PSYCO 457
Social Robotics

Social Robotics
Kismet and Descendants
Design Issues For Social Robotics

Social Situation

- In 2001, the crew tells an interviewer that HAL expresses emotion because of its programming
- The purpose of this programming is to make HAL easier for the crew to interact with
- Is it possible that one crucial aspect of humanoid situation involves cues for social interaction?

Social Feedback

- HAL's key problem is that it is very limited in terms of what it can do to express or to alter a social environment
- One advance in robotics is the development of interfaces that are intended to express – and elicit – social and emotional cues
- One famous example of such a robot is Kismet, created at MIT by Dr. Cynthia Breazeal

Kismet Basics

- A 3.6 kg robot head
- Purpose is to generate emotional expressions
- Intended to have similar senses as those of a human infant
- "Crucial to its drives are the behaviors that Kismet uses to keep its emotional balance. For example, when there are no visual cues to stimulate it, such as a face or toy, it will become increasingly sad and lonely and look for people to play with. Responding to Kismet restores its equilibrium, making it happy again. Similarly, if its caregiver endlessly repeats the same cue, such as shaking a doll in front of it, it will get bored and agitated. And if Kismet becomes overwhelmed with information, it is likely to tire and fall asleep."

Social Expressiveness

- After establishing her own lab at MIT, Breazeal has continued to explore social robotics
- One project, Leonardo, emphasizes the social expressiveness of the robot
- Brief video demonstrating Leonardo in action

Pepper

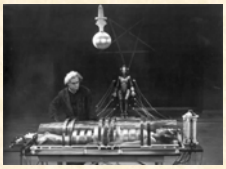
- Another important social robot is Pepper
- Pepper can recognize faces and basic human emotions. Pepper is optimized for human interaction and is able to engage with people through conversation and his touch screen.
- Here is a brief video illustrating Pepper in action

Four Classes Of Social Robots

- Breazeal defines four classes of social robots
- Socially Evocative
  - They rely on human tendency to anthropomorphize
- Social Interface
  - They merely provide a "natural" interface by employing human-like social cues and communication
- Socially Receptive
  - Socially passive, but can benefit from interaction (e.g. learning by imitating)
- Sociable
  - They pro-actively engage with humans in order to satisfy internal social aims or drives

What Is A Socially Interactive Robot?

- Fong et al. (2003) argue that socially interactive robots must demonstrate a number of different characteristics:
  - Express and/or perceive emotions
  - Communicate with high-level dialog
  - Learn/recognize models of other agents
  - Establish/maintain social relationships
  - Use natural cues (gaze, gestures)
  - Exhibit distinctive personality
  - Learn/develop social competencies
- At issue: what design decisions must be explored to develop machines that exhibit these characteristics?



Design Issue: Embodiment

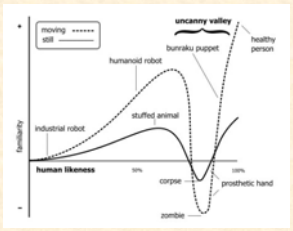
- "Embodiment is grounded in the relationship between a system and its environment. The more a robot can perturb an environment, and be perturbed by it, the more it is embodied" (Fong et al., 2003)
- So, embodiment can be quantified
- Furthermore, choice of embodiment is not theoretically or functionally neutral

Embodiment And Morphology

- For instance, the form of a robot because it helps establish social expectations
- These expectations in turn must be matched by the robot's function in order for it to be a useful device
- We don't want to choose a form that leads to users having false expectations about the robot's capabilities

The Uncanny Valley

- Our choice of the form of a robot can lead us into what has become known as the uncanny valley



Candidate Morphologies

- Anthropomorphic
  - Design robot in such a way that human characteristics will be assigned to it
- Zoomorphic
  - Design robot to imitate a living creature
- Caricatured
  - Use animation or graphics to establish interaction biases (to and away from robot strengths and weaknesses)
- Functional
  - Just use a design that will get the job done (e.g., add cargo space to health robots)


Grace's cartoonish face on a flat screen

Design Issue: Emotion

- Emotion is a key element of human social interaction
- Emotion is increasingly a component in the design of robot interfaces
- "Emotion helps facilitate believable human-robot interaction. Artificial emotion can also provide feedback to the user, such as indicating the robot's internal state, goals, and intentions" (Fong et al., 2003).

Emotional Embodiment

- Emotion can be used as a control mechanism to dictate which behavioral mode will be adopted by a robot
- Emotion can be a key component of robot behavior and appearance:
  - Speech
  - Facial expression
  - Body language

Design Issue: Social Perception

- "To interact meaningfully with humans, social robots must be able to perceive the world as humans do"
- "Similarity of perception requires more than similarity of sensors. It is also important that humans and robots find the same types of stimuli salient. Moreover, robot perception may need to mimic the way human perception works" (Fong et al., 2003)

Design Issue: Social Learning

- One of the primary goals of creating socially interactive robots concerns training them to do useful tasks
- "In socially situated learning, an individual interacts with his social environment to acquire new competencies"
- This kind of learning – e.g., via imitation – is required to make robots general purpose

Imitation Issues

- Imitation is an important method of learning
- But to get robots to imitate, lots of issues need to be dealt with:
  - How does the robot know when to imitate?
  - How does the robot know what to imitate?
  - How does the robot map observed action into behavior?
  - How does the robot evaluate its behavior, correct errors, and recognize when it has achieved its goal?