

People with disabilities have typically been early adopters of new technology, motivated primarily by the increased freedom that computer access can provide. When interviewed by the *San Diego Union Tribune*, Charlene Silvertson, who is hearing impaired, put it this way: "Advancing technology for most

the past decade, with word error rates continuing to drop by a factor of two every two years. The top two commercially available products, IBM's ViaVoice Millennium and Dragon Systems Inc.'s NaturallySpeaking, are capable of accuracy rates exceeding 98 percent. The state-of-the-art in this technology has advanced to the point that it is making a sig-

acommodate both types of needs, with additional bells and whistles available on the more sophisticated "Pro" versions of the software.

In the Trenches

To get a view from the front lines on how speech technology is being used by the disabled, Jayne Zilisch of the Center for Students with Disabilities at Northcentral Technical College in Wasau, Wisconsin, offers her perspective.

Zilisch was diagnosed with Multiple Sclerosis in 1984, and is wheelchair-bound. In the early nineties she bought herself a computer "to get through the Wisconsin winters" and thought perhaps there was some way she could use the computer to work from home, as she had previously left her job as a factory worker. A Department of Vocational Rehabilitation counselor suggested taking some additional computer classes and looking into medical transcription, but due to the MS, her fingers would become fatigued, numb, and spastic. Her top speed was about 19 words per minute. As she puts it "my fingers wouldn't go fast enough to type a single 'f', let alone a double". It was then that she was introduced to someone at the Center for Students with Disabilities at Northcentral Technical College, who started her on the discrete speech product DragonDictate, which was available at the time. This was in 1995. She taught herself how to use it and continued to learn the new products as they came out. One thing led to another and now she has a full time job at the college, helping others from all over the state get set up with the appropriate assistive technology that enables them to participate more fully in their lives.

Zilisch works with all types of people from the disabled community—paraplegics, quadriplegics, learning disabled, those with cerebral palsy, diabetics

Say it with Software and Hardware

Advancing Speech Recognition Technology

By Louise Julig, SWE

people represents a kind of rarefied convenience. But for people with disabilities, it is more miraculous than that. It can serve as a lifeline, the opportunity to participate in everyday life in a way that most people take for granted." Speech recognition software has become one of those lifelines that has given disabled people a special independence, with better access to information and communication.

Speech recognition technology has improved drastically over

nificant difference in the lives of those who want or need the option of hands-free computing, especially those who are disabled.

For those with disabilities who need to be completely hands free, they need both the discrete speech command and control capabilities to operate the computer, and the continuous speech dictation capabilities for writing documents, sending email, etc. Most of the commercially available products can

with neuropathy, those with low vision and the blind, from second graders to senior citizens. Whether a client's goal is to finish school, get a job, communicate with their grandkids, or simply adapt to everyday life after becoming disabled, she tries to make sure each person she touches gets some help.

To evaluate what products and training someone needs she asks them what they hope to accomplish, and what they really want to get out of it. "A lot of counselors tell a person what they need, but that doesn't always work out." She listens to their speech. "I start to listen like a computer." The product she most often recommends is Dragon Systems Inc.'s NaturallySpeaking Professional version, because it is the most customizable. The ability to change the text of a macro can work around problems for people whose speech may not be as clear as it could be for the product to work its best. For instance, a common problem is in pronouncing the consonant "t" in the middle of a phrase. NaturallySpeaking allows you to change the command "scratch that" to "erase it" or "fix it," and "go to sleep" can become "Take a nap."

One of the greatest areas of improvement that Zilisch has seen in speech recognition products over the past several years has been the integration of the

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command and control functions with the conversational dictation. In NaturallySpeaking you

can insert a command into a dictation stream by pausing slightly before the command, speaking the command with no breaks, and then pausing again, slightly, afterward. An example of where this seamless integration would be particularly useful is for periodically saving a document. The user must become fluent with all the commonly used commands to make it work, as any hesitation or pausing during the command will cause the system to

have the hardware on that computer to make it useful."

Talking Math

In addition to standard speech recognition, there are specialty products that fill other needs. Both ViaVoice and NaturallySpeaking have versions that recognize the specialized vocabularies of the medical and legal professions, and ViaVoice even has an online companion module for dictating chat room

"It's not Star Trek yet, but it's getting there."

— Jayne Zilisch, user of NaturallySpeaking.

interpret it as dictation. That is part of the reason why some training time is necessary before a user can get up to speed. The ability to customize command names also comes in handy if the user has trouble remembering a particular command.

Another improvement has been in the training time required for the system to learn a new user's voice. In just the past few years, the initial training has been reduced from approximately half an hour down to only ten minutes. This is particularly helpful when working with learning disabled children who don't have a very long attention span. It also just makes it easier for the average user to get going with their work.

However, despite the massive advances in speech recognition, there are still some problem areas that need to be addressed. One of these is the system's ability to work for those who speak English with an accent. NaturallySpeaking has an adaptation for Southeast Asian speakers, but Zilisch has not had much success with it. "It's not Star Trek yet, but it's getting there," she says. "A lot of people think you can just plug it in and talk away, but no, there are things you have to learn. You have to have a little time investment to make it work, and you have to

jargon, abbreviations, and emoticons. And for those who work with numbers, Metroplex Voice Computing provides a suite of products that work with NaturallySpeaking to enable dictation of mathematical symbols, equations and even graphing operations.

Metroplex was founded in Arlington, Texas seven years ago by Nancilu McClellan and her husband, Mike, when they became interested in speech recognition. "We liked the direction that it was going. We saw that it was on the cutting edge and think that that's the way everything is going to go," she says. They worked with a cousin who is a professor of mathematics and statistics at Southern Methodist University and developed the MathTalk suite of products.

