Social Robotics

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Introduction to Social Robotics

Definitions: Robot Centered

Fong, Nourbakhsh, Dautenhahn (2003)

Social robots are embodied agents that are part of a
heterogeneous group: a society of robots or humans. They are
able to recognize each other and engage in social interactions,
they possess histories (perceive and interpret the world in terms
of their own experience), and they explicitly communicate with
and learn from each other.

Bartneck, Forlizzi (2004)

A social robot is an autonomous or semi-autonomous robot that
interacts and communicates with humans by following the
behavioral norms expected by the people with whom the robot is
intended to interact.

Criticism (Seibt, 2016)[1]

The conceptual norms that govern the semantics of the verbs
highlighted—recognizing, engaging in social interactions,
perceiving, interpreting, communicating, learning, following a
norm —require that the subject of these verbs is aware, has
intentionality or the capacity of symbolic representation, and
understands what a norm is. Since robots—currently at
least—do not possess such capacities—at least not how they
are defined relative to our current conceptual norms—such
characterizations are strictly speaking false.

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[1] J. Seibt. "Integrative Social Robotics"—A New Method Paradigm to Solve the Description Problem And the Regulation Problem? In What Social Robots Can and Should Do—Proceedings of Robophilosophy 2016/TRANSOR 2016, IOS Press, pages 104–115, 2016.

Definitions: Human Centered

Breazeal (2003)

Augmenting such self-directed, creature-like behavior with the ability to communication with, cooperate with, and learn from people makes it almost impossible for one not to anthropomorphize them (i.e., attribute human or animal-like qualities). We refer to this class of autonomous robots as social robots, i.e., those that people apply a social model to in order to interact with and to understand.

Breazeal (2002)

We interact with [a sociable robot] as if it were a person, and ultimately as a friend.

Breazeal (2002)

Ideally, people will treat Kismet as if it were a socially aware creature with thoughts, intents, desires, and feelings. Believability is the goal. Realism is not necessary.

Criticism (Seibt, 2016)[2]

[...] the fictionalist interpretation of human-robot interactions collapses into what one might call the 'error account'. Social robots are items that humans mistakenly engage in since a social interaction, as we have understood this notion so far, requires the symmetric distribution of the capacity of understanding and following a norm.

[...] to treat something *as if* it were a person (a companion, a caregiver, a pet) is to take up the commitments that are attached to these social roles and treat it *as* a person (companion, caregiver, or pet).

(Analogy: One cannnot fake a promise without actually making that promise.)

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[2] J. Seibt. "Integrative Social Robotics"—A New Method Paradigm to Solve the Description Problem And the Regulation Problem? In What Social Robots Can and Should Do—Proceedings of Robophilosophy 2016/TRANSOR 2016, IOS Press, pages 104–115, 2016.

Definitions: Summary

- Current definitions of 'social robot'
  - Either, require robots to behave according to human norms (which may require too much from the robot)
  - Or, they only require robots to trigger human social behavior towards these robots (and may thus misprize what's really going on during interactions between robot and human)

Outlook

The following slides try to characterize social robots along seveal dimensions rather than defining the very notion of a social robot. The slides are based on:

Fong, T., Nourbaksh, I., Dautenhahn, K. (2003) A survey of socially interactive robots, Robotics and Autonomous Systems 42:143–166.

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.
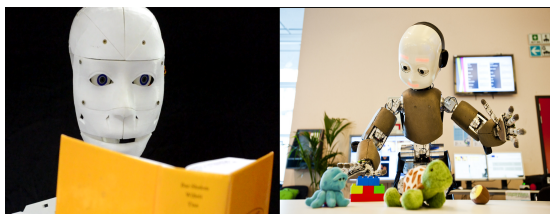
- Telenoid: Video

Roles of Social Robots: Research Platform

- Robot as research platform
  - Application: Study embodied models of social behavior.

- 'Immanuel' for studying human moral reasoning.

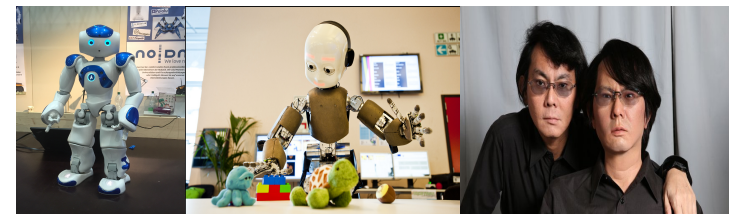- 'iCub' for studying developmental psychology: Video

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
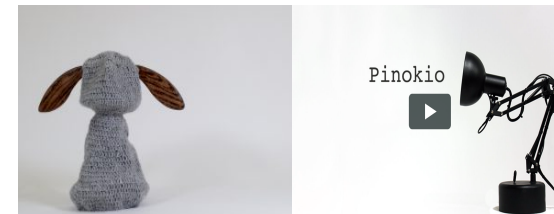
Design Space: Morphology: Functional

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

Design Space: Behavior Modeling: Bio-inspired

- 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

- 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

- 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

- 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

- 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

- 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

- Definitions of 'Social Robot' either require robots to follow humans' norms or humans to treat robots 'as if' they were persons.
  - What is a social robot?—Mainly a philosophical question.
- 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?

⇒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.