cisc3650
human-computer interaction
spring 2012
lecture # VI.2
human-robot interaction, part 2

topics:

- human-robot interaction

references:

- The Real Transformers, by Robin Marantz Henig, The New York Times Magazine, July 29, 2007.
- Human-Robot Interaction, by Robin R. Murphy, Tatsuya Nomura, Aude Billard and Jennifer L. Burke, IEEE Robotics and Automation Magazine, June 2010.

human-robot interaction: definitions and challenges

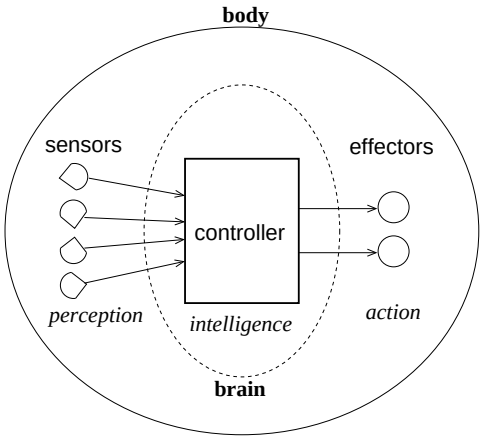
- "humanoid" robots
  - share physical traits with humans: head, torso, arms
- "sociable" robots
  - designed to interact with humans
  - (should) exhibit the following traits:
    - make eye contact
    - gaze in the same direction as human speaker
    - take turns speaking (in the interaction)
    - share attention
- research in robotics is typically "stuck" on building a platform that does only one—or a small number of—tasks, but cannot multi-task like humans do
  examples of these:
  - gripping and placing a can
  - "understanding" langauge
  - "learning" from a (human) teacher

robot: definitions

- the term "robot" was coined by Karel Capek, a Czech playwrite, in the 1920's, in a play called "R.U.R.", or "Rossum's Universal Robots"
  the word "robata" is Czech for "forced labor"
- today's researchers agree that the term "robot" has to have two characteristics:
  - *embodied*: have a physical body with which to sense and interact with the physical world
  - *situated*: sense the environment and respond to it

  which is why the GPS in a car is not a robot (it's not embodied) and neither is an assembly-line robot (it's not situated)

a robot is a canonical agent



sociable robotics

- sociable robots must be both *embodied* and *situated* AND must also exhibit understanding of social beings
- there are (at least) two reasons to pursue research in sociable robots:
  - *pragmatic*: if robots are "coming", then we should develop robots that fir into people's everyday lives
  - *theoretical*: to build robots that learn the way people do would "solve" artificial intelligence (AI)

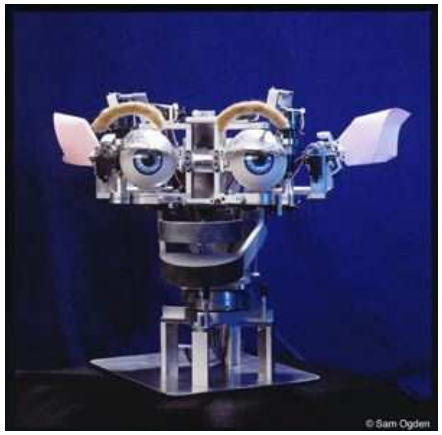
profile: Rodney Brooks

- Professor at MIT's AI Lab
- aims to build an AI that can LEARN to do "simple" things, like a 4-year-old human for example:
  - walk on two legs
  - carry on a natural language conversation
  - navigate around a home or office
- *learning* is key—instead of all behaviors being pre-programmed into a robot's control code
- emphasizes a *reactive*, *behavior-based* approach to controlling robots, where robots respond readily to changes in their environment and responses are organized into "behaviors"
  this is in contrast with traditional *deliberative* control methods, where robots sense their environment, but then "pause the world" and take time to "deliberate"—make decisions—about what to do—the problem is that, while the robot is deciding what to do, the world around it changes.
  a good example is a soccer-playing robot: while it is "thinking", the other team can take the ball and score a goal...

- example robots by Brooks' group (pictures in following slides):
  - Cog
    - robot that "learned" from interacting with humans
    - torso with arms and head
    - could learn limited things, like how to use a Slinky toy
  - Kismet
    - project of (then) graduate student Cynthia Breazeal (now MIT Media Lab professor)
    - sociable robot with facial expressions
    - designed to show "emotions":
      anger, fear, disgust, joy, surprise, sorrow
    - begs the question: what "emotions" are genuine for a robot?
  - Leonardo (or "Leo")
    - another robot that can learn using *inference*
    - combined some of the ideas of Cog and Kismet
    - looks like Yoda—"skin" made in a Hollywood studio

Cog

Kismet



Leonardo

robot learning

- all robot learning is contrived
- software learns lessons that human programmers want it to learn
- because the human programmers decide what information to represent in the robot's memory and what information can be changed—i.e., "inferred"
- A great quote: "Whatever is in HRI is because the human put it there." Lijin Aryananda (graduate researcher in Brooks' group)

uncanny valley

- the phrase "uncanny valley" was coined by Masahiro Mori, a Japanese researcher who conducted a study comparing different types of representations for human-like and animal-like robots
- he discovered that when an artifact looks "too human", we don't like it any more
- we can interact okay with a robot that looks like an animal or a stuffed toy (e.g., Furbie), but the closer the robot looks like a human, the more creepy it seems (e.g., Stepford Wives)

challenges in HRI

- HRI includes the following, in relation to human-robot systems:
  - design
  - understanding
  - evaluation
- challenges for teaching HRI:
  - HRI is multidisciplinary
    including: communications, computer science, electrical and mechanical engineering, psychology, theatre
  - HRI is new; resources are diverse; there are no textbooks or primary journal in the field
  - lack of pedagogical HRI platform
  - students need background in a wide range of topics:
    - interface modalities (vision, speech, haptics)
    - types of knowledge, knowledge representation
    - representations of intentions of others, user expectations

- social learning, skill acquisition
- social interaction, behaviors, emotions
- evaluation methodologies
- ethics
- natural language processing, dialogues
- robot control
- safety