# *For the Blind, Technology Does What a Guide Dog Can't*

By **MIGUEL HELFT**   JAN. 3, 2009



T. V. Raman of Google is a pioneer in customizing technology for blind users. His own PC reads text aloud at triple normal speed. Peter DaSilva for The New York Times

MOUNTAIN VIEW, Calif.

T. V. RAMAN was a bookish child who developed a love of math and puzzles at an early age.

That passion didn't change after glaucoma took his eyesight at the age of 14. What changed is the role that technology — and his own innovations — played in helping him pursue his interests.

A native of India, Mr. Raman went from relying on volunteers to read him textbooks at a top technical university there to leading a largely autonomous life in Silicon Valley, where he is a highly respected computer scientist and an engineer at [Google](#).

Along the way, Mr. Raman built a series of tools to help him take advantage of objects or technologies that were not designed with blind users in mind. They ranged from a Rubik's Cube covered in Braille to a software program that can take complex mathematical formulas and read them aloud, which became the subject of his Ph.D. dissertation at Cornell. He also built a version of Google's search service tailored for blind users.

Mr. Raman, 43, is now working to modify the latest technological gadget that he says could make life easier for blind people: a touch-screen phone.

"What Raman does is amazing," said Paul Schroeder, vice president for programs and policy at the American Foundation for the Blind, which conducts research on technology that can help visually impaired people. "He is a leading thinker on accessibility issues, and his capacity to design and alter technology to meet his needs is unique."

Some of Mr. Raman's innovations may help make electronic gadgets and Web services more user-friendly for everyone. Instead of asking how something should work if a person cannot see, he says he prefers to ask, "How should something work when the user is not looking at the screen?"

Such systems could prove useful for drivers or anyone else who could benefit from eyes-free access to a phone. They could also appeal to aging baby boomers with fading vision who want to keep using technology they've come to depend on.

Mr. Raman's approach reflects a recognition that many innovations designed primarily for people with disabilities have benefited the broader public, said Larry Goldberg, who oversees the National Center for Accessible Media at WGBH, the public broadcasting station in Boston. They include curb cuts for wheelchairs, captions for television broadcasts and optical character-recognition technology, which was fine-tuned to create software that could read printed books aloud and is now used in many computer applications, he said.

With no buttons to guide the fingers on its glassy surface, the touch-screen cellphone may seem a particularly daunting challenge. But Mr. Raman said

that with the right tweaks, touch-screen phones — many of which already come equipped with GPS technology and a compass — could help blind people navigate the world.

"How much of a leap of faith does it take for you to realize that your phone could say, 'Walk straight and within 200 feet you'll get to the intersection of X and Y,' " Mr. Raman said. "This is entirely doable."

ADVOCATES for the blind have long complained that technology companies have done a generally poor job of making their products accessible. The Web, while opening many opportunities for blind people, is still riddled with obstacles. And sophisticated screen-reader software, which turns documents and Web pages into synthesized speech, can cost more than $1,000. Even with a screen reader, many sites are hard to navigate.

Last year, the National Federation of the Blind reached a settlement of a landmark class-action lawsuit against one company whose site advocates found unusable, Target. In the settlement, the retailer agreed to make its Web site accessible to blind people. The federation assesses the usability of Web sites and currently certifies only a handful as being fully accessible.

One challenge is that technology often evolves much faster than the guidelines that ensure Web sites work well with screen readers. In December, the World Wide Web Consortium, an Internet standards group, released Version 2.0 of its accessibility guidelines for Web sites. The previous version dated back to 1999, when the Web consisted largely of static Web pages rather than interactive applications.

Obstacles on the Web take many forms. A common one is the Captcha, a security feature consisting of a string of distorted letters and numbers that users are supposed to read and retype before they register for a new service or send e-mail. Few Web sites offer audio Captchas.

Some pages are just poorly designed, like e-commerce sites where the "checkout" button is an image that isn't labeled so screen readers can find it.

"The overwhelming percentage of the industry really hasn't stepped up to the plate to provide the blindness community with equal access to their products," said Eric Bridges, director of advocacy and governmental affairs at the American Council of the Blind. Mr. Bridges and other advocates argue that accessibility should be built into new technologies, not added as an afterthought.
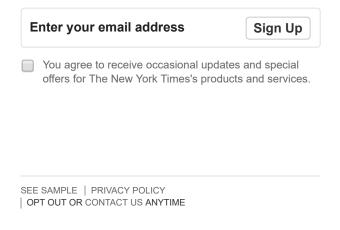
People with other disabilities face similar challenges on the Internet. "On the deafness side, the frustration is huge because of all of the video out there without captions," Mr. Goldberg said.

