SCIENCE & TECHNOLOGY

I, Geminoid

THE SOURCE: "The Man Who Made a Copy of Himself" by Erico Guizzo, in ***IEEE Spectrum***, April 2010.

Subtly but surely, robots are making their way into our everyday lives. By some estimates, 8.5 million service robots are already in use worldwide, doing a wide range of tasks such as performing surgery, milking cows, and handling meat. They don't resemble the friendly characters promised by science fiction, such as C-3PO from *Star Wars* and Rosie the Robot Maid from *The Jetsons*. But in a not-too-distant future, that may change. Robots will serve up our daily java at Starbucks and assist people with physical therapy. "But," writes Erico Guizzo, associate editor of *IEEE Spectrum*, "to be accepted in these roles, robots may have to behave less like machines and more like us."

Osaka University engineer Hiroshi Ishiguro has been a pioneer in the humanization of robots. Early in his career, he built one robot that "looked like a trash can with arms" and another that "resembled an overgrown insect." People did not react well to these creations, Guizzo reports; they couldn't relate to them.

Hiroshi Ishiguro (left) with his "geminoid," a robot he designed to look exactly like him. Ishiguro thought that a more human-looking machine might be easier for people to interact with.

To better understand the role appearance plays in communication, Ishiguro, who is 46, built an android to look exactly like himself. His "mechanical doppelgänger" is made of silicone rubber, pneumatic actuators, powerful electronics, and hair from his own head. The "geminoid" (derived from *geminus*, the Latin word for twin) has no autonomy; Ishiguro controls it remotely from his computer. When Ishiguro speaks, the android reproduces his speech. It blinks, twitches, and appears to breathe. It can even attend meetings for him on campus (though it can't get to the meetings on its own, and the university won't pay Ishiguro for his geminoid's time). Unlike the human Ishiguro, however, it doesn't smoke.

Robots may one day be indistinguishable from humans, but as Ishiguro's creation shows, the "uncanny valley" (as one robotocist put it) between life and lifelike remains. The technology blog Gizmodo included Ishiguro's Frankenstein in its list of "10 Creepy Machines From Robot Hell." Nonetheless, as the technology improves and people spend more time with androids, the machines may lose their unnerving edge. Ishiguro has found that at first people seem uneasy around his geminoid, but they quickly warm to it. Pet owners are particularly adept at reading its nonverbal cues. "Humankind is always trying to replace human abilities with machines. That's our history," Ishiguro says. "I'm doing the same thing. Nothing special."

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Cassava Rising

THE SOURCE: "Breeding Cassava" by Nagib Nassar and Rodomiro Ortiz, in ***Scientific American***, May 2010.

To many Americans, cassava root is a stranger in the produce aisle. But for 800 million people around the world, the starchy tuber (also called manioc, tapioca, and

yuca) is the main staple of their diets. Globally, it accounts for more calories consumed than any crop besides rice and wheat. Unfortunately for those who subsist on it, it's not particularly nutritious, containing little protein, vitamins, or minerals. A new and improved cassava could go a long way toward alleviating malnutrition in the developing world, and that's just what University of Brasília geneticists Nagib Nassar and Rodomiro Ortiz have set out to create.

Cassava originated in Brazil, but in the 16th century Portuguese sailors brought it to Africa, which today produces more than half the world's supply. From there it spread across tropical Asia as far as Indonesia. It can be fried, boiled, turned into flour, even consumed raw. In some parts of Africa and Asia, people eat the plant's leaves as well. Yet despite its widespread reach and versatility, the lowly cassava has never attracted much attention from scientists. Average yearly yields are low, leaving plenty of room for improvement.

Along with their colleagues, Nassar and Ortiz are cross-breeding the common, domesticated plant with its wild relatives in the hopes of creating hybrids that are more nutritious, hardier, and more drought resistant. Wild varieties of cassava are rich in essential amino acids, iron, zinc, and, importantly, beta carotene, which helps ward off eye diseases, a major problem in countries with high malnutrition rates. One new variety of cassava has 50 times as much beta carotene as the common plant.

Despite such advances, the authors and other cassava researchers have their hands full: *The New York Times* recently reported that a new and damaging virus is destroying crops around Lake Victoria, and may soon spread across Africa. Scientists will need to develop a resistant variety and distribute it quickly, or widespread food shortages will be on the horizon.

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Publish *and* Perish?

THE SOURCE: "Open Sesame" by the editors of *Nature* and "U.S. Seeks to Make Science Free for All" by Declan Butler, in ***Nature***, April 9, 2010.

In the 1990s, the advent of the Internet sparked calls for science journals to provide their content online for free. How to raise the revenue needed to produce the journals? Charge the authors!

The "authors-pay" model—no mincing words here—has proven successful for a handful of publications. When the nonprofit Public Library of Science (PLoS) launched in 2003, it aimed to charge authors just $1,500 per paper, but the fee for its top journals has risen to $2,900, which is often covered by grants or university funds. The organization's finances are highly dependent on the papers published in its online journal *PLoS ONE,* which reviews articles for technical soundness but does not make judgments about their importance. As a result of its light editorial touch, *PLoS ONE* has low costs and can get by charging authors $1,350 per paper.

Print journals such as *Science* and *Nature* rely on subscription fees to support the hefty costs of their editorial content, which includes reviews, sidebars, and supplementary materials online. (Subscribing to *Nature* costs a library upwards of $3,000 a year—not exactly chump change.) If such journals were to switch to an authors-pay model, the price per paper would need to be incredibly high. The editors of *Nature* say that research agencies would have to be willing to make more funding available to their scientists in order to help defray the fees.

The Internet is not the only source of pressure on science publishers. Washington is insisting that research

> A handful of online science journals offer free content by charging their authors hefty fees for publication.

funded by federal dollars be made public, particularly in fields with great public interest such as biomedicine. A 2007 law requires researchers at the National Institutes of Health to make all papers available in the agency's PubMed Central repository within 12 months of publication. A bill introduced in the Senate by Joseph Lieberman (I-Conn.) and John Cornyn (R-Texas) would create a comparable requirement for all research backed by federal agencies with research budgets greater than $100 million. It's also possible that the White House will issue a similar executive order.

If PubMed Central is any indication, such policies would have a large impact. Reporter Declan Butler writes that the archive now holds nearly two million articles. On an average weekday, some 420,000 visitors download a total of 750,000 articles.