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Feeling is believing for the blind

Friday, May 30, 2003

By John Chadwell/Special to the Free Lance

Someone in America becomes blind or visually impaired every seven minutes of every day, accounting for more than 10 million people, according to the American Federation for the Blind.

The majority of these cases are because of age-related degenerative diseases, and out of that number about only 5,500 use Braille as their primary method for reading and only 1.5 million, through the use of special voice programs and magnification techniques, use computers.

But how does a blind person read a map, appreciate a photograph or painting, study engineering specifications or mathematical equations? With great difficulty. However, that may soon change because of the efforts of a little known agency within the Department of Commerce.

The National Institute of Standards and Technology has developed a new technology that opens the world of photographic and artistic imagery to the blind and visually impaired similar to the way Braille enables them to read the printed word. The device, called a tactile graphic display, uses an array

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Department of Commerce employees inspect the NIST Tactile Display.

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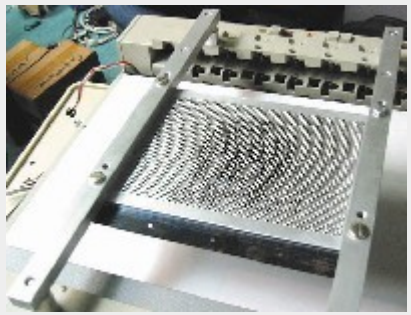
of 3,600 rounded pins that can be raised in any pattern and then locked into place to create electronic images.

"It all started several years ago with the electronic book project," said John Roberts, one of the electronics engineers who worked on the project in NIST's Information Technology Laboratory. "NIST hosted a set of conferences on e-books. One of the topics was accessibility. A lot of people said that while electronics can get information most of the way, it's the user interface (computer monitor, television, radio) that makes it accessible. Some of the speakers were blind or visually impaired and they pointed out the importance of the interface."



A woman's face is formed on the device.

As a result of the e-book conference, NIST began looking into developing an inexpensive electronic display for Braille text.

"We came up with one that was probably about a factor of 10 cheaper to make than existing Braille displays," Roberts said. "It was based on a rotating wheel with the Braille on its surface. When news of that got out, people said that Braille is very good, but there's also a need for graphics that can be viewed by the sense of touch."

The blind have long been able to "see" crude images by touching embossed plastic sheets or heavy paper. But both the embossing machines and the cost-per-page are expensive. Roberts explained what was needed was a refreshable display, such as a computer monitor, but in two dimensions.

Where the tactile graphic display differs from the embossers is that it can be used over and over again as each image is electronically created. Using software to determine how to generate a tactile display that matches a scanned image, saves the cost and disposal problems associated with printouts, which is important to people who need to view or modify large numbers of images.

Another big difference is the range of images that will eventually be reproduced from just about any scanned graphic, including illustrations - ranging from scientific, engineering, mathematics, education, and design - to photographs, map outlines, and even Internet Web pages and electronic books. Then after the pins are "viewed" with the fingertips, they can be withdrawn to form a flat surface ready to be reset into a new image.

"The traditional way of making a refreshable display to feel by touch is to have little pins that can move up and down in holes to form dots that can be felt," Roberts said. "That can be Braille text or if you have two dimensions it can be an image."

When it comes to designing innovated new devices, engineers can trek through uncharted territories, burning up thousands of hours and spending millions of dollars. Or they can practice a bit of insightful reengineering by looking back to past achievements,

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sometimes in totally unrelated industries to their own. In this case it was toys.

Roberts said the popular novelty toy, Bed of Nails, was, in part, the inspiration for the tactile graphic display. Where the Bed of Nails simply requires pressing an object into one side to create its likeness on the other, NIST s' Information Technology Laboratory researchers needed to find a way to connect the moveable pins with electric signals. To figure out how to do this, they looked back at old technology rather than forward.

The researchers took a 20-year-old scientific pen plotter, and literally turned it upside down. A pen plotter that was designed to push pens down to draw images on paper has morphed into a device that now pushes thousands of pins up to form a two-dimensional image, giving it the Braille-like capabilities that can evoke the emotions of art, as it were.

It can, however, be a long way between inspiration and application. Traditionally, each one of those 3,600 pins would have required its own piezoelectric actuator to raise it. While workable, this would be a prohibitively expensive way to go.

