Assistive Robotics

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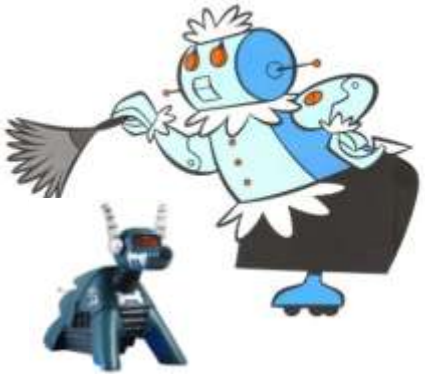
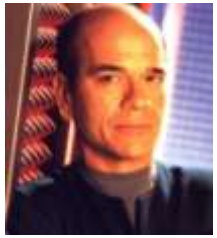
Agenda

- What is a robot?
- What is an assistive robot?
- Early assistive robots
- Assistive robots at VA
- Other assistive robots
- Robots in the news
- Summary
- Questions

Some images of robots





klaatu barada nikto

Robots

- **Industrial robots** – used in factories
- **Medical robots** – referred to as a medical device
  - Surgical robots – hip replacement, surgical master-slave manipulation
  - Movement Therapy Robots – provides diagnosis, trains, restores function, used in neurorehabilitation
  - Assistive robots – compensates for lost function
    - **Mobile servant** – assists with manipulation tasks such as grasping, feeding, cooking, activities of daily living, etc
    - **Physical assistant** – provides walking assistance, prosthetics, exoskeletons (wearable devices)
    - **Personal mobility** – cars, wheelchairs, transfer devices

What is assistive robotics?

My definition: An assistive robot is a device that can sense, process sensory information, and perform actions that benefit people with disabilities and older adults in the course of their daily living.

Activities of daily living include: bathing & showering, dressing, food preparation & eating, mobility, personal hygiene & grooming, housework, taking medications, managing money, shopping, communicating, using technology, pet care, child rearing, engaging in religious observances, working, playing, vacationing, exercising, reading, relaxing, socializing, pursuing and education, etc

Users of assistive robotics

	Prevalence	Potential users
Spinal cord injury:	90,000	90,000
Cerebral palsy:	500,000	50,000
Rheumatoid arthritis:	2,100,000	20,000
Other:		
Frail elderly		
ALS, MD, MS, stroke, temporary impairment, amputees, etc.		

[Stanger CA (1996) Cawley MF, Demographics of rehabilitation robotics users. *Technology and Disability* 5, pp. 125-137.]

