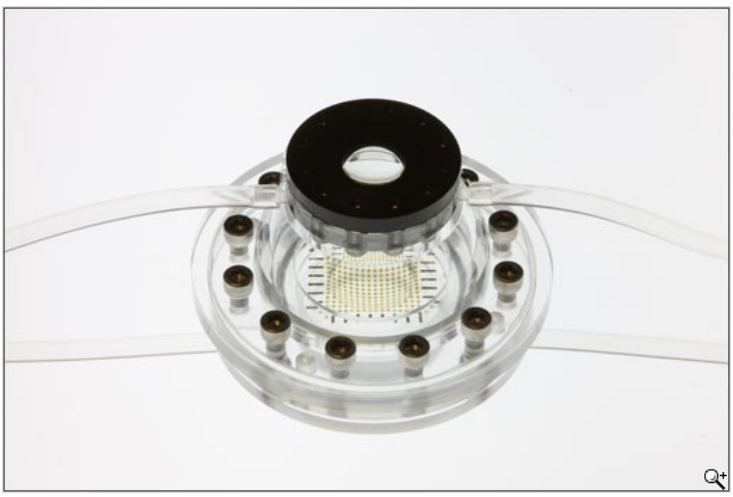
Scientists have successfully constructed a digital camera that can be flexed to focus an image, allowing its use with simple single-element lenses. Researchers from Northwestern University and the University of Illinois created a 16 x 16 pixel array on an elastomeric backing that can be distorted to correctly focus the image from a simple lens. In a paper to be published in the Proceedings of the National Academy of Sciences (PNAS), they combine this with a single-element, tunable lens to provide a camera with very simple optics capable of zooming. The technology could eventually provide 'studio quality' images from cellphone cameras, one of the lead researchers says.

At present, lens construction and design is greatly complicated by the need to project a flat image surface onto the usually flat surface of a sensor - simple, single-element lenses project non-flat image surfaces (so-called Petzval surfaces). With this latest work, the scientists have successfully shown the ability to adjust their sensor surface to match the curvature of the image surface being projected by an equally adjustable, fluid-filled lens.

In its paper, the team, led by Professor Yonggang Huang of Northwestern University, Illinois and Professor John Rogers, of University of Illinois, say: 'This type of technology could be useful for night-vision surveillance, endoscopic imaging, and other areas that require compact cameras with simple zoom optics and wideangle fields of view.'



The team's camera is made up of a 16 x 16 pixel CMOS sensor constructed on an elastomeric surface that can be controllably distorted by sucking liquid out of the reservoir underneath it. In its paper, the team combined this with a simple, single-element lens constructed from a clear elastic membrane over a water chamber.

Pumping water into this chamber changes the shape of the lens and hence its magnification, and the sensor surface can then be adjusted to match the shape of the image surface it projects. (*images courtesy of J. Rogers, Univ.of Illinois*)

Rogers expanded on this when approached by dpreview.com: 'Night vision and endoscopy are probably just the most promising initial applications, due to their requirements and cost structures. A successful development of the technology could, however, allow it to be used in any type of camera. We have in mind, for example, the use of this technology to achieve 'studio quality' imaging in small, cellphone cameras.'

Although not without challenges, he is confident the technology could be applied to commercial devices: 'We feel that the fabrication techniques are scalable, because they build on conventional silicon detector designs. A substantial amount of engineering effort is needed, however, to take the devices that we have now (few hundred pixels) and scale them into something more commercially relevant (few million pixels).'

He says any such devices are 'a few years out,' but there already is a company (MC10) looking to licence and commercialize the technology.

The paper 'Dynamically tunable hemispherical electronic eye camera system with adjustable zoom capability' will be published in *PNAS* on January 17th.

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