"With the Braille display you only have several hundred dots, so it s' at least affordable, " Roberts said. "But to get a good tactile image you need thousands of dots. A reasonable sized tactile image display using piezoelectric technology would end up costing about $40,000, which would be too expensive for the very people who would use it. We looked at ways to get around that and the big step was to avoid having a power actuator for every pin, what we call passive pins. You can set them into a pattern and lock them in place and a person is able to feel the image. That, we think, would ultimately cost around $2,000. "

With a stated mission of "..enhancing productivity, facilitating trade, and improving the quality of life, "NIST engineers saw the project as both an engineering challenge and an exciting innovation that, if it worked, would open a new world of images to the blind. A major consideration was controlling manufacturing costs.

Work began in September 2002. In less than a year, NIST delivered a working prototype as well as the software to run it.

"A big challenge was to design it so it didn t' require much intricate work so other people could build it at a low cost, "Roberts said, adding the NIST team worked simultaneously on the imaging device and the software. "We had to come up with our own driving software to take image files, convert them and put them on the display. "

Roberts said there were two basic ways of writing a display. One is similar to how a CRT monitor works, one line at a time until it scans the entire display.

"Electronically, that can be done very fast, but if you tried to do that mechanically it would take several minutes to access all of those pins, "he said. "The display works much more effectively in what s' called vector graphics. We used commercial vector conversion software that was readily available that lets us take a jpg image file and convert it into a line drawing, which is easily definable by the sense of touch. "

Before work began on the tactile graphic display, NIST researchers coordinated their efforts with the National Federation of the Blind, which has been field testing the

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prototype.

"Text and graphic conversion devices have in the past been difficult to produce and extremely expensive," NFB President Marc Mauer said. "Our work with NIST to foster the development of simple-to-manufacture, low-cost and easy-to-use alternatives will open opportunities for learning, exploration and growth to blind children and adults in the home, school and workplace."

NIST, which has filed patents on the device, has been involved in discussions with manufacturers to add the technology to their product lines, making it available to the public within the next two to three years.

"Engineering companies, in particular, are very interested in it," Roberts said. "In fact, blind engineers were the main people who asked us to develop this. The refreshable surface is really handy because you can change a parameter and you can see how that alters the outcome without having to look at hundreds of (embossed) images a day."

"Like any technology in its early development stage, moving this prototype to the marketplace will require consumer testing," said Samuel Bodman, deputy secretary of commerce for the Department of Commerce. "The collaboration between the Commerce Department and the NFB will help prepare this device to move to the next level and, eventually, through the private sector's further development and product commercialization, it will be in the homes, schools, and workplaces of those who will greatly benefit from it. The device will allow the blind to participate in the information revolution."

Headquartered in Gaithersburg, Md., NIST is an agency of the Commerce Department's Technology Administration. It was founded in 1901 as the nation's first federal physical science research laboratory. During the years, the more than 3,000 scientists, engineers, and technicians have contributed to image processing, DNA diagnostic "chips," smoke detectors and automated error-correcting software for machine tools, as well as atomic clocks, X-ray standards for mammography, scanning tunneling microscopy, pollution-control technology, and high-speed dental drills.

Founded in 1940, the National Federation of the Blind is the nation's largest and most influential membership organization of blind persons. With 50,000 members, the NFB has affiliates in all 50 states plus Washington, D.C., and Puerto Rico, and more than 700 local chapters.

Eye disease symptoms

Glaucoma

- Teary, aching eyes, blurred vision, occasional headaches and progressive loss of peripheral vision are signs of long-term glaucoma.

- A sudden onset of severe throbbing pain, headaches, blurred vision, rainbow halos around lights, redness in the eye, enlarged pupils, and sometimes nausea and vomiting

are signs of acute glaucoma, a medical emergency.

l Blurred vision, headaches and halos around lights following an eye injury are signs of secondary glaucoma.

l In infants, teary or cloudy eyes, unusual sensitivity to light and enlarged corneas are signs of congenital glaucoma.

Macular Degeneration

l Dim or distorted vision, especially while reading.

l Gradual, painless loss of precise central vision.

l Blank spots in your central field of vision; straight lines that appear wavy.

Macular degeneration is the No. 1 cause of vision loss in the United States, with more than 13 million Americans showing some sign of the disorder.

Because the symptoms usually do not appear in people younger than 55, the disorder is often referred to as age-related macular degeneration.

If you are older than 65, macular degeneration may already affect your central vision even though throughout life, most sufferers of the disease maintain functional side vision or peripheral vision.

The disorder occurs in two forms, dry and wet. The less-common wet form of ARMD requires immediate medical attention. Any delay in treatment may result in loss of your central vision.

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