Early assistive robots

Rancho Golden Arm

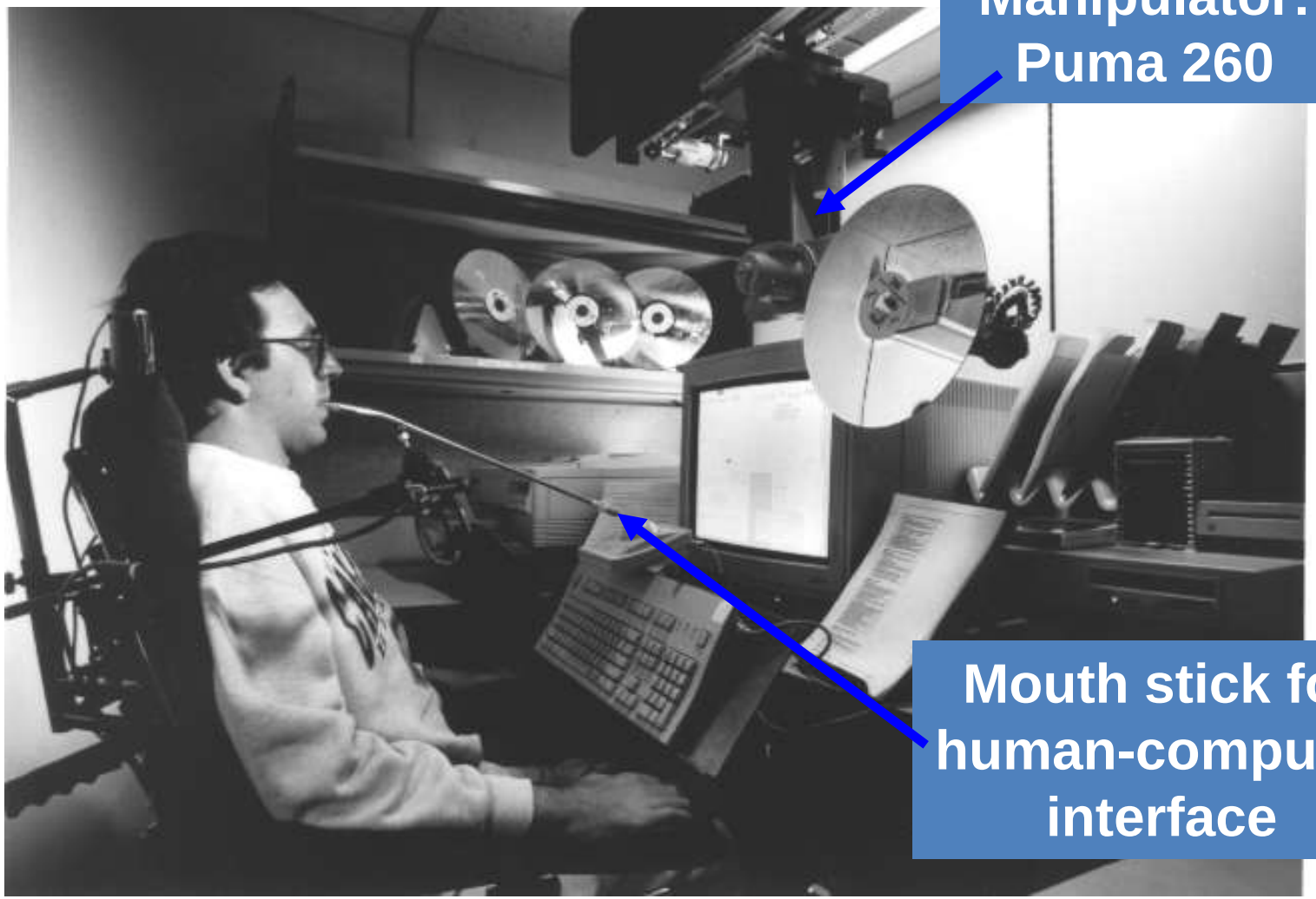
Early assistive robots

JHU / APL Robotic Workstation

VA / Stanford MoVar

DeVAR & ProVAR

Desktop Vocational Assistant Robot



DeVAR & ProVAR

Desktop Vocational Assistant Robot

Other assistive robotics

Handy-1

The Handy 1 is a rehabilitation robot designed to enable people with severe disability to gain/regain independence in important daily living activities such as: eating, drinking, washing, shaving, teeth cleaning and applying make-up. The introduction of systems such as Handy 1 has a dual purpose: it enables greater personal activity for persons with severe disabilities, thus leading to an increased level of independence; and helps to reduce the demand on caretakers for individualized, intensive assistance. Link

MANUS Wheelchair Robot

*i*Arm provides independence to people with severe disabilities in their upper extremities. Link

Hephaestus Navigation

The Hephaestus Smart Wheelchair System is envisioned as a series of components that clinicians and wheelchair manufacturers will be able to attach to standard power wheelchairs to convert them into “smart wheelchairs.” Link

PAMAID Robotic Walker

- Guido (PamAid)
- Wheels, not motorized
- Steering motorized
- Range sensors in front

A walker that could help navigate and avoid collisions with obstacles could help reduce health costs and increase the quality of care and independence of thousands of people. This study evaluated the safety and performance of the Veterans Affairs Personal Adaptive Mobility Aid (VA-PAMAID). Link

Robots in the news

PR2 Can Now Fetch You a Sandwich from Subway

The following demo, from the University of Tokyo and Technische Universität München, puts semantic search to the test by tasking a PR2 with fetching a sandwich. The PR2 has no detailed information on sandwiches, but its database tells it that sandwiches are a type of food, and that food can be found in kitchens and restaurants, and from that, it figures out where to look. Link

Willow Garage's PR2 robot can fold clothes, set a table, and bake cookies

Willow Garage's PR2 robot can fold clothes, set a table, and bake cookies. It costs too much and does too little to interest consumers, but researchers are rapidly developing technology to make it more useful and less expensive. Link

Assistive Mobile Manipulation for Older Adults at Home

There is great potential for robotics to support the needs of older adults - either directly or by supporting the activities of professional caregivers (e.g., nurses or physical therapists) who work in the homes of older adults. Link

Assistive Mobile Manipulation for People with Severe Motor Impairments

Robots that complement human abilities are extremely valuable, especially when they help us do things that we can't do by ourselves. Robots for Humanity's goal is to get robots in homes to help severely injured people like Henry Evans. Link

Will older adults roll out the welcome mat?

