

Freedom through Technology

Mobility and communication devices can increase your independence.

BY TOM VALEO

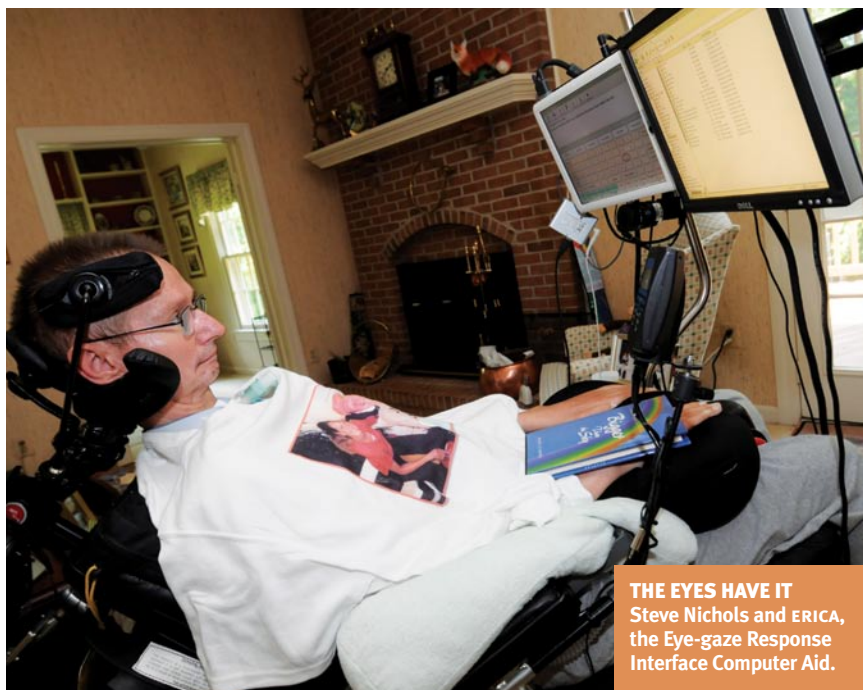
Steve Nichols used to jog and jump rope to stay fit for the vigorous tennis games he enjoyed on weekends. He cut down trees around his house in Clifton, VA, and did his own landscaping. He chopped his own firewood, fixed his own plumbing, hung his own wallpaper, and traveled with his wife and daughter.

Now he can't move much except his eyes. About 14 years ago he noticed his left foot felt heavy when he jogged. Then his tennis game deteriorated. He started having trouble swallowing, and felt muscles twitching in his arms and legs. Nichols was diagnosed with amyotrophic lateral sclerosis (ALS) in the fall of 1994 and has been losing control of his muscles ever since. Today he can't move his tongue, so he can't speak and needs a machine to help him breathe.

But Nichols can still move his eyes, and with the help of ERICA he speaks to his wife, daughter, and four grandchildren. He can write e-mails, surf the Internet, change channels on the TV, and control his electric wheelchair. He keeps track of family finances with his computer, pays bills online, and works as the Webmaster for two Web sites.

ERICA is his Eye-gaze Response Interface Computer Aid, one of the many computer-based devices that enable people with movement disorders and other disabilities to stay active. It works by tracking his eye movements. When Nichols looks at a picture of a keyboard displayed on his computer screen and lets his eyes pause for half a second on a letter, the computer types that letter. When he wants to say something, he types a message and activates his text-to-speech software, which speaks the words in a male voice.

"ERICA is my window to the world," Nichols says via e-mail. "It enables me to be a productive member of society and an active participant in conversa-



THE EYES HAVE IT
Steve Nichols and ERICA,
the Eye-gaze Response
Interface Computer Aid.

tions. It enables me not only to interact with my wife but also to access the Internet, where I can send cards and flowers, buy gifts, and say 'I love you.' I have been able to maintain relationships with friends and co-workers and participate in meetings via teleconferencing."

COMMUNICATION AIDS

The combination of computer power and clever engineering provides multiple ways for people to bypass neurological problems that may limit one or more of their abilities. Today, for example, people with vision problems due to multiple sclerosis, a brain tumor, or a stroke can continue to read by using the Kurzweil-National Federation of the Blind Reader, which takes a digital picture of a page and then uses a voice synthesizer to read the text. The Reader weighs only 4 ounces and retails for \$2,195.

People who can't speak can use their vocal cords to operate a computer with the help of the Audeo, a collar developed

by Ambient Corporation that picks up nerve impulses to the vocal cords and uses them to operate a computer.

