

# Human-Robot Dialogues for Explaining Activities

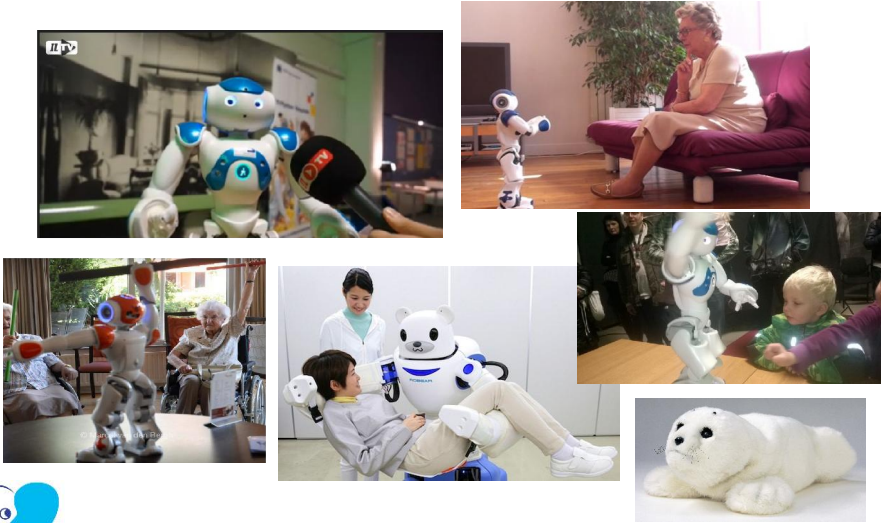
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IWSDS Singapore

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# Social Robots




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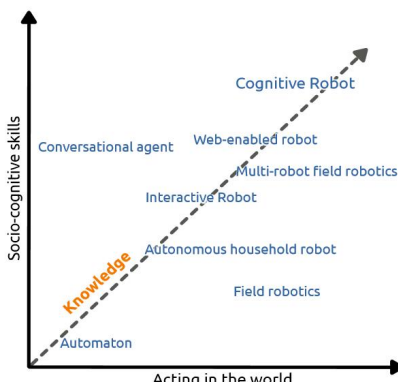
## Some projects

- Develop and explore innovate new paradigms, platforms and services especially for senior citizens
  - EU- project *Empathic*  
[http://cordis.europa.eu/project/rcn/212371\\_en.html](http://cordis.europa.eu/project/rcn/212371_en.html)
  - Japanese project *Robotic Devices for Nursing Care*
    - <http://robotcare.jp/?lang=en>
  - Finnish-Japanese project *Metese*
    - <http://www.vtt.fi/sites/METESE>
  -

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## Extending towards Interactive Cognitive Social Robots



The robot has knowledge and can represent

- objects and activities
- one's own mental state
- other agents' mental states
- surrounding world
- social norms and capabilities: ethics, agency, rationality, perspective taking
- communication skills

Lemaignan et al. 2016

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## AI Research Center

- The role of AI is not simply to improve operational efficiency or to lower costs.
- Rather, AI will also take on the role of improving the quality of services in various industries
  
- The “quality” of intelligence possessed by humans and AI is fundamentally different
  
- Future of AI can be considered the exploration of methods to combine the two types of intelligence in order to solve problems more effectively
  
- “We want to create a “space” for open innovation that connects industry, academia, and government together” (Jun-ichi Tsujii, director)





