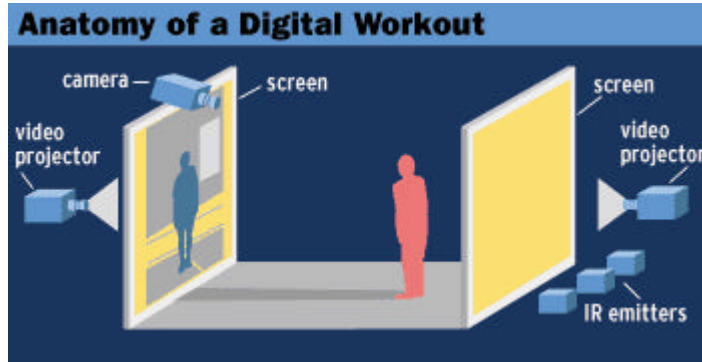




The Aware Computer: Seeking an Invisible User Interface

The Virtual Trainer

An aware computer would perceive what the human user is doing at any given time and respond accordingly.



During a workout, the computer can track the athlete's movements with cameras and infrared scanners and react appropriately. (Marco Doelling/ABCNEWS.com)

By Richard Martin
ABCNEWS.com

Nov. 7 — On the jumbo TV screen a T-shirted drill sergeant does jumping jacks. His gravelly voice barks out commands at the sweaty laggard in front of the set: “Get moving!” “Concentrate!”

Yet another workout video? Not quite; this video aerobics instructor can actually “see” when the user is falling behind, or botching the moves, or goofing off—and can respond in kind with praise and instruction.

Developed by James W. Davis at the MIT Media Lab, the prototype Virtual Personal Aerobics Trainer consists of a large-screen television, a sound system, a video camera and a controller that uses computer-vision techniques to interpret the user’s moves and come up with an appropriate response (from “Yer doin’ fantastic!” to “C’mon! Smell the coffee!”).

The user can program the system to select a specific sequence of moves, music and an instructor. The Virtual PAT synchs up motion and music, runs the video and exhorts or praises the user according to their



The virtual trainer gives some positive reinforcement. [148kb \(mov\)](#) [RealVideo](#) (download [RealPlayer](#))

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performance.

A virtual drill sergeant might give some people pause. After all, computers that can grade aerobics performance can also “judge” other kinds of behavior.

Effortless Control

This Fonda-in-fatigues was hardly the most far-out application at this year’s Perceptual User Interface

Conference, sponsored by Microsoft Research and held this week in San Francisco.

Presentations ranged from “Hands-Free Cursor Control With Real-Time 3D Face-Tracking” to

“Multimodal Interactive

Advertising.” Some were filled with jargon like “haptic interfaces,” “cognitive chunking,” and “Gaussian distributions.” But all of the 70 or so researchers present have a simple goal: changing the way people interact with computers.

“Our current interfaces—the mouse and keyboard—fall very short of human capabilities,” explains George Robertson, manager of the User Interface group at Microsoft Research.

But the goal is to abolish the interface altogether, says computer vision expert Jim Crowley, of the INRIA research institute in France. “What people want is effortless communication [with their computers and with each other]; effortless access to information and services; and effortless control of their appliances and the environment.”

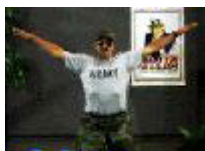
Big Brother in a Box

What that means is making computers aware; continuous machine awareness, says Crowley, is the “Holy Grail” of PUI research.

An aware computer would perceive what the human user is doing at any given time and respond accordingly. In the case of the Virtual PAT, the on-screen aerobics instructor can “see” the exerciser through a combination of robust silhouette extraction, in which the human figure is backlit with infrared light so that a video monitor can pick up a clear silhouette. Motion templates can then perceive various human actions and compare them to an “ideal” exercise movement. Statistical pattern recognition



Virtual PAT: A virtual Personal Aerobics Trainer. (Webb Chappell)



video

The trainer can also come down pretty hard on lazy athletes. [236kb \(mov\)](#)

[RealVideo](#)

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is used to make the comparison, while a feedback loop prompts the instructor periodically to encourage—or to reprimand—the user.

Having a computerized drill sergeant in your living room might give some people pause—after all, a computer that can grade aerobics performance can also “judge” other kinds of behavior—such as what Tat-Jen Cham, of Compaq’s Cambridge Research Lab, delicately referred to as “suspicious actions.” It’s a short leap from a virtual aerobics trainer to a desktop cop, and the monitoring and surveillance aspects of PUI research were not lost on the conferees.

Computer Expectations

“Eyetracking devices may tell us too much,” says Javier Movellan of the University of California at San Diego.

“Do people really want their emotions recognized by a machine?”

“We all know where surveillance technology is heading,” adds Matthew Brand of Mitsubishi’s Electric Research Lab. “In five to 10 years, you’ll be able to cue up anyone picking their nose anywhere.”

The debates over PUI will only become sharper as more sophisticated interfaces, and more aware machines, come to market. It’s not at all clear that many people really want a computer that interacts spontaneously with them—witness the universal annoyance with on-screen “assistants” like Microsoft’s “Bob.”

But it seems inevitable that, soon enough, plenty of computers will start talking back to us.

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