'Guide vests' -- robotic navigation aids for the visually impaired

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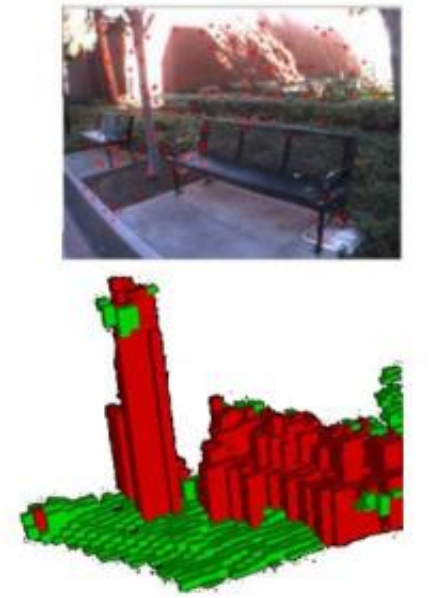

Simultaneous Localization and Mapping (SLAM) software analyzes data from stereo camera views (above) to create 3-D renderings of the scene (below), and then map a path through it. Credit: USC Viterbi School of Engineering

For the visually impaired, navigating city streets or neighborhoods has constant challenges. And most such people still must rely on a very rudimentary technology -- a simple cane -- to help them make their way through a complex world.

A group of University of Southern California engineering researchers is working to change that by developing a robot vision-based mobility aid

for the visually impaired. A design first shown a year ago is now being further developed.

The need is clear. According to the World Health Organization, 39 million people worldwide are totally blind and a much larger number, 284 million people, are visually impaired. In the United States, according to the American Foundation for the Blind, 109,000 visually impaired people use long white canes to get around. Guide dogs? About 7,000 nationwide.

"There are many limitations to canes for the visually impaired, from low hanging branches to large objects," according to Gérard Medioni, a professor in the Institute for Robotics and Intelligent Systems at USC Viterbi. "We wanted to build an effective system that would provide new opportunities for the visually impaired."

Medioni and his colleagues, including James Weiland, a Viterbi School associate professor of biomedical engineering who is also a professor of ophthalmology at the USC Keck School of Medicine's Doheny Eye Institute; and Vivek Pradeep, a recent Viterbi Ph.D who is now at the Applied Sciences Group of Microsoft, have developed software that "sees" the world, and linked it to a system that provides tactile messages to alert users about objects in their paths. Pradeep won the 2010 USC Department of Biomedial Engineering Grodins Graduate Research Award and a USC Stevens Institute 'most inventive' award for his work on the system.

The system uses cameras worn on the head connected to PCs that use Simultaneous Localization and Mapping (SLAM) software to build maps of the environment and identify a safe path through obstacles. This route information is conveyed to the user through a guide vest that includes four micro motors located on an individual's shoulder and waist that vibrate like cell phones.

A user wearing the system, with binocular camera linked by sophisticated direction finding software to a vest that signals where to go. Credit: USC Viterbi School of Engineering

For example, a vibration on the left shoulder indicates a higher object to the left, such as a low-hanging branch, and the individual can in turn use that information to take a new path. Medioni said that canes have clear limitations with larger objects, from walls to concrete structures, and the technology will enable users to avoid falls and injuries.

The USC team tested the system on blind subjects at the Braille Institute. The users there "like the system, and they feel it really helps them," Medioni said. "We greatly appreciate the cooperation and help of the Institute and the test subjects," added Weiland.

Medioni is pleased with the prototype of the system presented at the 2010 International IEEE Engineering in Medicine and Biology Society (EMBS) Conference, and more recently, May 1 at the 2011 meeting of Association for Research in Vision and Opthalmology. But he and the team are now working to improve it. The current head-mounted camera is bulky, and the team is now working on a micro-camera system that could be attached to glasses. The goal is to have a new system in place by the end of 2011, he said.

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