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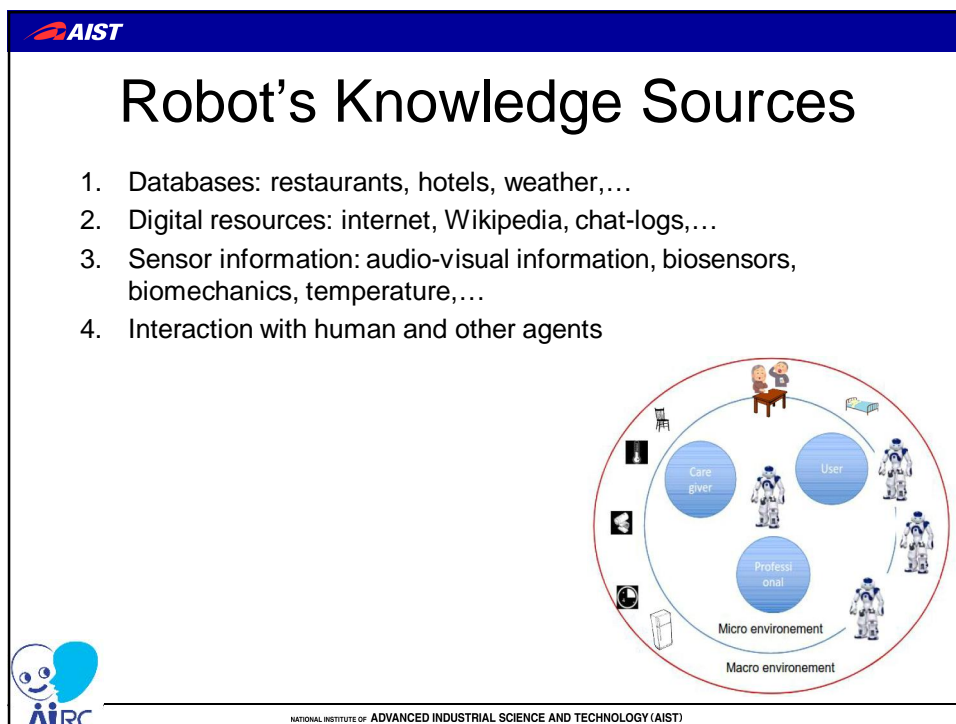
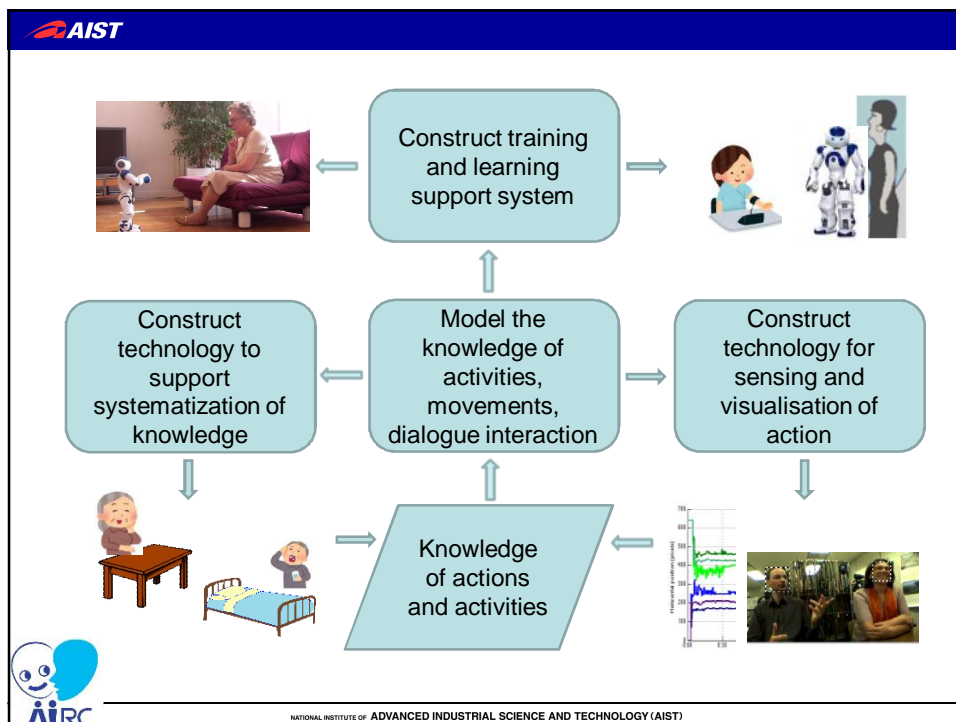


## Research Goals

- **Gathering and modelling of the knowledge** related to actions that underlie human activities
- **Modelling of interaction** that enables humans and social robots interact and communicate with each other in a natural and multimodal manner
- **Explore novel ways** in which social robots can be used to improve the quality of life of citizens, the quality of services in various industries, and create a community through shared tasks, and opportunities to learn and communicate.
  - possibilities for a social robot assisting a human care-taker



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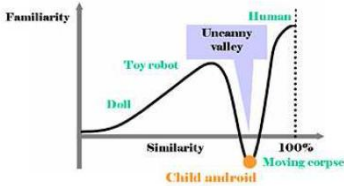
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## Socio-technical Systems

*Software agents operate as boundary-crossing agents that facilitate interaction and mutual intelligibility between the perspectives*

