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Perfecting the 'seeing-eye glove'

A glove that buzzes to indicate the location of objects
is one of the technologies aimed at improving 'wayfinding'
for the blind, reports STEPHEN STRAUSS

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GUELPH, ONT. -- The thought comes to mind as you put on the tight, white golf glove in the laboratory of University of Guelph professor John Zelek that a metaphor is changing beneath your fingers.

In place of the Bible's image of the "the blind leading the blind," the future for the visually impaired may mean the buzz leading the blind. The buzz in this case is the tingling from one of 15 vibrating motors on the glove, which the enthusiastic Prof. Zelek hopes will this fall be guiding test subjects about in a world they cannot see.

The idea is to translate the objects about us into a set of location signals on the hand.

And through those signals, represent the world with enough accuracy to let blind people navigate through it.

Yes, says Prof. Zelek with a laugh, it is what you might legitimately call a "seeing-eye glove," which will communicate with its wearer through what you might just as legitimately call "hand braille."

It is a technology born of frustration with the present state of what the blind call "wayfinding."

The most popular existing wayfinding technologies -- the cane and the guide dog -- each have problems and limitations. The cane, which clearly only "sees" when it touches objects close to its users, sometimes makes its judgments in an antisocial makes its judgments in an antisocial fashion.

"A lot of time you can be walking around in a shopping centre and you will smack someone in the leg with your cane. Sure, it tells you something is there, but it is awkward for you if you are apologizing about hitting someone," says Marty Cutting, a 31-year-old blind man living in Guelph who was the first potential user to test the seeing-eye glove.

Guide dogs, on the other hand, must be looked after, trained and taken to the vet, and can miss obstacles like overhanging branches. The result is that less than 1 per cent of blind people in this country currently own seeing-eye dogs, estimates Bill Thornton, executive director of B.C. Guide Dog Services.

Thus the Guelph push toward better wayfinding. "I like to think of the glove as replacing the photoreceptors in the eye. A buzz to the left will tell you there is an object over there, a buzz to the right [tells you there's one] to the right," is how Prof. Zelek explains the thrust of his efforts.

The directional buzzing grows out of what two small chest-high cameras are seeing. Visual-interpretation software translates the camera's sightings into the glove's vibrations.

The hand has been chosen to receive the signals because, after the tongue, it is the most sensitive part of the body.

Sensitivity is vital because efforts by another research group using prick sensors located in the chest failed, says Prof. Zelek, because the chest wasn't sensitive enough for people to differentiate the meaning of the prickings.

But depicting the complexity of the real world is clearly more complicated than the conveyance of a simple buzz signalling something to the left or sometime to the right.

To manoeuvre accurately, judging distance is also important. The dramatically different dangers that attend stepping into a pothole rather than into a street stain tells you that being able to perceive grade also matters. The fact that an object -- a car or a person -- may be coming toward you or going away is also vital information about what you might call the visual ecology of the universe that surrounds you.

To resolve these issues, the Guelph group and others are trying to link the problem of helping the blind manoeuvre through a crowded universe with the equally tough issue of teaching robots how to see more like humans. "The communality issue is the representation of our world. Our work should solve both problems of how a robot and a visually impaired person are to see," says Prof. Zelek.

In aid of this, robots will complement people as test subjects.

"Rather than having someone who is visually impaired going up and down staircases and tweaking parameters and experimenting, we are actually going to be having a walking robot go up and down," says Prof. Zelek.

"Walking" in this case doesn’t mean moving feet but rather having the robot manoeuvre about on wheels with flexible joints.

While conjointly solving the problems of robot vision and blind wayfinding is the holy grail, actually doing it is something else.

One conundrum is that the more information you want, the more complex the problems of conveying what the camera has seen via buzzes on the hand. For example, do you depict distance with intensity? Is movement the frequency of buzzing? Is slope a movement of buzzes up or down the hand? "We don’t want to make a pattern of hand activity so complicated it isn’t intuitive," says Prof. Zelek.

"That is why we want to combine the research with field trials to determine what is intuitive and what isn’t when you are visually deprived."

Results so far are promising. When Mr. Cutting tried out a prototype model of the seeing-eye glove, he gave it an initial thumbs up. "It seems like a really good idea and it did help with obstacles around you," he says.

