Social Robotics

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SoSe 2019

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Social Robots: A Taxonomy

Outline

- Definitions of ‘Social Robot’ are notoriously difficult.
- Other approach: Map the types of social robots in terms of central dimensions[1]:
  - Role of the social robot
  - Design of the social robot: Morphology & Behaviour
  - Competencies: Dialogue, Emotions, Personality

[1] Fong, T., Nourbakhsh, I., Dautenhahn, K.: A survey of socially interactive robots. Robotics and Autonomous Systems 42:143–166, 2003.

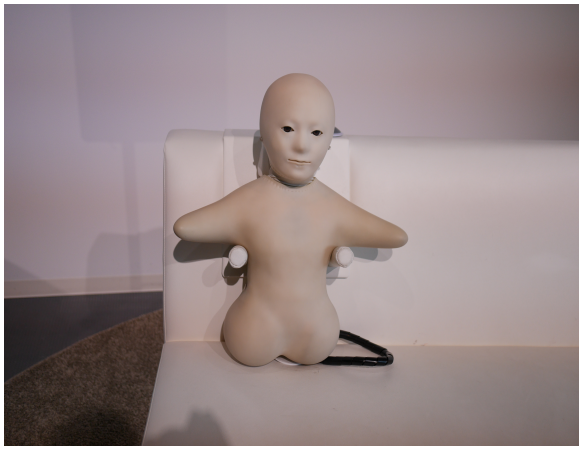
Roles of Social Robots: Persuasive Machine

- Robot as persuasive machine
  - Robot is used to change behavior, feelings, attitudes of humans.
  - Application: mediation of human-human interaction.
- ‘Pet therapy’ with Paro: Video
- Children with autism (Keepon): Video

Roles of Social Robots: Avatar

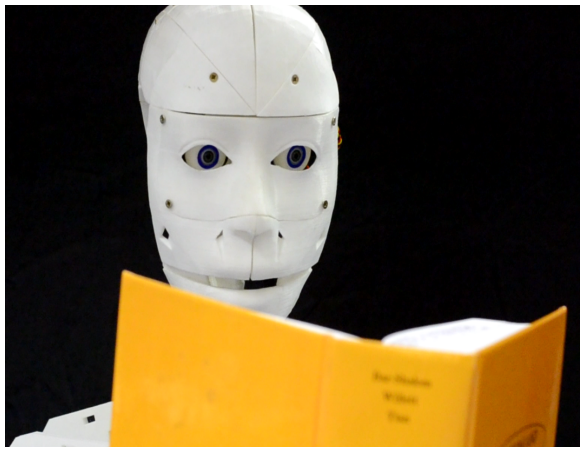
- Robot as avatar
  - Robot functions as representative for the human.
  - Application: Remote presence & communication.

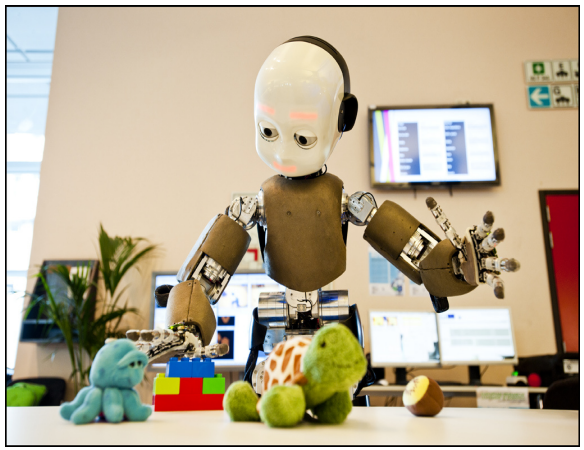
- Telenoid: Video



Roles of Social Robots: Research Platform

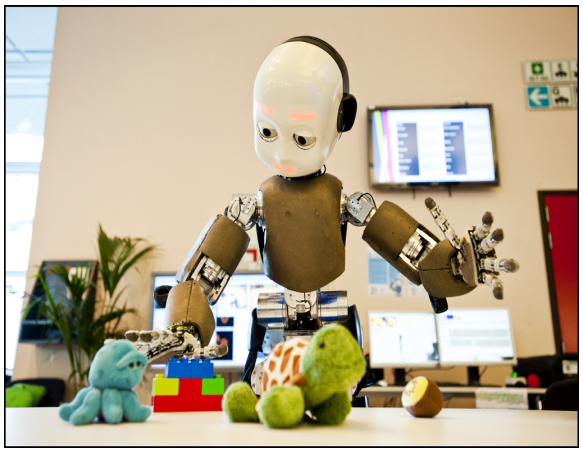
- Robot as research platform
  - Application: Study embodied models of social behavior.
- ‘Immanuel’ for studying human moral reasoning.
- ‘iCub’ for studying developmental psychology: Video





Design Space: Morphology: Anthropomorphic

- Anthropomorphism: Tendency to attribute human characteristics to non-human entities.
- Claim 1: Facilitates social interaction.
- Claim 2: Necessary for meaningful social interaction.
- Disadvantage (most of the times): Robot is expected to have human-like capacities.


