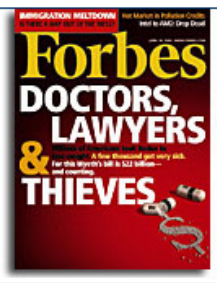
Technology

The Silent Speaker

David Armstrong 04.10.06



NASA researchers can hear what you're saying, even when you don't make a sound.

In space, no one can hear you scream. Use a cell phone on a crowded commuter train and everyone can.

Charles Jorgensen is working to solve both problems, using an uncanny technology called subvocal speech recognition. Jorgensen demonstrates it at his offices at NASA's Ames Research Laboratory in Mountain View, Calif. He attaches a set of electrodes to the skin of his throat and, without his opening his mouth or uttering a sound, his words are recognized and begin appearing on a computer screen. The Ames lab has already used subvocal commands to drive a car around a virtual city in a computer simulation and to **Google** (nasdaq: GOOG - news - people) the Web using nothing but unuttered search terms and commands. Jorgensen sees abundant applications for his technology where audible speech is impossible: for astronauts, underwater Navy Seals, fighter pilots and emergency workers charging into loud, harsh environments.

When we speak aloud, we're forcing air past the larynx and tongue, sculpting words using the articulator muscles in the mouth and jaw. But these muscles go into action regardless of whether air is sent past them. All you have to do is say the words to yourself and you're sending weak electrical currents from your brain to the speech muscles. Jorgensen's trick is to record those signals (known as electromyograms), process them with statistical algorithms and compare the output with prerecorded signal patterns of spoken words, phrases and commands. When there's a match, the unspoken turns into speech.

Jorgensen, who earned a Ph.D. in 1974 in mathematical psychology (before it was known as artificial intelligence), hit upon the idea for subvocal speech recognition after working on electromyographic interfaces for fighter pilots. "That work led us to ask, 'How small an electromagnetic current can we discriminate?'" says Jorgensen. (The fact that nerves produce current has been known since 1848, when Emil DuBois-Reymond sliced open his hand and plunged his clenched fist into a saline solution, triggering a jump in an attached galvanometer.)

Subvocal speech recognition still needs a lot of work before it can achieve consistent, accurate readings. Audible-speech-recognition software is now proficient enough to convert both "tom-ah-to" and "tom-ay-to" to "tomato." Under optimal conditions normal speech-recognition software that works with sound is 95% accurate.

But subvocal recognition is dealing with electromyograms that are different for each speaker. Consistency can be thrown off just by the positioning of an electrode. To improve accuracy, researchers in this field are relying on statistical models that get better at pattern-matching the more times a subject "speaks" through the electrodes. But even then there are lapses. At Carnegie Mellon University, researchers found that the same "speaker" with accuracy rates of 94% one day can see that rate drop to 48% a day later. Between two different speakers it drops even more.

Carnegie Mellon researcher Tanja Schultz says one possible application is a "silent" cell phone that can detect and translate unuttered phrases like "I'm in a meeting" and "I'll call you later." Japan's NTT Docomo is working on a subvocal mobile phone operated by sensors worn on the fingers and thumb. A speaker grips his face, putting the sensors in contact with the cheekbone, upper lip and chin. So far Docomo's system recognizes the five Japanese vowels 90% of the time.

Jorgensen sees the day when electromagnetic sensors will be woven into the fibers of turtlenecks or rescue workers' outfits. "As long as people have had machines and tools, they've been dependent on the physicality of the body," Jorgensen says. "Separate those control activities from the body and it opens a whole new generation of interface design."

More On This Topic
Companies: GOOG
E-Mail Newsletters: Sign Up Now To Stay Informed On A Range Of Topics
Attaché: Customize Forbes.com Now To Track This Author And Industry

Article Controls
E-mail | Print | Comments | Request Reprints | E-Mail Newsletters | My Yahoo! | RSS

Related Sections
Home > Magazines > Forbes Magazine