

Plug-and-Play Robots Originally published in April 2004

PERSONAL ROBOTS MAY SOON BE AS CHEAP AND CUSTOMIZABLE AS PERSONAL COMPUTERS BY W. WAYT GIBBS

“Could this be the place?” I wonder as I stand before a nondescript storefront, formerly a tattoo parlor, in the tiny borough of Youngwood, Pa. The windows are covered by blinds; the door bears forbidding bars. The building lacks a sign or even a house number. It seems an odd location from which to launch an ambitious new species of robot.

But when Thomas J. Burick opens the door and I see three prototype “PC-Bots” sitting on his small workbench, I realize that this 34-year-old entrepreneur is no ordinary inventor. The half-meter-high robots look like R2-D2 droids that have been redesigned by Cadillac. Burick says that he spent a year honing their appearance, something almost unheard of in serious robotics, where function usually trumps form.

To Burick, form is function, and it is very important that he get the design right the first time. This is his life’s dream, and it has consumed his life savings. “As a kid, I watched *Lost in Space* on TV and thought it was so fantastic that Will Robinson had this machine who protected him and was the best friend anyone could have,” he says, with boyish earnestness. In seventh grade Burick built a voice-controlled mobile robot, and in high school he constructed an autonomous fire-fighting rover.

As he got older, Burick dabbled with the low-level microcontrollers, servos and sensors used these days by amateur robot builders, but he finally gave up in frustration. His jobs had been in retail, selling consumer electronics rather than making them. With no formal training in programming or electrical engineering, “the learning curve was too steep,” he says. “I thought there has got to be a better way.”

The better way occurred to him 18

months ago as he was repairing one of the generic “white box” PCs he assembles from components and sells at his small computer store half a block up the street. What if robots could be built up from interchangeable, commodity parts just the way that desktop computers are? Better yet, what if there were a robotic platform that could accept the thousands of plug-and-play PC peripherals and accessories already on the market?

Soon there will be. White Box Robotics, Burick’s nascent company, is preparing three varieties of its mobile robotic chassis for mass production this summer. Sitting on the workbench, each of the final prototypes for the three robots looks quite distinct.

“This one is customized for security,” Burick says, putting his hand on the 912 HMV. “It’s painted with the same paint used on the Hummer H2,” he notes. Hella driving lamps are mounted on its front, and webcams peer out from its head and belly. “It could patrol your house while you are away and e-mail or page you if it detects a loud noise or an unfamiliar person.”

“And we call this one the 912 MP3,” Burick says, gesturing toward a white robot of the same size and shape but sporting a color LCD screen in its back, a stereo control panel in its midriff and a striking blue lamp in its head instead of a camera. “We designed this to appeal to young people, who could use it as their bedroom computer. It can download music and play DVDs in response to voice commands.”

But at the moment it is the third robot, the basic model, that illustrates Burick’s idea best. Its exterior shell has been removed to reveal an inner skeleton, common to all three siblings, that allows them to work like PCs on wheels.

A simple metal frame holds up to six shelves at various positions. “All of the electronics mount on these trays, which slide out,” he explains. One tray holds the motherboard, which is a diminutive Mini-ITX made by VIA that crams an Intel-compatible processor with 512 megabytes of memory, video, audio and networking chips all onto a circuit board the size of a bread plate. Another tray contains two hefty but inexpensive 12-volt batteries that allow the robot to run for three hours between charges. Standard laptop hard drives, CD burners, DVD drives—virtually any PC gadget you can find at CompUSA—can be mounted securely to these trays inside the robot’s body.

“These robots run Windows XP, so they can do anything your PC will do,” Burick points out. But they can also do things that no PC can—move, for example. Below the metal frame is a drive assembly: two motors connected to two four-inch wheels and a spring-mounted hard plastic ball. “This Delrin ball keeps the robot stable even on uneven surfaces and allows it to track its position precisely even as it turns and spins,” he notes. “And this whole drive assembly comes off with four bolts, so if you want to replace it—with tank-style treads, for example—it’s a five-minute job.” Eventually he hopes to offer an optional drive mechanism capable of climbing stairs.

With an oomph, Burick lifts the 40-pound machine down to the floor and turns it on. To my surprise, the 18-inch-tall rover is quieter than my laptop computer. Just like any PC, it has ports on its backside for a monitor, keyboard, mouse, Ethernet cable and so on. But untethering the machine is only a matter of plugging an inexpensive WiFi receiver into the motherboard. Burick uses his laptop to log in over the wireless link. “Okay,

this software is now running on the robot,” he says as he launches the Robot Control Center, a program he has licensed from Evolution Robotics.