However, the project has its skeptics. Prof. Zelek arrived at the buzz-touch technique because he has doubts about existing technologies that use sound to communicate an image of the outer world to the blind. As Prof. Zelek points out, "the blind use sound cues around them constantly, and so you worry about information overload." But others are have similar doubts about touch.

"I am very skeptical that people will be able to follow tactile signals at walking speed. Our experience is that they work at very slow speeds, say one foot per second, but normal walking speed is one metre per second. The performance of these things deteriorates very quickly as you increase speed, simply because you can’t comprehend their signals in time," says University of Michigan engineer Johann Borenstein, who has worked on aids for the blind for the better part of two decades.

Frustrated, he developed what he called the GuideCane. Instead of sensing the surroundings and reporting back its findings, the two-wheeled GuideCane avoided obstacles as it moved in a direction its user wanted. The blind person in essence followed the cane.

However, glove or cane is clearly only a stopping point. "It is not any substitute for having your sight," says Mr. Cutting about the new aids. Thus, the ultimate answer may be not to represent the world by touch or sound but to eliminate blindness through technology. And even as Prof. Zelek works on the seeing-eye glove, there are indications that a revolution may be coming.

In June, the first successful demonstration of electronic artificial eyes was conducted in New York. The three-part system combined a miniature video camera, a signal processor and brain implants. The processor translated images from a camera mounted on glasses into signals the visual part of the brain could understand.

The apparent result: A blind man who could drive a car.

Aids for the visually impaired

Guide animals

The first recorded use of guide dogs was in 1819 at the Institute for the Blind in Vienna. The idea remained largely unknown until the First World War when Dr. Gerhard Stalling established a school devoted to training dogs to lead soldiers blinded in the fighting. It was 10 years later before the first North American use of guide dogs. Guide dog facts:

Because dogs are colourblind, they can’t tell when lights change, so the handler must listen to the flow of traffic to determine when it is safe to cross the street.

The usual breeds of dogs used in guiding are Labrador and golden retrievers, German shepherds and crosses between these breeds. However, to help people who have allergies to dog hair, a "Labradoodle" -- a cross between a Labrador and a standard poodle -- has also been enlisted.

It takes four or five months to train a dog, starting when they are 14 to 18 months old. It takes about a month to train to person to use a guide dog.

The dog learns to lead a person along a straight path, stop at changes in elevations, avoid obstacles and ignore distractions. People participate by giving a command to go forward.

Other animals are being used to guide people including, most recently, "guide horses" -- miniature horses about the size of a dog that among other things are recommended for people who are allergic to dog hair or who fear dogs. An added plus is that while the working life of a guide dog is generally over after eight years of service, guide horses may work for as long as 20 years.

White canes

While the white cane is the most ubiquitous walking-aid tool for the visually impaired, its origin is relatively modern.

The "touch technique" by which blind people feel their way through the world was developed in 1871 by Englishman W. Hanks Levy. The cane became white because of an increasing risk caused by another technology -- the car. In 1921, to make himself more visible to motorists, James Biggs of Bristol, England, painted his black cane white.

Other technology

The seeing-eye glove enters the world of wayfinding in competition with a number of other technologies and approaches.

Talking signs: In and around buildings, transmitters emit coded, invisible infrared light beams. However, when decoded by a receiver pointed in the direction of the Talking Sign a voice tells a blind person such useful things as "public telephone" or "stairs to second floor."

Sonar canes and sonar glasses: Imitating the way bats image their world, these emit sounds too high-pitched for humans to hear. An image of the world is created by computing differences in the timing of echoes as these sounds bounce off objects. One potential competitor for the seeing-eye glove is the "Batcane," which is being put through final tests by an English company. It conveys wayfinding directions to a blind user via vibrations on directional pads on the cane's handle.

It sounds wonderful, but Prof. Zelek also points out that sonar is intrinsically problematic because corners and textured surfaces give confused sound patterns, and there is often is a significant time lag between when a sound signal is sent out and when it projects an image.

Audio devices: "The vOICe Learning Edition" translates the visual world into sounds. In so doing, it has developed its own kind of visual sound language. A rising elevation, for example, is signalled by the pitch of the sound rising. Loudness is equal to colour brightness. And a sound to your right indicates an object to your right.
-- *Stephen Strauss*

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