Design Space: Morphology: Zoomorphic

- Robots designed like animals.
- Claim: Facilitates human-creature relationships (e.g., owner-pet).

Design Space: Morphology: Caricatured

- Animators have long shown that believable characters need not appear realistic.
- Pixar-like lamp ‘Pinokio’: Video
- Blossom: Video

Design Space: Morphology: Functional

- Design explicitly reflects task.
- Example: Autonomous car, robotic walker, roomba



Design Space: Behavior Modeling: Bio-inspired

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- Bio-inspiredness: Internal simulation or mimicry of social behavior found in living creatures.
- Claim 1: For a robot to be understandable by humans, it must act the same way living creatures do, and it must perceive the same things that humans find to be salient and relevant.
- Claim 2: Scientific theories can be tested using robots.

Design Space: Behavior Modeling: Functional Design

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- Functional Design: Robot's internal design has no basis in nature.
- Claim: To create social intelligence, it is not necessary to understand how human mind actually works. It is sufficient to descibe the mechanisms by which people in everyday life understand their social world.

Emotion modeling

- Three theories of (artificial) emotion
  1. Basic categories: happiness, anger, ...
  2. Continous Scales: Arousal and Valence
  3. Coponential: Both (1) and (2) necessary
- Purpose in social robotics
  - Facilitate believable human-robot interaction
  - Feedback to the user (e.g., robot's internal state)
  - Drive robot behavior (e.g., action selection)
- Communicating emotions
  - Speech: Loudness, pitch, prosody (stress, tempo etc.)
  - Facial expressions: dependent on the degrees of freedom, mechanic vs. animated, FACS
- Body language
  - Gaze, Body orientation, Walking motions
  - Video

Dialogue modeling

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- Communication between humans and robots
- Non-verbal: Body positioning, gesturing, gaze, ...
  - Signalling intent by actions
  - Signalling attention and comprehension (backchanneling)
- Natural language
  - Limited by the NLP techniques nowadays available. High robustness requirements.

Personality

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- Theories of personality and personality perception
  - Big Five: Extroversion (sociable), Agreeableness (friendliness), Conscientiousness (helpful), Neuroticism (emotional stability), Openness (intelligent, flexibility)
  - Warmth-Competence: Warmth, Competence (, Morality) (, Discomfort)
- Rationale
  - Claim 1: Robot personality gives users a way to understand robot behavior.
  - Claim 2: If a robot had a compelling personality, people would be more willing to interact with it.
- Conveyed by all the other aspects, i.e., morphology, emotions, way of communication etc.

Technical Challenge: Human-oriented Perception

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- People tracking
- Speech recognition
- Gesture recognition
- Face detection & recognition
- Facial expressions
- Gaze tracking

- In social robotics research, researchers often avoid the difficulties connected to perception by employing special experimental methods like Wizard-Of-Oz.

Technical Challenge: User Modeling

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- To enable a robot to behave socially, its behavior must take human behavior and preferences into account.
  - Helps robot to understand human behavior
  - Robot can adapt its behavior to human needs
- Approaches
  - Quantitative modeling: Use some metric to evaluate parameters to classify humans into subgroups.
  - Qualitative: Script-based, BDI, Cognitive architectures
- Social robotics research investigates human behavior and preferences in the first place. Feedback into actual user modeling (unfortunately) relatively rare.

Summary

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- Social robots can be characterized along the dimensions ‘Role’, ‘Behavior Modeling’, ‘Morphology’, ‘Emotion’, ‘Dialogue’, ‘Personality’
  - Which kind of robot for which application?
- Core technical challenges include human-oriented perception and user modeling
  - What do humans expect from a robot?
  - How do humans behave towards robots?

$\Rightarrow$We are in need of means to systematically analyse human expectations, preferences, and behavior towards social robots.
Next, we will learn about empirical research methods.