Clicking on buttons in the program, he drives the robot toward a 20-year-old Heath Hero Junior robot gathering dust in the corner. When it gets within three feet or so, the 912 stops and says in its synthesized voice, “Hello, Hero Junior.”

It’s a nice trick, and as I try the software myself, I find that creating such pseudointelligent behaviors is quite simple. A small window shows onscreen what the robot sees through its “eye” camera. Burick sets a model of the B9 robot from *Lost in Space* on the floor, and

I turn the 912 to look at it. I click the “capture” button, and the machine adds it to a memorized list of objects that it can recognize. I back the 912 up, turn it around, and create a new behavior by checking a box here and making a menu selection there. Six clicks later I have taught it to speak a phrase whenever it sees the B9 toy. And it works: even from four feet away and at an odd angle, the 912 recognizes the toy and says, “Hey, get out of my way!”

It is a trivial example of a powerful combination: easy-to-use software and easily customized hardware. Plug in a microphone, and the robot can respond to voice commands. Attach an infrared

sensor and tuck a few speakers in its case, and it becomes a CD player that follows you around the house. Bolt on a couple of gripper arms, and you can program it to empty the kitty litter box every other day.

Because the chassis can be stamped out by the same factories that make computer cases, the PC-Bots will cost in the neighborhood of \$1,000—about as much as a decent desktop system, Burick declares: “My goal is to make it affordable enough that a 14-year-old can buy one with the money earned on a paper route. I want people to use this platform like a blank canvas, to let their imaginations run wild.”

Robots That Suck

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HAVE THEY FINALLY COME OUT WITH A ROBOT FOR THE REST OF US? BY GEORGE MUSSER

For generations, tinkers have been pointing out how much their projects will lighten the load of housework. For generations, spouses and parents have failed to be impressed by these claims. When I built my first robot seven years ago, people kept asking, “So what does it do?” I explained that it would eventually vacuum the floor. I should have just been honest: “Not much, but it sure is cool, isn’t it?” All these years later I still have trouble getting my creations to do the most basic things, like move in a straight line. My professions of usefulness don’t carry much weight around the house anymore.

At least I am not alone. Seldom in the history of technology has an industry been so eagerly anticipated, and so slow to emerge, as the consumer robot industry. Back in the early 1980s, when computers were turning from hobbyist playthings into mass-market appliances, it looked as though robots would soon follow. Heathkit’s famous Hero I robot kit came out in 1982, not long after the original IBM PC. *Entrepreneur* magazine predicted a \$2-billion home robot market by 1990. Today the original PC is a museum

piece, and Hero I is still the state of the art.

Anyone who builds a robot appreciates what happened. When humans use a personal computer, we enter into the computer’s world. If it can’t do something, or if it crashes, too bad; we have to deal. But a robot enters into our world. If floors are uneven, if legs get in the way, if lighting conditions change, the robot has to deal. Extra computing power doesn’t necessarily help; on the contrary, more sophistication typically means less resilience.

Through the school of hard knocks (lots of them), robot experimenters have learned to keep things simple. Massachusetts Institute of Technology professor and robo-guru Rodney A. Brooks led the way in the mid-1980s with a new style of robot programming, in which cheap sensors directly trigger elementary behaviors. Most robot kits these days, such as Lego Mindstorms, embrace this approach. And a similar design philosophy is reviving the fortunes of the home robot industry.

Some products, admittedly, achieve simplicity by giving up the pretense of doing anything useful at all. Robot dogs such as Sony’s Aibo are the classic exam-

ple. Others, such as robotic lawnmowers and pool cleaners, aim to do a single task in a highly controlled environment. The next step up is to do a single task in a highly uncontrolled environment, and the most obvious candidate for that is vacuuming. Over the past several years, a number of companies have promised to roll out floor-cleaning robots. A few of them have even delivered.

Apart from DustBot, a cheap but clever toy made by the Japanese company Tomy, the first consumer robot that could vacuum was Cye. Released in 1999 by Pittsburgh-based Probotics, Cye is the Apple II of robots: just pull it out of the box and plug it in. I tested one back in the fall of 2000. It’s about the size of a toaster oven, with two wheels, a pair of wheel odometers to measure its movement, and a bump switch to sense when it hits something. To prove its usefulness, it can tow a small upright vacuum cleaner.

You control Cye from a PC via a wireless link, and the desktop software is where Cye really shines. As the bot blunders around, it relays back odometry readings, and the software estimates its posi-