=>

*We need to find novel ways to interact with robots as cooperative agents*

Cf. Moore 2016

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## Situated Cognition

- Interactions are situated: they occur in a particular situation with a particular user in a particular context
  - the user can either look for structured information of how to do tasks or conduct unstructured searches through digital repositories
- Adaptation and integration of technologies into various service systems (Watanabe and Mochimaru 2017)
  - Impact of technology-assisted service systems on societal levels
- Robots have dual essence:
  - both as embodied agent and elaborated computer,
- Crossing of two fundamental approaches to knowledge management:
  - Either physically and experientially grounded, central, internal to the agent
  - Or ungrounded, distributed, pervasive


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## Knowledge Explication

- Ordinary tasks:
  - Care-taking services, training, teaching,...
- Knowledge about how to deal with various activities
  - work situation, elder care, education etc,
- Structure the human tacit knowledge into a systematic collection of non-tangible things
  - Make implicit knowledge explicit, available
- Robot explaining what it is doing
- Explaining knowledge:
  - Moore & Swartout (1988): Explanation in expert systems
  - Cawsey (1989): Explanatory Dialogues






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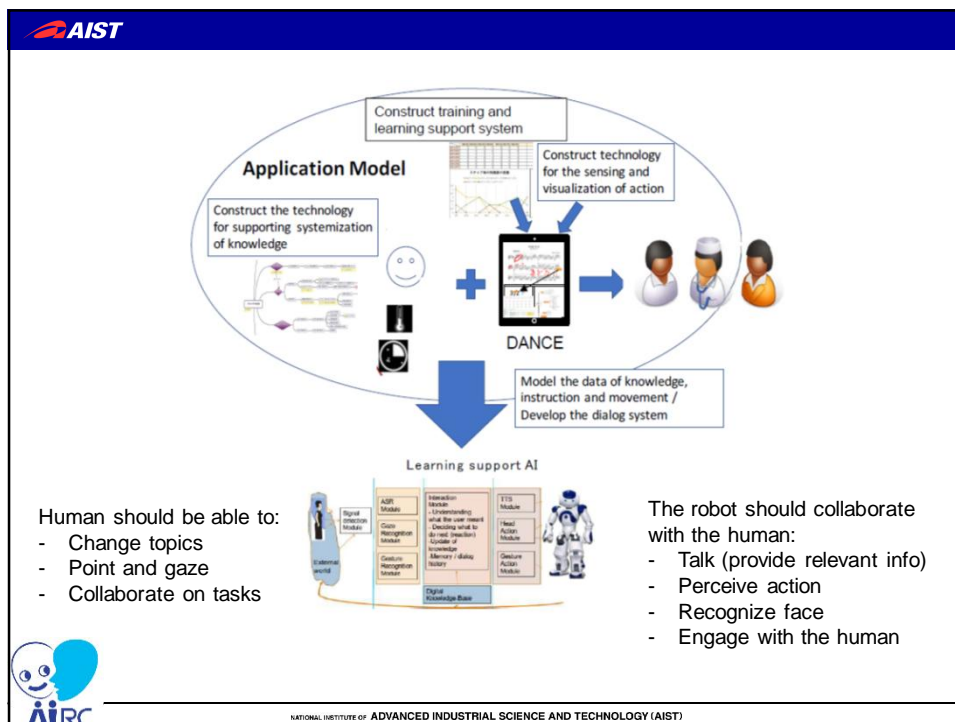
## Types of knowledge

- **Explicit** refers to the knowledge that the agent can explicate:
  - the agent is aware of possessing the knowledge and
  - has a representation for its verbalisation
- **Implicit** is a general term that refers to all non-explicit knowledge
  - the agent cannot explicate either because of not being aware of it or having no appropriate conceptual representation for it

		Conceptual representation	
		Yes	No
Agent's awareness	Yes	Explicit knowledge	Action-centred knowledge
	No	Tacit knowledge	Unknown knowledge



