Disney's magical vision calls for 3-D printed optical elements (w/ Video)

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Chess pieces with embedded light pipes display content piped from an interactive tabletop. Contextual information, such as chess piece location and suggested moves, can be displayed on each individual piece.

(Phys.org)—Disney Research is serious about mixing science with play and pushing further into imaginative results with 3-D printing. A research paper, "Printed Optics: 3D Printing of Embedded Optical Elements for Interactive Devices," talks about explorations into 3-D printing with custom optical elements for interactive devices. As such,

Disney Research is thinking toward a next-step in digital printing when one will print interactive objects on the fly. Authors of the paper, Karl D.D. Willis, Eric Brockmeyer, Scott E. Hudson, Ivan Poupyrev, are all focused on future printing techniques and applications.

Willis and Brockmeyer are from Disney Research in Pittsburgh and Hudson and Poupyrev are from Carnegie Mellon University. The two sites provide opportunities for collaboration partly stemming from the fact that Carnegie Mellon is one of the leading seedbeds of research into robotics, computer vision, and human-computer interaction (HCI). The relationship with Carnegie Mellon gives Disney researchers added expertise as well as access to lab facilities in robotics and motion capture.

"We envision future interactive devices that are not assembled but 3-D printed layer by layer," the authors said. They talk about how novel elements can be fabricated with 3-D printing and embedded in interactive devices. They talk about new possibilities in display surfaces and embedded optoelectronics. They see "tremendous potential" for rapid high fidelity prototyping, and eventually for production of customized devices tailored to specific tasks.

A 3D printed mobile projector accessory with embedded light pipes. Projected imagery is mapped onto the character's eyes. The character responds to user interaction such as sound or physical movement.

"Display surfaces can be created on arbitrary shaped objects using 3-D printed 'light pipes,'" they said.

"Novel illumination techniques allow the internal space within a 3-D printed object to be used for illumination and display purposes. Custom optical sensors can be 3-D printed with the structure of interactive devices to sense user input. Optoelectronic components can be completely enclosed inside optical elements to produce highly customizable and robust interactive devices."
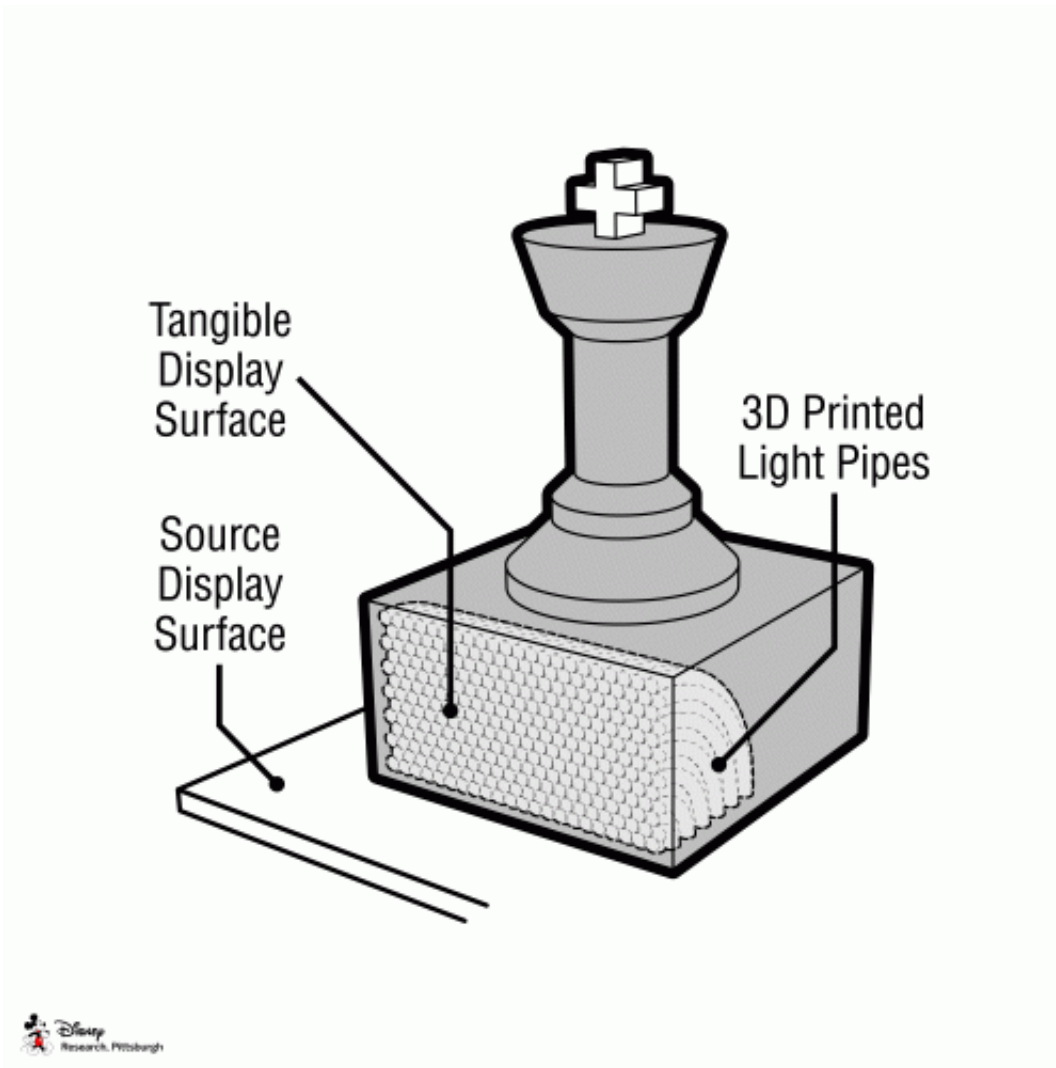
3D printed light pipes can create display areas on physical objects, by guiding light from regular screens.

