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Once they roamed only science fiction. Now faster computer chips are leading to the ...

RISE OF THE ROBOTS

By Doug Bedell Staff Writer of The Dallas Morning News
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It was supposed to be 2173 when Woody Allen awoke in the movie *Sleeper* and freaked at the sight of a robotic dog.

Dog: "Hi, I'm Rags. Woof. Woof."

Mr. Allen: "Is he housebroken? Or will he be leaving little piles of batteries all over the place?"

Well, the real Rags has arrived a little early.

Sony calls him Aibo, and 5,000 of him will be unleashed to new owners beginning June 1. For \$2,500 - and \$450 more for the programs that customize his character - Aibo can be adopted from the Sony Web site, www.world.sony.com.

Cheap computer processors have accelerated the development of all sorts of robotic gizmos. They're slowly clomping, wriggling and hopping their way into our lives. Star Wars' C-3PO may seem futuristic in the context of George Lucas' long-awaited prequel this week, but he's really just around the corner.

At this rate, reasoning, rational, responsive mobile robots will be our companions and employees by 2040, predicts Hans Moravec, principal research scientist at Carnegie Mellon University's Robotics Institute in Pittsburgh.

"We're paralleling our own evolution, only 10 times faster," says Mr. Moravec, author of *Robot: Mere Machine to Transcendent Mind* (Oxford University Press). "With the advances in processor power, we're seeing the growth of a nervous system that is



reptile in intelligence. The next generation in about 2020 will be sort of mammal-like.

"By 2030, they'll be primate-type - able to imitate, model their environments, rehearse behaviors in their mind and learn."

A decade later, he says, and they'll be reasoning with the best of us.

One small step for robot-kind

Such pronouncements may seem geek-gone-mad, but Mr. Moravec has spent 19 years pushing the robotics technological envelope. After dismal progress through the 1980s, he sees encouraging signs that Earthling and robot may be ready for a techno-evolution.

Ever-faster computer processor speeds now enable robots to "see" by creating three-dimensional maps of their surroundings (see www.frc.ri.cmu.edu/~hpm/).

Humans are warming to robot applications. Firefighters are heavily backing development of machines that can enter burning buildings and extinguish flames. Baylor University Hospital employees have adopted a messenger robot that delivers supplies to nursing stations.

Robots are disarming bombs, spot-welding cars and conducting security patrols inside remote warehouses. Lego's Mindstorms Robotics Invention System, which went on sale before Christmas, was wildly successful even with its \$200 price tag.

And, across the Internet, scientists and hobbyists are sharing their thoughts in discussion groups such as comp.robotics.misc, while spending freely at a rising number of robotics supply houses such as Mondo-tronics Robot Store (www.robotstore.com).

"So far, nobody's made money on robots; in fact, as an industry it's been rather pathetic," says Mr. Moravec. "But the money's about to start."

Sony, Honda and numerous other companies are angling for a piece.

While Honda is busy crafting designs for a humanoid robot (www.honda.co.jp/english/), Sony, the electronics giant that makes the popular PlayStation gaming platform, has gone to the dogs.

Aibo, described by one reviewer as "Robocop meets the Taco Bell chihuahua," is a silver-gray, four-legged robot that responds to external stimulation and its own judgments, expresses petlike emotions and can recognize forms and colors.

An "entertainment robot," in Sony's words.

Aibo happens to be the word for buddy in Japanese, but it is also the acronym for Artificial Intelligence roBOt.

The machine, Sony says, is imbued with adaptive learning and growth capabilities. Whack or scold Aibo and he's likely to react by sitting down and tilting his head quizzically. Ostensibly, the little guy will remember the reprimand to correlate new responses and avoid a recurrence. Knock Aibo over and he rights himself almost gracefully, then continues about his meanderings.

At a recent demonstration in San Francisco, three of the robo-pets played feistily with each other in an office building foyer, drawing a crowd of curious workers from their cubicles. While a handler with a tone-based remote control instructed each Aibo to perform tasks such as kicking a ball, one would suddenly break off to scratch himself. Another might wander toward anything that moved within "sight" - camera range.

"It's somewhat useless," says Takeshi Yazawa, head of the Sony entourage and general manager of a unit called the ER Business Incubation Department. "But, you know, it's a pet."

Motion editor software, purchased separately, can be used by Aibo owners to create Windows-based programs with personal computers to add an endless array of motions and responses. All are stored in an 8-megabyte Sony Memory Stick that slides into the robot's derriere.

Sony is leaving most software development to third parties, but specific, routine petlike motions and responses are programmed into each unit at the factory. That includes, Sony says, the "desire" to interact and play, to move about six yards a minute, then gradually slow down to "sleep" when lacking stimulation. Aibo supposedly gets "hungry" for recharges to his lithium batteries and fills up by laying down in an electrical tray with an interface like a cordless phone's.