Robots have the potential to help older adults with daily activities that can become more challenging with age. But are people willing to use and accept the new technology? A new study indicates the answer is yes, unless the tasks involve personal care or social activities. Link

Exoskeleton Technology Helps Paraplegic Student Walk Again

The exoskeleton legs were developed by Professor of Mechanical Engineering Homayoon Kazerooni and a team of students at the University of California, Berkeley. What made the project even more important was a desire to help fellow student Austin Whitney - who lost the use of his legs after an accident in 2007 - walk at his own graduation. Link

eLEGS: Wearable, Artificially Intelligent, Bionic Device

eLEGS is a wearable, artificially intelligent, bionic device that enables people with paralysis to stand up and walk again. The exoskeleton is battery-powered and rechargeable, fitting comfortably and securely over clothing. A battery-powered exoskeleton helps paraplegics stand and walk in a straight line, using a gesture-based human-machine interface. Link

Advanced exoskeleton promises more independence for people with paraplegia

A team of engineers at Vanderbilt University's Center for Intelligent Mechatronics has developed a powered exoskeleton that enables people with severe spinal cord injuries to stand, walk, sit, and climb stairs. Its light weight, compact size and modular design promise to provide users with an unprecedented degree of independence. Link

Robosoldier

Using artificial muscles and controls, these powerful exoskeleton suits could soon be available to soldiers, firemen, even the handicapped. Link

Ready for the robot revolution?

Robotic gym instructors are popular with old and young people. Link

Panasonic's Hospi-Rimo robot tends to patients

Panasonic has developed a robot with telepresence functions can help bedridden patients communicate with loved ones. Link

Giraff - a mobile solution for the home

Giraff is a mobile communication solution which facilitates the elderly's contact with the outside world. It is remote-controlled, on wheels and has a camera and monitor. Link

Eldercare Robots

Robot & Frank - The many stakeholders in robotic healthcare (family members and caregivers; healthcare providers; technology providers; aging or disabled individuals) all have similar goals: to provide independence, preserve dignity, empower those with special needs, and provide peace of mind to all of the stakeholders. Link

Student develops revolutionary elderly care robot

A University of Salford researcher has come up with a novel way of dealing with stretched resources caused by us all living longer – an interactive care robot for elderly people. Link

CompanionAble

CompanionAble will provide the synergy of Robotics and Ambient Intelligence technologies and their semantic integration to provide for a caregiver's assistive environment. This will support the cognitive stimulation and therapy management of the care-recipient. This is mediated by a robotic companion (mobile facilitation) working collaboratively with a smart home environment (stationary facilitation). Link

Vgo

Remote Student - Students with extended illness, injuries, disabilities and immune deficiencies attend school without leaving home. Link

Remote Visiting - Visit with extended stay hospital patients and elderly in nursing homes or assisted living communities. Link

Hair-washing robot leaves your hair silky-smooth

Panasonic has developed a hair-washing bot that lets you lie down while your hair is gently shampooed. Designed for Japan's growing elderly and bedridden population, the device consists of a reclining chair and a computerized washbasin. Link

Panasonic's Robotic Bed transforms into wheelchair

Bed Mode

Shown with the back rest up

The wheelchair separated from the bed

Panasonic has created a robotic bed that can transform into a wheelchair, allowing the elderly or people with disabilities to get up without assistance. Users can remain in the bed while it turns into a wheelchair. Half of the mattress rises and half lowers while a motorized unit beneath it automatically slides out from the bed. Link

The Revolution Will Be Prosthetized - DARPA

DARPA's prosthetic arm gives amputees new hope. Link

Giant teddy bear robot can pick you off the floor

Developed by the Riken research center and Tokai Rubber Industries, the new Robot for Interactive Body Assistance (Riba) can now lift patients weighing up to 176 pounds, better than its previous load limit of 134 pounds. It can also bend down and deposit or pick up patients on the floor. This is useful in Japan, where people often sleep on futon floor bedding or relax on floor tatami mats. Link