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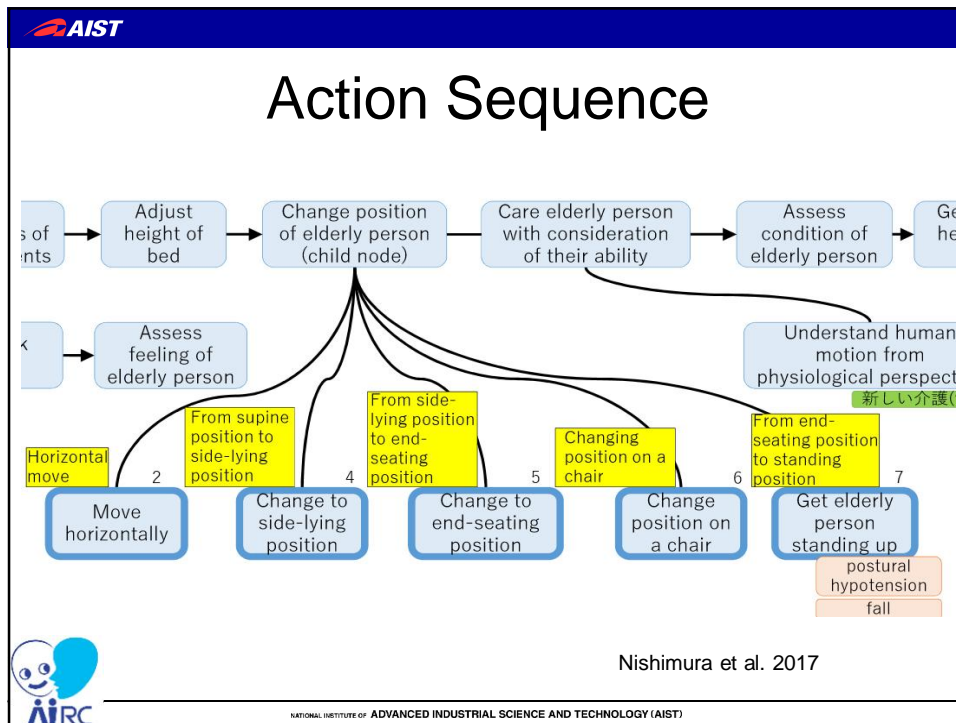
## Care support tasks

Care support	# of actions
Feeding	140
Oral care	170
Position change	197
Dressing	226
Moving	236
Transferring	247
Bathing	253
Excretion	277

- Each task considered as a goal, with a number of subactions relevant to reaching the goal
- Subtasks can be performed in the given order or they are commutable
- Altogether 1746 tasks and subtasks
- Stored in a json-type database

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- 
- Common-sense knowledge**
- What does it mean to change a person's position?
    - The robot needs to understand the partner and the situation:
      - Who is the person (identity)?
      - What is the person's physical condition? (pressure ulcer, pain, paralysis, shaking, ...)
      - What is the person's consciousness state? (dementia, wakefulness, mood, temper)
      - What are the person's communication skills? (can communicate, understand speech)
      - What is the person's history in the current state (how long has been lying in the bed)
      - Can the person lift up and stand up herself?
    - Access to a knowledge source, e.g. through
      - facts available at startup,
      - access to a web-based knowledge base like Wikipedia
      - sensors and automatic recognition (speech, face, movement, finger-prints; heart-rate, breathing, etc.)
    - Context



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## Human Aware Task Planner (HATP)

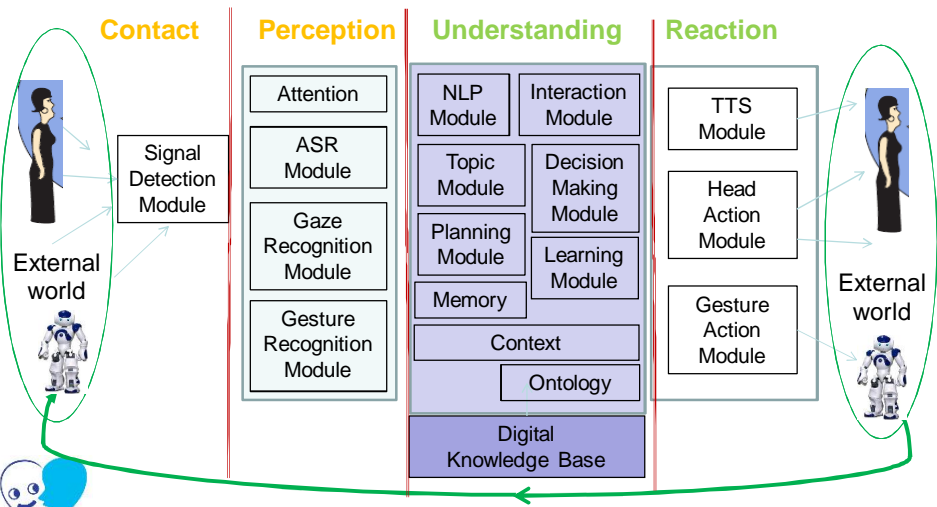
- Lemaignan et al. (2012)
- OpenRobot Ontology (based on OpenCYK)
- Symbolic task planner
  - converts long-term desires into a set of partially ordered elementary actions
- Extends the traditional Hierarchical Task Network to be more suitable to produce plans which involve humans and robots acting together toward a joint goal
- Robot can:
  - produce human-robot shared plans,
  - anticipate human action,
  - suggest a course of action to humans, or ask help from the human if needed

