

Post-print customization of 3-D prints

March 6 2017



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Three-dimensional printing makes all conceivable varieties of layered, three-dimensional objects possible, a benefit appreciated by industry and private users alike. However, once an object is printed, any freedom of design is a thing of the past and the workpiece can no longer be modified. To address this restriction, computer scientists at Saarland

University are working on the integration of specifically developed components at predefined points within such 3-D objects, a technique that makes alterations to the object possible even after printing. Their novel procedure is being presented at the CeBIT computer fair from March 20 to 24 in Hannover, Germany (Hall 6, Stand E28).

"After printing, the 3-D object is static. You can no longer change it or adapt it to your needs," says Daniel Gröger, a doctoral student with the Cluster of Excellence at Saarland University. Together with Jürgen Steimle, head of the chair for Human-Computer Interaction at Saarland University, Gröger developed a procedure named Hotflex to work around this shortcoming. To that end, the computer scientists developed a flat composite, consisting of several individual layers controlled by an Arduino, a miniature computer. When the composite structure is energized by the computer, it becomes deformable almost instantly. This is made possible by the multi-layer composition of the device. The innermost layer is the so-called heating structure, which is connected to the miniature computer. Next comes the so-called moldable structure, consisting of a biodegradable plastic. If the computer-activated heating structure heats the plastic layer to a temperature of just under 60 degrees Celsius, the material becomes malleable and can be formed into the desired shape simply using bare hands. Once the object has cooled down, it will remain in this modified shape. For additional stability and outside protection, the outermost layer is made of a flexible plastic. The researchers printed the composites themselves using a regular office printer with special ink as well as a commercially available 3-D printer.

By integrating the composite elements produced in this manner into the 3-D object at certain points, its shape can be modified even after the [printing process](#) is completed. And there is more: These composites can also be used to make 3-D objects touch-responsive or to display information on them. The Saarland scientists demonstrated this with a range of printed prototypes, including an adjustable bracelet, a jewelry

box that opens with knock signals, and a computer mouse with a customizable supporting surface. "We are presently integrating our flexible heating structures into the workpieces during the printing process," Gröger says. "But this will soon also be done automatically."

With Hotflex, the researchers are staying true to their vision: Using sophisticated information technology to develop useful IT devices that still do not feel as if you are handling a computer. "This is an entirely new style of modeling. You no longer have to click around in a digital 3-D model, but can work with your own hands and receive a completely different kind of feedback. At the same time, you reduce the number of iterations and waste less material and time," Jürgen Steimle explains.

Provided by Saarland University

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