Light pipes are 3-D printed optical elements that are similar but not identical to optical fiber. They can be used to guide light from point to point. The paper explained that "Unlike conventional optical fiber, 3-D printed light pipes allow arbitrary geometries to be created in software and then locations on the surface of a mobile device to a single sensor array." They add that light pipes can be printed into the walls of a device to create robust and exceptionally thin, sub mm, embedded sensing with

minimal hardware assembly.

As for when all this will be possible, the authors are optimistic about possibilities for fabricating light pipes in the next generation of optically optimized 3D printers.
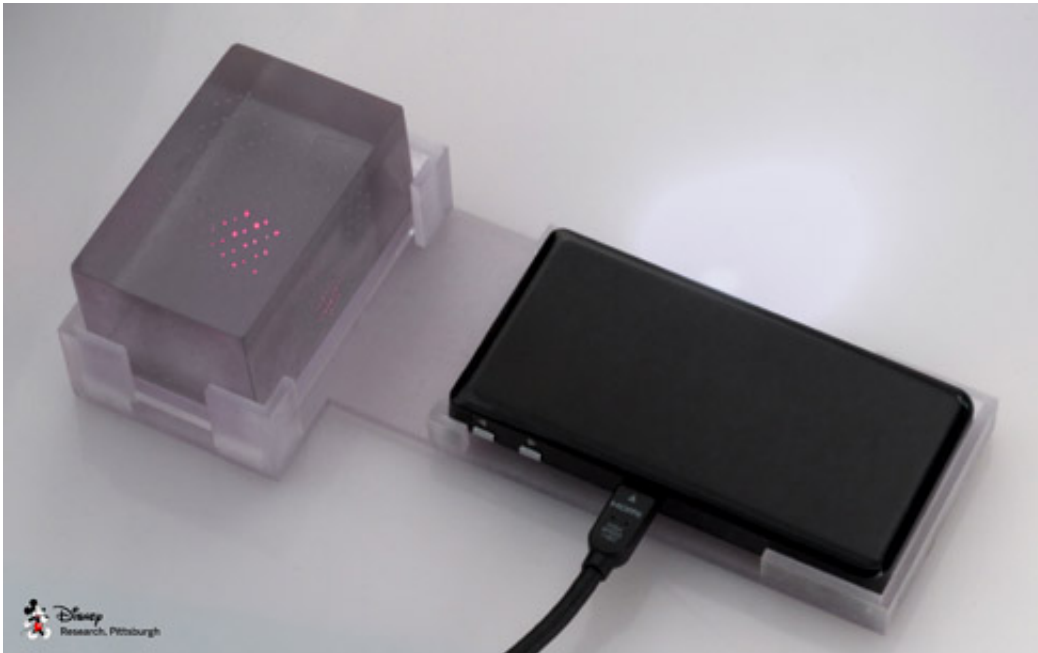
A mobile 3D display created by projecting on internal bubbles within a 3D printed model.

They said that the ability to dynamically control optical properties such as the refractive index, reflectivity, transmittance, absorption, and diffusion will enable a richer design space for sensing, display, and illumination.

"Although that time is not upon us yet, Printed Optics demonstrates what is possible today." They define Printed Optics as a new approach to creating custom optical elements for interactive devices using 3-D

printing.

 More information: Printed Optics: 3D Printing of Embedded Optical Elements for Interactive Devices, Willis, K. D.D., Brockmeyer, E., Hudson, S. E., and Poupyrev, I. Printed Optics: 3D Printing of Embedded Optical Elements for Interactive Devices. In Proc. *ACM UIST* (2012). Paper [PDF, 1.5MB]

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