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## Symbolic CDM Architecture


Jokinen (2009), Jokinen & Wilcock (2014)

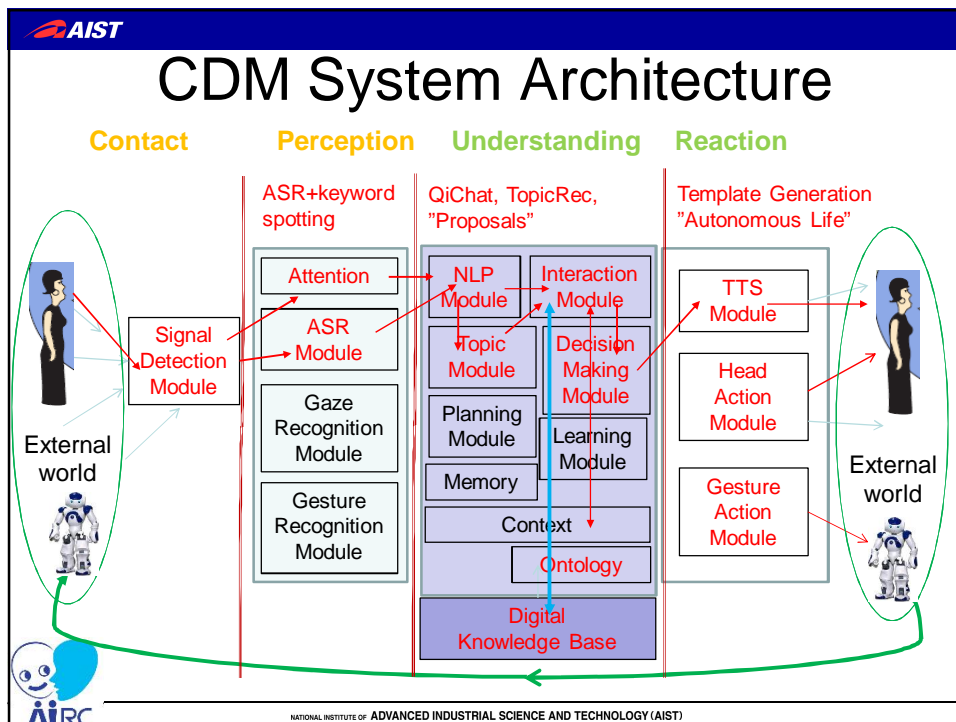
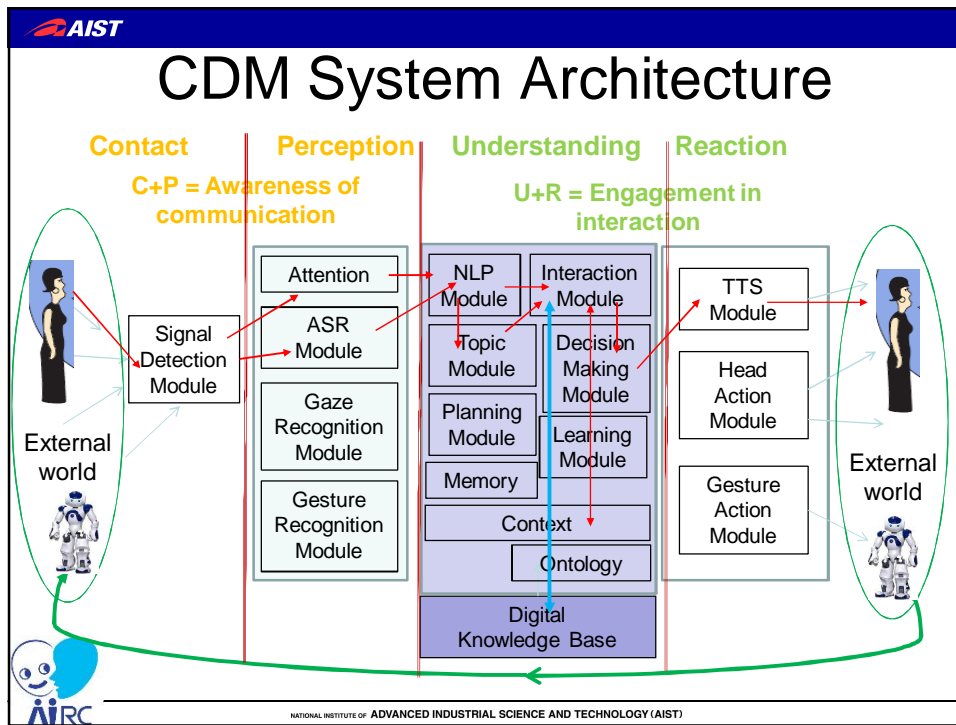


