Socially interactive robots

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Outline

Socially interactive robots

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Socially interactive robots

Definition

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. ([Fong et al., 2003])
Classifying social robots

Robots can be classified according to

- how well the robot can support the social model that is assigned to it
- the complexity of the interaction scenario that can be supported
Classes of social robots - Part I

- socially evocative: encourage people to anthropomorphize
- social interface: natural interface which uses human-like social cues and communication modalities
- socially receptive: socially passive
- sociable: pro-actively engage with humans

these four originally from [Breazeal, 2003b]
Classes of social robots - Part II

- socially situated: surrounded by social environment which they perceive and react to
- socially embedded: interact with others in social environments, structurally coupled with environment, partially aware of human interactional structure
- socially intelligent: show aspects of human style social intelligence
Developing social robots

- embodiment
- recognition of interaction partners
- communication
  - natural language
  - gestures
  - facial expressions
- emotions
- learning and imitation
Human-oriented perception

- social robots must be able to perceive the world similar to humans
- track people, people’s gaze, human features
- identify people
- recognize facial expressions, gestures, human activity
- interpret speech
Emotions

- emotions are an important motivation system for complex organisms
- involved in determining reactions to internal and external events
- positive emotions
  - events that satisfy some motive
- negative emotions
  - painful / threatening situations
  - motivate to get things straight / prevent situations
Emotion theory

- **basic emotions:** anger, disgust, fear, joy, sorrow, surprise
- basic emotion has a function
- emotional development: refine emotions and acquire new
- emotions as a means of relevance-detection and response-preparation
Role of emotions in communication

- emotions influence voice, facial expressions, gestures and posture
- emotions can thereby be communicated
  - communicate feelings to others
  - influence other’s behaviour
Communication of emotions through facial expressions

picture is an adapted version from [Russel, 1997] by [Breazeal, 2003a]
Kismet

- [Breazeal, 2003a]
- anthropomorphic robot head
- engages people in face-to-face interaction reminiscent of parent-infant exchange
- inspired by infant social development, psychology, ethology, evolution
Kismet's hardware

- 21 degrees of freedom
  - robot's gaze: 3
  - orientation of head: 3
  - facial features (eyelids, eyebrows, lips, ears): 15
- 4 cameras: 2 narrow field of view, 2 wide field of view
- 2 microphones (1 per ear), 1 microphone worn by the person
- 15 processors
  - 9 for visual processing
  - 5 for emotional processing and "speech" synthesis

[Breazeal, 2003a]
Kismet’s abilities

- direct gaze towards objects / people
- track objects
- "recognise" human’s emotions through voice
- express emotions
  - "speech"
  - facial expressions
- act according to its drives and emotions
- react to external stimuli
Kismet’s emotional state

► long-term influence by drives
  ▶ social drive: be in presence of humans, interact with humans
  ▶ stimulation drive: interact with things (colorful toys)
  ▶ fatigue drive: shut out world after a certain time and "reset"
    drives and emotions

► short-term influence by emotions
  ▶ reaction to a certain condition like the need of an absent and
    desired stimulus
  ▶ triggers behaviour like seeking to explore the environment for
    the desired stimulus
A drive process

[Breazeal, 2003a]
Kismet's facial expressions

[Breazeal, 2003a]
Evaluation of expressive behaviour

- 47% to 83% (average: 70.9%) of the subjects recognised a facial expression from an image (random 10%)
- 57% to 86% (average: 77.6%) of the subjects recognised a facial expression from a video clip (random 14%)
- viewing movement of robot’s face and body strengthens recognition
Humans interacting with Kismet

- social cues help to tune human’s behaviour
- persons actively engage the robot without under-stimulating and without over-stimulating
- people were able to "interact" with Kismet and reacted according to Kismet’s (re)action
Outlook and summary

- a lot of different research fields involved in creating socially interactive robots
  - many problems in these fields not solved yet (speech recognition/synthesis, visual processing, ...) or not solved as good as humans can cope with these problems
- robots only capable of human-like social interaction in restricted scenarios
Literature