"It doesn't pick up the vibration of vocal cords," says Michael Callahan, the developer of the device and founder and CEO of the company. "It picks up the instruction signal that a brain would send to the vocal cords to make them vibrate. We've tested the Audeo on patients with ALS, stroke, traumatic brain injury, and even locked-in syndrome, and we've had some success with all of them."

The first patient they tested was a young man with brain damage from a car accident. Callahan was doubtful his device would work because the man seemed unresponsive. "If a person doesn't know what he wants to say, then our technology doesn't have as much use," he says.

But the young man's mother was adamant that her son was aware of the world. "She told him a joke and he laughed," Callahan recalls. "It was clear he was cognitively there."

Sure enough, when they put the Audeo collar on him they immediately saw on a computer monitor that his brain was producing signals expressing “yes” and “no.”

“It was a great moment for us and for him and his family to see that we were on our way to restoring communication for him and many other people like him,” Callahan says.

COMPUTER AIDS

Computers even help people interact with computers. They offer speech recognition in both directions—the computer’s voice synthesizer can read what’s on the screen to the user, or transform what the user types into speech. Special keyboards have larger print keys for people with poor vision, and touch screens allow users to bypass a typical keyboard altogether.

People who cannot use their hands can type with the LOMAK (Light-Operated Mouse and Keyboard), which consists of a headset outfitted with a laser beam. This beam operates a virtual keyboard displayed on a screen.

Microsoft has long offered functions that increase the size and clarity of type for people with vision problems. Users also can move the cursor by voice and change the behavior of the keyboard to accommodate people with movement difficulties.

“For example, if you’re typing with a mouth stick, sometimes if you press too long you get multiple characters, so you can change the keyboard to limit the repeat rate,” says Robert Sinclair, director of Accessibility at Microsoft.

Many of these functions come with the software. Microsoft’s new Vista operating system includes an “Ease of Access Center” that helps all users—disabled or not—to customize the machine.

“If you have dyslexia you can have your e-mail read to you,” Sinclair says. “You can turn on a screen magnifier. If

you have trouble pressing multiple key combinations—the shift key for capital letters, for example—you can turn on the sticky keys and press certain keys in sequence. We pulled all this together in the Ease of Access Center.”

MOBILITY AIDS

Wheelchairs encounter many obstacles in the environment, such as curbs, stairs, and narrow doorways, but a persistent problem has been their own weight. Now, borrowing technology from the mountain bike industry, wheelchairs are becoming increasingly lighter, primarily by replacing traditional aluminum with stronger, lighter titanium. Some chairs even sport wheels made out of Vectran, an extremely strong, light textile similar to the Kevlar used in bulletproof vests. Lightweight materials also improve motorized wheelchairs, which now come with more power as well as improved control devices.

Computer technology has been joined with a gyroscope to produce the iBot 4000, an electric wheelchair that goes up and down stairs, lifts the passenger to eye level, and has four-wheel drive for tough terrain. Although it costs as much as a compact car, it is a prescription product and therefore covered by some insurance policies and, in some circumstances, the Veterans Administration.

In addition, many power wheelchairs now offer an array of computerized controls for people who cannot operate a standard joystick. Some use a “sip-and-puff” control that enables the operator to move the chair by sipping or blowing into a straw-like device attached to the controls.

People can even operate a power wheelchair with an eye-gaze system. “The operator utilizes eye movements in

“Individuals with the most limited available movements can now operate a power wheelchair.”

conjunction with a tracking system and a computer in order to drive the wheelchair and access all its functions,” says Sean

McCarthy, M.S., O.T.R., A.T.P., a clinical specialist in Inpatient Wheelchair Seating at the Kessler Institute for Rehabilitation in New Jersey. “The operator blinks, which breaks a beam of light and triggers the chair to move,” McCarthy says. “We also integrate more into the chair. The operator can turn on the TV, the lights, and so on with the chair controls. They also incorporate advances in technology from mainstream society, like Bluetooth wireless technology.”

“Eye-gaze driving is a major step forward in the advancement of wheelchair drive controls,” continues McCarthy. “Individuals with the most limited available movements can now operate a power wheelchair.”

INDEPENDENCE

Accessibility and mobility for people with disabilities has improved thanks to computers. And while neurological problems will always present challenges, computer-enhanced devices make them more manageable, for both patients and caregivers. As Steve Nichols says of his eye tracking system, “Without ERICA, my window to the world would have its shade pulled, and I’d lose much of my independence, which wouldn’t leave any free time for my wife, my primary caregiver.” NN

Tom Valeo is a science and medical writer whose articles have appeared on WebMD and in Scientific American, Heart Insight, and other publications.



For more information on technological assistance, see RESOURCE CENTRAL on page 37.