Oxygen burst

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MIT is readying new technologies that put humans in the center of computing

By Robert Weisman, Globe Staff | June 21, 2004

CAMBRIDGE -- Three years ago, Michael Dertouzos, the high-spirited director of MIT's Laboratory for Computer Science, spelled out his vision of a future in which computers recede into the background as enabling tools. "I don't want us to be slaves to our machines," he declared. "I want our machines to serve us."

Dertouzos had launched Project Oxygen in June 2000, convincing six global business partners to pony up $30 million over five years to promote "pervasive human-centered computing."

But he died suddenly the following summer. Although his lab has since been merged and moved, the Dertouzos vision lives on.

And Project Oxygen -- so named because he believed computers should be as invisible to their users as the air they breathe -- has begun to bear technology fruit.

Last week, in a series of demonstrations at MIT's futuristic Stata Center, researchers showed off a new reconfigurable microchip that enables a mobile device to change, chameleon-like, from cellphone to hand-held computer to music player; a 1,020-microphone array that can isolate a single voice or conversation at a cocktail party; a family of kiosks that use wireless technologies to provide a building's employees and visitors with maps, up-to-the-minute information about events in progress, and people's locations; a sensor network that can track the movements of autonomous robots; and a voice-activated software program that, in response to questions, dispatches intelligent agents to crawl hundreds of thousands of Web pages and recite weather forecasts or financialdata.

Enabling these and other applications to work together will be a kind of super-network operating system, called O{+2}S, still on the drawing board. It is expected to be released as an open source technology, like Linux, that other technologists could embrace, adapt, and improve on.

"The goal is to have a unified operating system," said Victor Zue, who became Project Oxygen's leader after Dertouzos died. "But it wasn't possible to predesign the operating system because all the pieces were still under development."

Many of those pieces were developed at Dertouzos' lab, which was merged into CSAIL, the Computer Science and Artificial Intelligence Laboratory, last summer. And, in March, that larger MIT research lab moved into the Frank Gehry-designed Stata Center, a block away from the drab Technology Square building where Dertouzos labored for 27 years.

There is still one year remaining in the five-year Project Oxygen, and it may be several years after that before many of its technologies are ready for consumers. But with last week's demos, held in conjunction with an annual meeting of "Oxygen Alliance" sponsors, the outlines of the research initiative have begun to come into clearer view.

Its technologies fall into four broad categories: hardware, environments, networking, and interfaces. Some research avenues favored by Dertouzos, such as machine-to-machine interaction, have been put on hold, while new ideas have moved to the fore, like secure chips that give devices individual identities. But the project has retained enough elements of the Dertouzos vision -- location awareness, speech recognition, reconfigurable hardware -- to cement his legacy.

"With the general vision of pervasive human-centered computing, we've been staying the course," Zue maintained. "As Michael used to say, we're not born with a keyboard on our hip."

For the MIT research community, Project Oxygen represents a departure and a potential template for future research projects. It is CSAIL's largest research initiative by far, making up 15 percent of the lab's annual budget. And it's funded with larger contributions from a smaller number of companies than the typical business collaboration, along with about $3 million in seed money from the Pentagon's ideas factory, the Defense Advanced Research Projects Agency.

Its business sponsors -- Hewlett-Packard Co., Nokia Corp., Royal Philips Electronics, Acer Group, and Nippon

Telegraph and Telephone -- are global giants less interested in product innovation help than in creating a technology environment that could expand the market for their own products. And, perhaps most significant, the research is oriented squarely toward applications rather than pure technology.

"Oxygen is important because it's making a statement that it's not about technology for technology's sake," said John V. Guttag, head of MIT's Department of Electrical Engineering and Computer Science. "It's about technology to improve the human condition."

Hewing to the goal of making computing more invisible and intuitive, the technologies demonstrated Wednesday included:

The Raw microchip, a tiled parallel processor designed to be able to reconfigure itself to adapt to its environment and the needs of its user. A single hand-held device powered by the chip, for example, could morph from cellphone to pager to music player to wireless e-mail machine by accessing the software required for each specific task.

The world's largest microphone array, running on the Raw chip and a three-dimensional tracking camera. The 1,020-node array, built into a wall, can isolate and capture an individual voice in a meeting, or any of dozens of simultaneous discussions at a business reception.

The Oxygen Kiosk network, called OK-Net, which serves as a building-wide smart information repository. The speech-enabled kiosks use Web-crawling software agents to provide employees with up-to-date data about projects and meetings. Visitors with wireless portable devices can download maps and track the whereabouts of their colleagues.

An indoor location system using electronic beacons, called "crickets," which can estimate the distance to one another without a fixed reference point. Such a distributed sensor network can be used, among other applications, for the real-time tracking of autonomous robots.

A program enabling conversation between humans and computers. One of several of the project's "smart meeting" technologies, it uses voice recognition and intelligent software agents to understand and respond to questions about thousands of facts that can be rapidly culled over the Internet. A business traveler can ask, for example, "What will the weather be like tomorrow in Ypsilanti?" and be told, in a matter of seconds, "Showers are expected in the afternoon."

MIT officials think Project Oxygen eventually could spawn as many as a dozen businesses. Some of its technologies will be licensed by the Oxygen Alliance partners and incorporated into their products, while others could be licensed by student researchers as springboards for start-up companies. One start-up already has been launched to manufacture crickets, while computer-maker Hewlett-Packard has begun to employ audio compression technology, developed in the early years of Project Oxygen, in new versions of its iPAC pocket computers.

Frederick Kitson, director of HP's Mobile and Media Systems Laboratory in Palo Alto, Calif., said his company pushed MIT to make all of the Project Oxygen technologies work together in a common architecture. "One of the advantages of investing in a university is there's a potential for an open standard" that many companies can embrace, accelerating consumer acceptance, he said. "It's still not there yet," Kitson said. "But now, in the fourth year, you're seeing bigger aggregation and less isolated activity. You're seeing progress."

Like HP and other sponsors, Nokia tracks the progress of Project Oxygen while pursuing parallel research in its own labs, in Finland and in Burlington. "This is a benchmark to our own work," said Juha Yla-Jaaski, the Nokia director of strategic planning in Helsinki. "The overall goals of Nokia and Oxygen are very much aligned." The voice control and user interfaces emerging from Oxygen, for example, could find their way into the next generation of Nokia cellphones.

Some of MIT's business sponsors have assigned representatives to work with Project Oxygen researchers, while others dispatch their own researchers to Cambridge for a few months at a time. Those with Boston-area labs, such as HP and Nokia, can use those operations to monitor the project. For almost all of them, Project Oxygen represents their single largest academic research collaboration. "You write one big check and hope everything works out," Kitson said.

For MIT, one of the goals for the final year of Project Oxygen will be creating what Zue calls "an oxygenated environment" in the Stata Center, the project's new home. The microphone array, for example, will be installed in the center's 350-seat auditorium, while a voice-controlled network of OK-Net kiosks will be placed around the building. And smart meeting technologies will be tested throughout.

"We're going to eat our own dog food," Zue promised.

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