MathTalk works in conjunction with Scientific Notebook by MacKichan software. Scientific Notebook is in essence a "math processor" in the same way Microsoft Word is a word processor. MathTalk is the voice command interface that works with NaturallySpeaking and enables a user to dictate numbers, symbols, and expressions into Scientific Notebook. Metroplex also makes an arithmetic only product for younger

students that works with MathPad. Other products include VoiceEZcad and VoiceEZcalc, which operate AutoCAD and the Microsoft Windows calculator, respectively, by voice. In line for a summer of 2001 release is MathTalk for the visually impaired, which will have an echo feature and commands for reading lines and sending to a braille translator. It will work with the JAWS screen reading software. Besides being of use to the blind or visually impaired person, this product allows teachers or transcribers to voice mathematics and use the braille translator which will emboss or print, saving time and effort in memorization of complex braille keystrokes.

Besides being able to be hands free, McClellan has observed other side benefits of dictating versus typing mathematics. "The person generally learns to formulate their thoughts, focus on what they are doing, and also learns the language of math." The MathTalk products will also work in conjunction with keystrokes for those who like a hybrid style of work. Although most of their client base is from the disabled community, she hopes that dictating math will gain more acceptance among non-disabled users as well because of its speed, accuracy and intuitiveness.

Hardware

For all of this software to work together and work well, there are hardware issues that must be addressed. Zilisch specifically recommends three things:

- A good computer, preferably a Pentium III or better, with lots of memory. These products are resource intensive. The majority of adaptive software products are for Windows, although ViaVoice is available for Mac OS and Linux, as are a few others.

- A separate sound card, otherwise the system resources are spread too thin. Zilisch prefers SoundBlaster for reliability and compatibility with the other products.

- A good noise -cancelling microphone makes a world of difference.

For people with certain speech disabilities, however, even the best of the standard equipment may not be sufficient. A recent product that may help is called the Speech Enhancer by Electronic Speech Enhancement, Inc. The product consists of a microphone and lightweight unit worn at the

many it may open doors of communication to a wider audience than was ever before possible.

Creative Thinking

All of these advances in voice technology have helped the disabled community in many ways. Sometimes all it takes is a little innovative thinking to find a new and completely different way of putting it to use. Jack

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waist or hung on a wheelchair. Through signal processing and advanced microelectronics, the person's speech is analyzed and rebuilt acoustically using a model of hyper-intelligible speech to create a "prosthetic voice." The processing minimizes omissions and distortions, in addition to adjusting vocal intensity higher or lower to the correct functional level.

The results are rebroadcast to a wireless speaker, and it comes out sounding like a more intelligible version of the user's own speech. The output can also be plugged directly into the microphone input of a sound card to be used with NaturallySpeaking or other speech recognition products. There is even a colorful "ruggedized" version called Mighty Mouth for use by children.

This type of voice enhancement can be a great liberator to people who, due to conditions such as cerebral palsy, Parkinson's disease, laryngectomy, stroke, vocal nodules, spinal cord injury, or others have great difficulty being understood by anyone outside their immediate family, or whose voice is so low as to be inaudible by most people or speech recognizers. Several months of training may be required, and the results are not a miracle cure, but for

Glasheen of San Diego is one of those people who thought "Why not?" Glasheen is retired and volunteers with Able-Disabled Advocacy, an organization that helps disabled people in San Diego County who are in the process of getting their resumes together and looking for work, primarily focusing on their assistive technology needs.

One deaf candidate that Glasheen was working with had computer repair experience, but instead of going in that direction, he was looking for data entry jobs, primarily because his deafness made communication a problem for him. Glasheen thought this was a waste of the man's talent, and started thinking of ways to work around the problem. He thought about setting up a speech recognition system so a supervisor could speak into it and the man could read the results on a screen and type his replies back. "He could be working at a bench repairing computers, doing what he enjoys doing, getting a lot of satisfaction from it, and being paid much more than he might be doing something else." This is a twist on how speech recognition is usually thought of as an enabler, but nevertheless is a very viable, equally enabling and beneficial

use of the technology.

Glasheen got a laptop with NaturallySpeaking set up with some help and equipment donated from local companies, and has approached several potential employers on behalf of the candidate with favorable response. Thinking that there might be many others who could benefit from this idea, he will be demonstrating it to other companies in the area to make them aware of the possibilities. Ideally a deaf candidate could be provided with a basic computer to use so the employer would only have to provide a small investment in time for those who would need to train their voices. "We have high hopes for it," Glasheen says, "and what we want to do is to build up a certain amount of success here, and then to promulgate that information, because the technology certainly is adaptable to anyplace." Looking to the future, he sees a time not too far off when handheld devices such as the Palm organizer could include a microphone and speech recognizer to make it even easier for a deaf person to communicate. All it takes is a little innovation.

Making a Difference

Helping people communicate is technology at its best. Not the pin-drop, cable modem, wireless Web kind of communication, but the sharing, listening, laughing kind of communication. Speech recognition is one technology that can have a direct impact on the lives of those who are disabled, helping them communicate with the world. Jayne Zilisch says, "Using Dragon NaturallySpeaking has enabled me to hold a full-time job, improve my quality of life and help others to do the same even from my wheelchair." Sometimes it's easy to get caught up in technology for its own sake, so it's refreshing to see it provide such an immediate benefit. Making the world a better place—after all, that's what we signed on for when we became engineers.

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