3-D printing hair structures opens up fascinating design space

May 20 2016, by Nancy Owano

Credit: Tangible Media Group

(Tech Xplore)—Scientific research into *stuff*—what things are made of, what they could be made of, what everyday applications could expand into groundbreaking applications with everyday materials—is very much alive and turning up surprising results.

The latest surprise comes from innovative thinkers at MIT Media Lab's

Tangible Media Group. Does 3D printed hair have a place in retail's future? Hair is one of the most common structures in daily life. They posed a challenge for themselves: Can we design and fabricate programmable hair structure with new functionalities?

At the recent ACM CHI 2016 conference for Human-Computer Interaction in San Jose a preview emerged of what could lie ahead, as a Tangible Media Group team's work (from Jifei Ou, Gershon Dublon, Chin-Yi Chen, Liang Zhou, Felix Heibeck, and Hiroshi Ishii) was revealed.

They also have a video of "Cilllia as 3D Printed Hair Structures for Surface Texture, Actuation and Sensing."

The possibilities of what they created put to functional use inspired an article in *Discovery News* by Alyssa Danigelis earlier this month, headlined "3d printed hair is going to great lengths." She said their material can be programmed to work for a number of purposes. The software program that they built enabled them to rapidly define the angle, thickness, density, and height of the hair, said Danigelis.

The name of the project is Cilllia, and it is a reminder that real hair is not just to look great but, in nature, to provide warmth and help with a sense of touch.

Discovery News reported on the applications; these included a toy; blocks covered in short hair stuck together and pulled apart; objects with glue-like bonds; and customized brushes for painting. Programmable hair enabled the researchers to build finger swipe sensors and passive actuators.

That last bit was highlighted when Michael Irving reported on their work

in *Gizmag*. He said, "where it gets particularly interesting is when vibration is thrown into the mix. Objects placed on top of the hairs will move in the direction the fibers are pointing, and designing particular patterns in the surface can send them along a set path. The researchers demonstrated actuating motors made with the hair as well, which they used to make a windmill device that spins when vibrations are detected to provide a visual notification for when your phone is on silent. When attached to a microphone, the hairs can become like a touchscreen, able to detect the direction and speed of a swipe."

Credit: Tangible Media Group

The Tangible Media Group team said in their notes:

"Looking into the Nature, hair has numerous functions such as to provide warmth, adhesion, locomotion, sensing, a sense of touch, as well as it's well known aesthetic qualities. This work presents a computational method of 3D printing hair structures. It allows us to design and generate hair geometry at 50 micrometer resolution and assign various functionalities to the hair. The ability to fabricate customized hair structures enables us to create super fine surface texture; mechanical adhesion property; new passive actuators and touch sensors on a 3D printed artifact. We also present several applications to show how the 3D-printed hair can be used for designing everyday interactive objects."

They described their approach. They created a bitmap generating program, they said in the video. This allowed them to create thousands of strands of hair without CAD models. "With this method we can 3D-print super dense hair surface at micron resolution."

This furthermore opened a design space, they said, for printing figures with detailed surface texture.

Take jewelry with a soft touch. Paint brushes with customizable strokes. Objects with 3D printed hair can also attach to each other with mechanical adhesion. They said if you attach a single vibration source to the printed hair then the hair becomes an actuator to move objects along a path. Also it can turn a vibration into a rotary motor or a linear motor or a combination of two.

More information: — tangible.media.mit.edu/project/cilllia/

— research paper (PDF): tmg-trackr.media.mit.edu/publi … a/Papers/607-Cilllia%20%203D%20Printed%20Micro/Published/PDF