MR. RAMAN, who before joining Google in 2005 worked at Adobe Systems and as a researcher at I.B.M., is intimately familiar with accessibility problems, both personally and professionally. In 2006, he developed a version of Google's search engine that gives a slight preference to Web sites that work well with screen readers. The system had to test millions of Web pages.

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For his own use, he has built a highly customized system that allows him efficient access to much of what he needs on his PC and on the Web, stripping out anything that could slow him down. For instance, the system goes directly to the article text on the news sites he reads regularly, bypassing navigational links and other features found on most Web pages.

On a recent day, Mr. Raman was working on a research paper about the future structure of the Web. A monitor hung above the desk. It is usually turned off, unless he wants to show a colleague or visitor what he is working on. He typed at his keyboard,

his head slightly tilted to one side, listening to his screen reader through a pair of wireless headphones.

The screen reader is calibrated to speak at roughly triple the speed of a normal voice. To the untrained ear, the output is incomprehensible, but it allows Mr. Raman to "read" at roughly the same speed as a sighted person.

Processing information quickly is a skill he has developed over the years: a video on YouTube shows him solving his Braille Rubik's Cube in 23 seconds. When he is not typing, Mr. Raman, who wears large sunglasses, is often folding and unfolding pieces of paper into tiny, origami-like geometrical shapes at prodigious speed.

He shares a work area at Google with Charles Chen, a 25-year-old engineer, and Hubbell, Mr. Raman's guide dog. (Hubbell has his own Web site.)

Mr. Chen, who is sighted, developed a free screen reader for Web pages that works with the Firefox browser. Working together, the two recently added keyboard shortcuts that help blind and low-vision users navigate quickly through Google's search results. They've also developed tools to make sophisticated Web applications, like e-mail and blog readers, suitable for screen-reading software.

Now, much of their effort is focused on touch-screen phones.

"The thing I am most interested in is all of the stuff moving to the mobile world, because it is a big life-changer," Mr. Raman said.

To show their progress, Mr. Raman pulled his T-Mobile G1, a touch-screen phone with Google's Android software, from a pocket of his jeans. He and Mr. Chen have already outfitted it with software that speaks much like a screen reader on a PC. Now they are working on ways to allow blind people, or anyone who is not looking at the screen, to enter text, numbers and commands.

That development would complement voice-recognition systems, which are not always reliable and don't work well in noisy environments.

Since he cannot precisely hit a button on a touch screen, Mr. Raman created a dialer that works based on relative positions. It interprets any place where he first touches the screen as a 5, the center of a regular telephone dial pad. To dial any other number, he simply slides his finger in its direction — up and to the left for 1, down and to the right for 9, and so on. If he makes a mistake, he can erase a digit simply by shaking the phone, which can detect motion.

He and Mr. Chen are testing several other input methods. None of these technologies have been rolled out, but Mr. Raman, who is already using the G1 as his primary cellphone, hopes to make them freely available soon.

(Few screen readers are available for smartphones today, and they can often cost as much as a phone itself.)

What may become the most life-changing mobile technology — a phone that can recognize and read signs through its camera — may still be a few years away, Mr. Raman said. Already, some devices can read text this way. But because blind users don't know where signs are, they can't point the camera at them or align it properly, Mr. Raman said. Once chips become powerful enough, they will be able to detect a sign's location and read skewed type, he said.

"Those things will happen," he said. When they do, sighted users will benefit, too.

"If you have the technology that can recognize a street sign as you drive by it, that is helpful for everyone," he said. "In a foreign country, it will translate it."

Mr. Raman's innovations have already made their way onto millions of PCs. At Adobe in the 1990s, he helped to adapt the PDF format so it could be read by screen readers. That was required for PDF to be used by the federal government, and it eventually led to the technology's being embraced as a global standard for electronic documents.

"It was incredibly important to us as a business, and to the blind," said John Warnock, the chairman and founder of Adobe.

Mr. Raman says he thinks he has the largest impact when he can persuade other engineers to make their products accessible — or, better yet, when he can convince them that there are interesting problems to be solved in this area. "If I can get another 10 engineers motivated to work on accessibility," he said, "it is a huge win."