

The DIY Chip



IMAGE CREDIT: JOHN BERENS/COURTESY BITFORMS GALLERY NYC AND ITP NYU

PHYSICAL COMPUTERS AS populist devices may be the most momentous tech trend of the past five years that practically no one has heard about. Typically a small circuit board housed in a customized case, a physical computer is an easily programmable device that is aware of its surroundings. It is designed to interface with sensors that measure things around it—say, how fast an object is going, how close something is to it, the temperature around it. Based on that input, the computer takes action by moving switches and levers, displaying information, or otherwise controlling the environment.

For humans, connecting to computers via a mouse and keyboard has long been cheap and easy. For sensors, not so much. Now an inexpensive physical computer called the Arduino is changing all that. When the Arduino burst onto the do-it-yourself (“DIY” to devotees) scene in 2005, all manner of tinkerers seized on it as a device that could easily and cheaply run interactive projects.

Using an Arduino is fairly straightforward: buy a board (ranging from about \$19 to \$65) and attach it to a personal computer via a cable. Then load instructions into the Arduino’s processor via the personal computer. Once programmed, the Arduino makes decisions based on the information transmitted by whatever sensors you’ve hooked up, and does something corporeal, such as turn on or off the motors, displays, valves, and lights attached to it. For a few dollars, creative and motivated individuals—rather than just corporations or institutions—can make highly intelligent tools, perfectly customized for a particular need.

Most uses for physical computers are, at present, a bit curious. Robot-builders turn out autonomous, terrain-aware robots in their workshops. Tinkerers cruise sidewalks in Segway knockoffs. Sensualists use a tub of intelligent mud instead of a mouse to control their computer.

But especially in the art world, the Arduino is beginning to open new realms of creation and experience. Art galleries and museums, including New York's Museum of Modern Art and San Francisco's Exploratorium, have displayed interactive pieces that change shape and form based on what the people who gaze at them are doing. Consider the work of the New York artist Daniel Rozin, whose *Weave Mirror* (now on exhibit at London's Victoria and Albert Museum) forms images by individually rotating 768 motorized planes. A physical computer inside senses the gallery environment, and a woven portrait of the viewer emerges as the planes rotate into place.

Such large artistic installations used to require multiple programmers and engineers. But now "artists and designers have the ability to do 100 percent of these projects by themselves and have total control over everything," Rozin says. "The expertise isn't that specialized anymore."

The number of devices—and the number of people who understand how to use them—grows daily (more than 100,000 are out there). Thousands of increasingly practical projects can be found on DIY, computer, and art Web sites. Security-conscious users can build intricate home-control systems. Photographers can connect lasers to physical computers to take ultra-high-speed photographs. Drivers can cruise more economically by tracking real-time engine performance and fuel-consumption data.

"In any community—art, plumbing, medicine—when users make adaptations of the tools, they make them just right, because they localize them for the community using them," says Tom Igoe, one of the primary developers of the Arduino and the head of physical-computing classes at the Interactive Telecommunications Program at New York University. "It's like Leonardo da Vinci designing his own brushes and paints."

Sensors, as well as physical computers themselves, are still in their infancy. But what's coming off the Arduino drawing board suggests possibilities limited only by our imaginations: the Arduino LilyPad, for example, is a wearable (and washable) physical computer that allows input, output, and sensor devices to be sewn into clothing. Think handbags that know whether you have your keys, or jackets that know your preferred level of personal space and blow air on people who come too close (to name just two recent creations). Never has the phrase "the right tool for the job" been more ripe with opportunity.

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