HEALTH

ROBOTS ENTER INTIMATE DOMAINS OF HEALTH AND CARING

Our population is aging rapidly. By 2020, more than 700 million people around the world will be over the age of 65. And many in this population will live with chronic diseases, requiring care and assistance in their daily lives. Add to this the millions of people in every age group living with various impairments and those simply trying to extend and improve their lives, and it becomes clear that health will be a key driver of robotics adoption in the future. At the same time, machines that surpass humans' ability to perform specific medical tasks will expand health care options beyond their current limits.

UNDERSTANDING HUMANS: Deciphering the Specs

In our attempts to build machines that emulate human intelligence and physical functions, we need more intricate knowledge of the workings of our bodies and minds. Basically, we need the specs for humans. To understand the adaptive, flexible behavior people exhibit, scientists need to imitate the design of a whole brain, the body it lives in, and the drives that motivate it. In designing such systems we are gaining a better understanding of our bodies and minds, which in turn, will lead us to create better intelligent systems and more humanlike machines.

Source: http://www.popsci.com/scitech/article/2009-04/robots-fight-autism

Autism helpers

Robots such as Keepon are used to study kids with autism spectrum disorders by monitoring their interactions and emotional states.
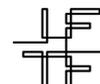

Source: http://www.newscientist.com/article/mg18825241.700
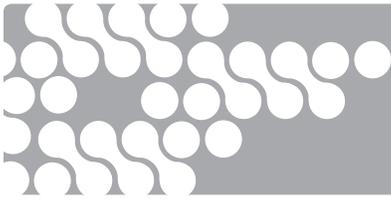
Autonomous behaviors

Dynamic Anthropomorphic Robot with Intelligence (DARwin) is a family of fully autonomous humanoid robots capable of bipedal walking and performing humanlike motions that serve as a research platform for studying autonomous behaviors.

THE FUTURE OF HUMAN-MACHINE INTERACTION

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AUGMENTING HUMANS: Restoring and Extending Capabilities

One of the most promising areas for development in robotics are machine companions that extend human senses and capabilities or help to compensate for frailties and deficits. Research in this domain ranges from assistance for the elderly to helping experts in the medical profession complete sophisticated tasks with greater precision and accuracy. Robots can perform repetitive tasks with consistency and without getting bored or fatigued. As human extensions, they can also track and provide feedback on human performance.

Source: http://spectrum.ieee.org/automaton/robotics/medical-robots/041910-bandit-little-dog-and-more-usc-shows-off-its-robots

Social cognitive support

The humanoid robot Bandit, developed by USC's Center for Robotics and Embedded Systems, provides social cognitive support for the elderly by engaging them in various cognitive tasks (solving puzzles, responding to questions, playing music); it also serves as a therapist and playmate to children with autism.

Source: http://www.newscientist.com/article/mg19926745.800-robot-assistant-gives-surgeons-a-cutting-look.html

Surgical assistants

Eye-tracking technology in robotic assistants for surgeons enables them to respond to the doctor's needs.

**Source:** http://www.newscientist.com

Medical positioning robots

A pneumatic robot has been designed to automatically position patients' limbs inside an MRI machine, allowing more accurate diagnosis of tendon injuries.

**AUTOMATING TASKS:** Going Where No Man Has Gone Before

Machines are particularly useful for performing tasks in hazardous environments, such as battlefields, burning homes, and contaminated areas. We are also relying on machines to take over routine tasks in medical and residential care environments for the elderly and people with disabilities. From providing physical therapy to cutting and sewing human tissue to produce less scarring, robots are able to perform existing tasks at new levels of perfection.
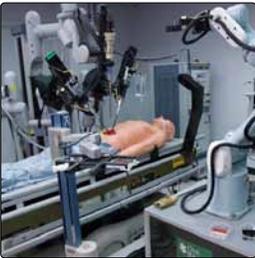
Battlefield medics

SRI International's Trauma Pod mobile operating theatre uses robotic surgeons for quick response away from the hospital setting.

Source: http://www.newscientist.com/article/mg20126982.600-er-20-robots-team-up-for-surgery.html
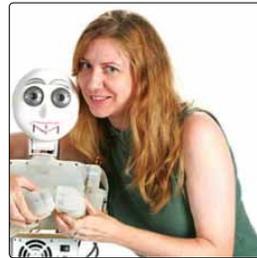
Robots that care

USC professor Maja Mataríc has developed a robot that can encourage physical and cognitive rehabilitation following an incident such as a stroke.

Source: http://www.newyorker.com/reporting/2009/11/02/091102fa_fact_groopman

Physical therapists

An MIT-developed robotic system called MIT-Manus delivers high-intensity physical therapy to help stroke victims get back some use of their arms.

Source: http://www.techshout.com/science/2010/17/mit-manus-robot-assisted-therapy-may-help-stroke-patients-regain-function

FORECAST

Demographics will drive the adoption of robotics in health and caring. In the process of building machines that extend and take care of us, we will also be developing new approaches to artificial intelligence and reaching new levels of accuracy and precision in medical procedures.

(1) elderly and people with disabilities as early adopters

We have come to see the young as the "digital natives"—people with a level of fluency and intimacy with technologies that is far ahead of older generations. With the proliferation of robotics in health and caring, we are likely to see new types of early adopters. These are populations who will simply have to rely on robotic assistants for help with activities of daily living.

(2) rethinking artificial intelligence

The idea of an artificial neural network that could perform computations was proposed decades ago, but efforts to create intelligent machines from these networks progressed in relative isolation from brain research. As a result, artificial neural networks bear little relation to the structure of neural networks in real brains. Increasingly, however, neuroscientists and AI researchers will come together to create new approaches to AI. By embedding "brains" into physical robotic bodies that can explore, sense, and learn they will be uncovering new ways of building intelligent agents.

(3) New standards of performance

Making more precise cuts, reducing the surgeon's tremor during microsurgery, performing less invasive and more precise autopsies, completing surgical treatments more cleanly and in less time—these are all ways in which robotic systems will set new performance standards. This new higher bar will in turn become expected in many medical procedures

As the advent of technologies to extend and augment our cognitive and physical capabilities leads to an increasingly diverse array of human senses and abilities, we will increasingly confront new social dilemmas regarding what we decide to augment with the help of our robotic companions, when we do so, and how. Clearly, all members of the population will not have equal levels of access to robotic technologies. Which ones will we claim as new rights? How will we deal with ensuing disparities in access? How will we make decisions about their use? And as machine companions increasingly store and transmit data about us, questions about privacy are likely to become even more critical than they have been so far.

RESOURCES

- Georgia Tech's robotics program, including the Simon project, which is developing an upper-torso robot with side-by-side human-robot interaction in mind. Simon has similar proportions to a 5' 7" woman so as not to intimidate an individual working alongside it. **http://www.athomaz.com/?p=116**

- *Flesh and Machines* by MIT robotics professor Rodney Brooks (Pantheon, 2002) envisions a future of intelligent machines and explores the implications for our perception of our own human nature. **http://www.robotbooks.com/Rodney_Brooks.htm**

- At Johns Hopkins University, engineers and doctors are collaborating to create the next generation of robots for the operating room. **http://spectrum.ieee.org/podcast/robotics/medical-robots/surgeons-and-robots-scrub-up#transcript**

- MIT's Mind Machine Project (MMP) brings together neuroscientists and five generations of AI researchers to "go back and fix what's broken in the foundations of information technology." **http://web.mit.edu/newsoffice/2009/ai-overview-1207.html**

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