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Today's Edition

## Health/Science

### We're going the way of the robot

BY BRYN NELSON

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February 20, 2007



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SAN FRANCISCO -- Robots already are driving cars, vacuuming rooms, tracking wildlife, climbing up walls and spying on nannies. In the not-so-distant future, a new generation of machines may be driving for us, watching our kids and dispensing medicine, according to a panel of experts assembled at the annual conference of the American Association for the Advancement of Science.

The remarkable potential has engineers and computer scientists thinking big even as other researchers ponder our increasingly complicated relationships with the machines we've endowed with ever-greater artificial intelligence.

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"Not only must they be intelligent, but they must be able to go anywhere," said Robert Full, a biologist at the University of California, Berkeley.

And with nature as a source of inspiration, many are doing just that. Full's studies of how a cockroach runs, for example, led to the collaborative development of a robot known as RHex and its smaller sibling, EduBot - each equipped with six legs that can independently move forward or backward and climb over a variety of terrains.

Stanford engineering graduate student Sangbae Kim took similar inspiration from geckos to design Stickybot, a four-limbed robot equipped with gecko-like foot pads

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that allow it to climb vertical glass surfaces. The same principal allowed him to develop a new adhesive that Full likened to "Velcro without needing the other side."

Ken Goldberg, an engineering professor at Berkeley, said robots can return nature's favor by acting as active environmental observatories in places where the working conditions may be difficult and dangerous.

While working to automate a high-resolution camera that "can read a credit card from across the room," Goldberg heard about a Cornell University-led search for the ivory-billed woodpecker, a bird long believed extinct but potentially spotted in 2004 in an Arkansas bayou. Goldberg helped develop a statistical program that allows a twin camera system aimed at the sky to discriminate among the possible images it tracks, keeping only one in every 10,000 images and helping researchers zero in on birds.

Now running continuously for three months, the camera has captured images of a red-tailed hawk, a flock of geese and a blue heron, Goldberg said, encouraging him that the project is on the right track. Other researchers already have expressed interest in using similar setups to track bears, penguins and gorillas.

Robots may soon be working in more urban settings, too. In 2005, a team of Stanford University engineers took top prize in a challenge requiring a robotic car to travel 132 miles on its own through a desert course. The next challenge, said Stanford University robotics expert Sebastian Thrun, "is making a car that drives where we live," including densely populated cities and suburbs.

The Stanford Racing Team has designed a robotic car named Junior to compete in the 2007 DARPA Urban Challenge, a fall competition sponsored by the Defense Advanced Research Projects Agency that will require cars to conduct simulated military supply missions while navigating through traffic.

The older robotic cars couldn't distinguish a car from a bush, Thrun said. The new ones not only must make that distinction, but also operate with a 360-degree field of sensing that will allow them to back out of a driveway, change lanes and avoid other vehicles. Training the robot to deal with unpredictable human behavior, Thrun said, is still a work in progress, but he envisions cars that can go up to 1,000 miles on their own by 2010 and highway-ready versions by 2030 that have lower error rates than human drivers.

Beyond serving as chauffeurs, robots may be designed to become effective domestic companions and caregivers, said David Calkins, a professor of robotics and computer engineering at San Francisco State University.

Nannybots, for example, are WiFi-connected robots that allow parents to check in on their children. The next generation of robots may do much more.



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"Instead of looking in on the nanny, the robot becomes the nanny," he said.

Despite the huge potential, some technical limitations are still readily apparent. A Roomba may do a reasonable job of vacuuming your floor, Calkins said, but it can't distinguish between a human and a chair leg. And the independently-moving EduBot scurrying past him across a meeting room carpet had to be freed from the tall gold curtains by the window.

Other potential issues may require an army of ethicists and lawyers to sort out. What happens if a home health aide robot neglects to dispense the right medicine, for example? Who is liable if a robotic car causes a crash? Can high-resolution camera systems be used to spy on the public? And can we become too dependent on robots?

Calkins agreed that the push for robots to perform more detailed tasks is a "slippery slope" toward increasing dependence, but a trend that he's not particularly anxious about. Despite the ubiquity of automatic dishwashers, he said, everyone still has a sink and dish soap and is capable of doing dishes, though many of his friends let the dishes pile up when the dishwasher breaks.

"I think the net benefit is radically in favor of the technology saving more lives," Calkins said.

'Stickybot'

WHAT IS IT Four-legged robot that can climb smooth vertical surfaces. Its feet use a special adhesive inspired by the gecko.

DESIGNED BY Sangbae Kim, of the Biomimetics Dexterous Manipulation Lab at Stanford University

'Junior'

WHAT IS IT Artificial intelligence built into a 2006 Volkswagen Passat. Junior uses cameras, lasers, radar, GPS and a computer "brain" to maneuver in simulated traffic, predicting trouble, avoiding collisions and learning right-of-way.

DESIGNED BY Stanford University School of Engineering

'ACONE'

WHAT IS IT Robotic bird-watcher. It uses two digital cameras to distinguish birds from other objects and record the video in its system, discarding non-bird footage. Conservationists hope to use the video to spot ivory-billed woodpeckers, thought to be extinct since the 1930s or 1940s.

DESIGNED BY Texas A&M University and University of California, Berkeley team

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