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New Backpack Makes 3D Maps of Buildings

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Category: [News](#) > [University](#) > [Research and Ideas](#)



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Graduate student Mason Smith sports a backpack made by UC Berkeley researchers that is equipped with scanners and cameras and can create 3D maps of building interiors.

A new backpack laden with cameras and laser scanners could be the newest architectural breakthrough that enables its wearer to create a 3D map of any building - even confounding mazes like Dwinelle Hall - simply by walking through it.

A nine-person team of UC Berkeley researchers led by professor Avideh Zakhor from the campus department of electrical engineering and computer sciences recently completed a prototype backpack equipped with six laser scanners and four cameras that researchers said could serve civilian and military purposes.

While the laser scanners map a building's interior, the backpack's cameras simultaneously take photographs as the wearer walks through the environment. Then, the photographs are mapped onto the 3D model created from the scans to make it "photorealistic," Zakhor said. The time needed to build the 3D model from the scans is roughly equivalent to the time it takes to carry the backpack through the interior space, according to Zakhor.

In 2007, the team began the project - sponsored and funded by the Army Research Office - to develop the technology used to model indoor environments.

So far, production costs for the backpack have totaled about \$200,000, but Zakhor said the final design cost only \$20,000, as most of the costs went to a "ground truth unit" that was initially needed to "localize" the backpack.

"In order to localize the backpack ... you need to develop new algorithms," she said. "In order to figure out which algorithm works and which algorithm doesn't work, you need to have a very expensive sensor on the backpack."

One of the backpack's first tests created a model of two stories of Cory Hall. John Hua, a researcher for the project, said the team is hoping to create a model of the entire building as a part of their ongoing research.

"We're looking at collecting larger data sets so that we get an entire building in one data set," Hua said.

Prior to focusing on indoor modeling technologies, the team worked on modeling buildings' exteriors using similar devices mounted on a moving vehicle to map neighborhoods - technology that was licensed by Google for its Google Earth mapping software.

Hua said the team switched to modeling interiors after pioneering technology to model outdoor environments.

"We sort of felt we had a good handle on the outdoors," he said. "The big distinction is outside we can use GPS. You know your position just from convenient satellites ... Indoors we have to use the laser scanners."

Although the team does not yet have any plans to sell or lease the technology, researchers said the backpack has many potential applications, including video game design, military training and architectural design.

"The military is looking at it for sort of training purposes ... You can model an actual building and plan routes and things through it," Hua said.

He added that the backpack's technology could also be used to virtually preserve famous and historic buildings as well as provide realistic designs for video games.

Now that they have a functioning prototype, researchers said they want to expand the backpack's uses and collect more architectural data with the models while continuing to improve the technology.

"The backpack is an evolving thing," Zakhor said. "It's still a work in progress."

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