

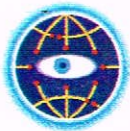
MAKING COMPUTERS DISAPPEAR

Why should you have to see them?

Ted Selker's enthusiasm is clear even over the coast-to-coast videoconference. Selker—a research fellow at IBM's Almaden (Calif.) lab—is showing off some of the ideas that IBM has for 21st-century information appliances. A 1.4-pound, 4-by-7-by-1-inch computer is strapped to his waist. Imagine, he says, you're inspecting a chemical plant or a Boeing 747 and need your hands free but also need to look at a schematic diagram. He flips open the unit, displaying a tiny keyboard and screen. Next, Selker reaches into his pocket and pulls out a wallet. Sewn into one side is a pager. In another part of the wallet is a scanner and even a tiny keyboard. Add a 3-ounce battery pack and it's a cellular phone, too.

At Almaden and at industry and university labs around the world, researchers are on a quest for the ideal information appliance. Their objective is simple yet frustratingly elusive: new types of computers that do their jobs so unobtrusively that they almost disappear. "The best computer interface is my car's antilock braking system," says Randy F. Pausch, associate professor of computer science at the University of Virginia, "I jam on the pedal and a computer makes thousands of complex decisions for me and saves my life."

Making computers that "transparent" and as effortless to use as, say, the telephone, has been the goal of computer scientists since the 1960s. Now, researchers have an astonishing range of prototypes that are approaching that ideal—and are taking computers far from the keyboard-and-mouse machines we know now. They include computers to wear, computers built into desks or walls, computers that take you into 3-D worlds, and those that can understand what you say and interpret your gestures. "We now have the computing power to adapt computers to what we



Researchers are hiding computers in the strangest places, including the heel of a Nike sneaker

ILLUSTRATION BY JOSE ORTEGA

need, not the other way around," says Dan R. Olsen, director of the Human-Computer Interaction Institute at Carnegie Mellon University.

Perhaps the best way to make computers usable by just about anyone is to get them to communicate the way people do—by talking and listening. "Speech is the most natural of all the extensions we have," says Michael Dertouzos, director of the Lab for Computer Science at Massachusetts Institute of Technology. Computer-generated speech is now commonplace. But getting computers to recognize spoken words and act on them has proved fiendishly difficult. At this point, the most advanced systems are good enough to use in situations where only a limited vocabulary is needed. But that could suffice for systems to let you ask a computer to book your airline reservation or retrieve a weather report, says Victor W. Zue, head of MIT's Spoken Language Systems Group.

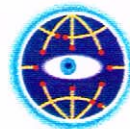
It would help, too, if computers could respond to gestures. Shake your head, say, and your PC would back off from deleting that file you've just clicked on. Researchers at Japan's Sony Corp. have programmed a computer to recognize and, through a simulated face, return their smiles. At this point, Sony has no plans to commercialize the technology, and at AT&T, researchers reckon gesture recognition is still 5 to 15 years away from being useful.

formation—the computers could perhaps swap electronic business cards and check calendars for a future meeting date. Modified eyeglasses and wristwatches might display the data.

Best dressed for the Digital Age, it seems, is Media Lab's Steve Mann, a researcher whose waking life is almost entirely mediated by computer. His experimental "wearcam" headgear includes earphones, a video camera, and a tiny screen that shows live video and computer data. Everything is connected to a computer on his vest that's linked by wireless modem to the World Wide Web. Mann's purpose is to explore how being at one with a computer and the Net can extend one's senses.

CLUTTER COP. The ultimate in digital disappearing acts may be what computer scientists are calling ubiquitous computing. In this scenario, computer sensors are embedded in furniture and office walls. They would constantly feed information to the Net, to track where a worker is so phone calls could be rerouted, say. At Media Lab, researchers have built a table that detects the position of your hands in the air above it. This "table mouse" is handy for moving objects on a computer screen.

Another effort is under way at Xerox, where researchers have designed a desk that reads over your shoulder, using cameras on the ceiling. The system can be used to automatically trans-



Computers embedded in furniture and office walls would track down a worker to reroute his phone call

What's Next

SPEECH RECOGNITION

After 20 years of trying, IBM and Carnegie Mellon are closing in on the technology that will let computers respond to ordinary speech.

3-D GRAPHICS

This technology can cram more information onto a screen

and, with animation, make it more compelling. Walt Disney, MIT, and the University of Virginia are among the leaders.

WEARABLE COMPUTERS

These wireless gizmos would exchange electronic business cards or let you Web-surf while you walk the dog.

NEC, MIT, and Carnegie Mellon are working on them.

UBIQUITOUS COMPUTING

Computers and sensors built into desks and walls could read your handwriting and keep track of papers on your desk. Xerox and Olivetti are at the forefront.

Another major avenue of research is creating gizmos that accompany us wherever we go. Future mobile computers might use so-called heads-up displays that seem to project see-through images over whatever you're looking at. Out on a hike, for example, you might see a digital map superimposed onto the actual landscape it describes. Xerox Corp. envisions such "augmented reality" helping its repair people: Diagrams of a copier's electrical wiring would seem to appear on the copier's surface.

SOLE MATES. At MIT's Media Lab, where corporate sponsors fund prototypes of new digital technologies, computers are appearing in wildly unlikely places. As part of a project called Things That Think, researchers have embedded a computer in a Nike Inc. sneaker. Using a piezoelectric polymer to generate power from foot movement, a computer in the heel might act as a sort of personal secretary. When two people shake hands, for instance, the skin-to-skin contact would be detected by sensors in each person's shoe. That would trigger an exchange of in-

formation to the Net and organize them.

This is just the sort of thing that might help Carnegie Mellon's Olsen realize what he says is his ideal information appliance: a system to help him find things in the clutter of his office. A high-resolution camera, he speculates, could watch all documents moving across his desk, read what it could of their visible text, and remember where each one eventually lands. Weeks later, Olsen could ask the machine—perhaps out loud—to locate that May, 1989, magazine he needed. In a flash, a laser on the ceiling would point to the right spot in the right pile. "When I needed it, it would help me," he says.

An abundance of cheap computing power and human imagination are fueling an explosion in new digital species. Which of these myriad creations will make it from laboratory to market and then into people's lives? Nobody can say. But somewhere in this evolutionary stew may lie the perfect information appliance.

By John W. Verity in New York and Paul C. Judge in Cambridge, Mass.