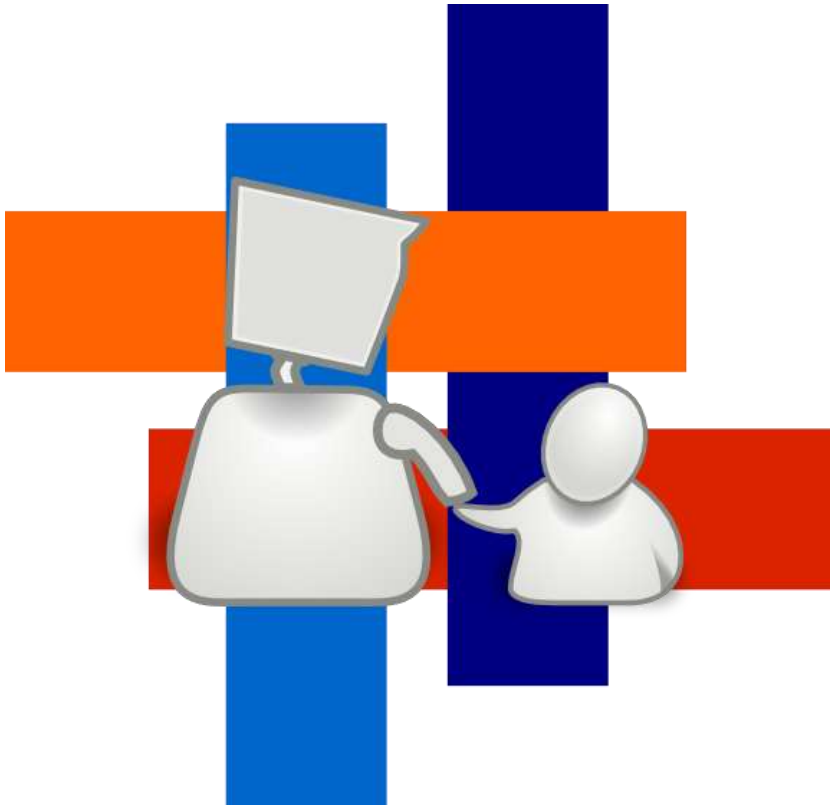
Babyloid: Therapeutic Baby Robot for the Elderly

Babyloid is designed to resemble an infant. It weighs 2.2kg, measures 44cm in length and has a movable mouth, arms and eyelids. Babyloid inventor Kanou Masayoshi says his robot can, by simulating certain human emotions (i.e. crying), trigger emotional responses in users, something that may be helpful to fight symptoms of depression especially seen with the elderly. Link

New Robotic Animals Help Dementia Patients

A robotic animal companion (Paro) may provide a therapeutic effect to seniors struggling with dementia while adding few demands on nursing home staffs, new research has found. Link

Socially Assistive Robotics



An NSF Expedition in Computing - Our mission is to develop the computational techniques that will enable the design, implementation, and evaluation of robots that encourage social, emotional, and cognitive growth in children, including those with social or cognitive deficits. Link

Biologically Inspired Assistive Robotics

Service animals have successfully provided assistance to thousands of motor-impaired people worldwide. As a step towards the creation of robots that provide comparable assistance, we present a biologically inspired robot system capable of obeying many of the same commands and exploiting the same environmental modifications as service dogs. Link

Robotic Playmates

Robotic playmates capable of physically manipulating toys have the potential to engage children in therapeutic play and augment the beneficial interactions provided by overtaxed care givers and costly therapists. To date, assistive robots for children have almost exclusively focused on social interactions and teleoperative control. This project represents progress towards the creation of robots that can engage children in manipulative play. Link

Kinova

The goal: creating the best assistive robot for upper-body disabled people. Link

An Assistive Robot

EL-E is an assistive robot that is explicitly designed to retrieve unmodeled, everyday objects for people with motor impairments. Link

Bestic - an eating assistive device

Bestic is an eating assistive device for people who can not eat on their own. With buttons or a joystick, the user decides what should be picked up from the plate. The product has been launched on the Swedish and European market and in the autumn of 2012 a clinical pilot study of the product was conducted at a chain of non-profit nursing homes in the US. Link

Humanoid Robots: STEM Vehicles Today, Classroom Assistants Tomorrow

If humanoid robots are ever to succeed as classroom assistants, they have to be stable, agile, and programmable - but above all, said Bruno Maisonnier, they have to be *cute*. Link

Humanoid robot "Russell" engages children with autism

The robot teaches learning skills to autistic children and gauges their response in real time. Link

Face to Face with Sweden's Social Robot

Human interaction with robots is about to get a little more personal. Meet "Furhat," the face of tomorrow's interactive technology. Link

Summary

- Robots come in many forms
- Robots can be used in many ways to help people with disabilities (and their caregivers)
- Much research being pursued, resulting in one-of-a-kind prototypes
- Few assistive robots in common use today
- High cost and uncertain benefit are major barriers to their widespread adoption

Questions?

[zoom]uphill - takes you out into nature

[zoom]uphill is an all-terrain, electrically powered four-wheeler for people who have difficulty walking, and is aimed primarily at those who like to move about in the forest and open country.
Link