Aibo's sleek, foot-tall, tail-wagging body hides speakers that blurt out custom-made sounds or prerecorded human speech. Mr. Yazawa says the robot's custom Aiperios operating system supports voice-recognition software, which could be used to fixate on a single person's voice commands.

To start, Sony will market 2,000 Aibos in the United States and 3,000 in Japan. Promotional efforts include a side event to soccer's World Cup called RoboCup, for which about 100 teams of college students from across the globe are designing their own autonomous robotic soccer teams.

"We're pretty sure we're going to sell them quickly - within a couple weeks," says Mr. Yazawa. "But this is our first time

selling over the Internet only.

"Nobody knows."

Beyond toys

The mention of Aibo to robot designers such as Mr. Moravec and Southern Methodist University's David Anderson is likely to elicit sniffs and sneers.

"I'm not a fan of toys," says Mr. Anderson, a geology department senior systems analyst who helps model the surface of Venus for NASA. He has been improving his SRO4 mobile robot (www.geology.smu.edu/~dpa-www/robots/sr04/sr04.html) for 10 years now.

Although Mr. Anderson and others in the Dallas Personal Robotics Group (www.dprg.org) may poo-poo the Sony pet's basic design - "You don't evolve a sophisticated brain, then say, 'How do you develop the intelligence for it?' " says Mr. Anderson - they applaud the swelling interest in robotics and urge others to develop useful designs.

"You're working on the development of hardware systems, mechanical systems and software systems," he says. "You watch your robot run around the room, get stuck under chair, then say, 'How can I teach this robot to be free?' It's very fulfilling."

Mr. Anderson's creation senses its surroundings using an eclectic array of sonar, photocells, household security motion detectors and pressure-touch sensors. At SMU, SRO4 can roam hallways, picking up soda cans it finds purposefully left for it by Mr. Anderson's co-workers.

"It'll pick them up and wander around trying to decide what to do with them," says Mr. Anderson. "Someday, I hope to teach it to be a recycling robot."

Around the house, SRO4 rambles about, getting into trouble. Based on Mr. Anderson's programming, it logically deduces where hallways and humans are likely to travel.

"I'll hear the motors have stopped and wonder what it's doing," says Mr. Anderson. "Inevitably, it's gotten behind a door or something to wait for stimulus."

When Mr. Anderson's wife or Nova the cat enters SRO4's lair, the robot will pinpoint the interloper, then make a quick, straight-line lunge.

"My wife likes the robot quite a bit, but not where it just jumps out. It charges toward her with the flashing lights," he says. "Sometimes she's carrying something, and it'll give her a start

and she'll drop it. The cat - well, the cat doesn't like it at all."

Mr. Anderson has gotten untold thrills from watching his \$400 contraption grow more and more sophisticated with each new tweak. SRO4 may become entangled in an umbrella during its patrols, then spend four hours backtracking to extricate itself.

Truly useful functions are elusive in its current state of evolution. But with every new layer of intelligence Mr. Anderson gives SRO4, more possibilities loom.

"These are just sophisticated combinations of extremely simple behaviors," he says. "You watch it and wonder, 'Now why did it do that?' There's usually a logical explanation. Either that or there's more work to do."

Like Mr. Moravec, Mr. Anderson sees a future filled with specialized, robotlike creatures.

"I don't seek a C-3PO bringing me a drink," he says. "I picture the house itself as the robot where the appliances are all networked. . . .-You don't have a bunch of robots. You have one robot who can do this; one that can do that.

"Machines actually empower humans," Mr. Anderson says. "Attempts to replace humans have not gone well."

Moving toward sophistication

Mr. Moravec, who has developed sophisticated robot "eyes," believes society is on the cusp of a new age of friendly interaction with machines.

"The first products we'll see produced will retrofit existing machines to do their jobs better," he says. "The idea is to create confidence in the technology. If it's good enough, the first mass-market product is probably going to be an autonomous machine. The thing will be smart enough to understand its location in 3-D and can be trained.

"In the case of a cleaning robot, it could be told, 'Clean this room.' Or 'Go here and do this under the following conditions.' It'll be smart enough that it will generally do the right thing."

Down the line, things get trickier. As robotic intelligence evolves, it will be possible to set up autonomous, robot-run industries, Mr. Moravec says.

Our "mind children," as he calls them, will have to obey sophisticated behavior laws in order to keep order. While war-fighting robots may be beneficial in some circumstances, they could be dangerous if programmed with nefarious intent.

"The ones that live in your home are going to be nicer than just

about any of your friends," says Mr. Moravec. "The society we're part of is going to be much wealthier, because the robots are doing everything and we're doing nothing. Productivity's infinite because they never stop."

In short, Hollywood's futuristic visions of robots will become reality faster than we might think.

"We're in control right now," Mr. Moravec says. "But we've got to make sure they don't do some things they shouldn't do - like eat us. They could very well do that if not programmed correctly.

"They may just see us as raw materials."

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