The diagram illustrates the Symbolic CDM Architecture, which is divided into four main stages: Contact, Perception, Understanding, and Reaction. The architecture is shown interacting with an 'External world' on both sides, represented by icons of a human and a robot.

- Contact:** Includes the Signal Detection Module.
- Perception:** Includes Attention, ASR Module, Gaze Recognition Module, and Gesture Recognition Module.
- Understanding:** Includes NLP Module, Interaction Module, Topic Module, Decision Making Module, Planning Module, Learning Module, Memory, Context, and Ontology. This stage is supported by a Digital Knowledge Base.
- Reaction:** Includes TTS Module, Head Action Module, and Gesture Action Module.


Arrows indicate the flow of information from the external world through these modules. A green arrow at the bottom points from the Reaction stage back to the Contact stage, suggesting a feedback loop.

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## Short Example Dialogue





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## Example Dialogue (training)

[user] Hello

[system] Hi Kristiina!

[user] What can you do for me?

[system] Well. You can ask me for instance how to change a position of a patient, or what is their condition. How can I help you?

[user] Well I would need some help to move a patient.

[system] Ok, let me instruct you how to change the person's position. Would you like general or step-wise instructions?

[user] Step-wise please

[system] Ok, I'll go for step-wise instructions. There are 5 steps. First, move the person sideways. If you are ready, please say next.

[user] Next

[system] Ok, then lift the person up.


[user] Next

[system] Check if the person sits properly and feels good. Does the person seem to be fine?

[user] Just a minute please. The person is sitting properly and seems to be fine

[system] Ok, very good. Then we are done.

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## Social Robots Require Situational Awareness

Knowledge of what is going on around the agent  
(cf. Endsley, 2000, Jokinen 2009)

Depends on:

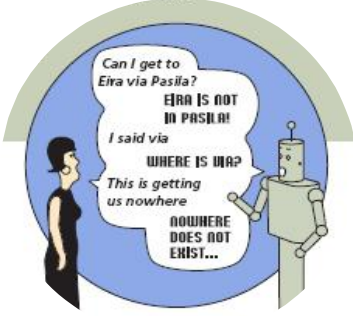
- Level of the robot's autonomous behaviour
- The role of the human in the situation
- Particular activity the partners are engaged in

Feedback:

- Communicate the awareness to the partner
- Signals to indicate the interlocutors' intention, engagement, attention to the partner's communicative needs

Listen to the user

- Speech understanding, interest level, attention



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## Challenges for HRI

- Human and robot collaborate in the same situation
  - Joint task, collaboration and cooperation
  - Inferences and reasoning
  - "The three reports are inconsistent"
- Theory of Mind
  - Perspective taking: model of the partner's knowledge
    - robot knows that the care-taker needs the information but the care-taker does not know it
  - Grounding of information
- Situational Awareness
  - Listen to the human
- Location, distance
  - "next to me", "behind you", "is reachable"
- Social norms and habits
- Robot learning from demonstration (LfD)
- Ethical issues


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## Future Work

1. Robots and human attention
  - Eye-gaze patterns with social robots (LREC 2018)
  - How long the human participants wait before taking a turn, repeat a command in misunderstanding situation
  - When do they lose visual attention and interest in the robot
2. Social robots and human interaction
  - Presentation of information
  - Topic management in robot's story telling
  - Adaptation to users, languages, different cultures (localisation, internationalisation)
3. Social robots and knowledge
  - Focus on daily activities, behavioural aspects
  - Interaction across the domains (using ontology for relevant concepts, and abstractions)




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## Take home messages

1. **Robots** have dual essence:
  - **Computers** with unlimited access to remote sources of knowledge (Web, database, other agents)
  - **Agents** that act in the physical world
2. They need to talk to their human partners -> **social interaction**
3. To talk about the necessary activities requires **knowledge explication**
  - **Structure the human (tacit) knowledge** into a systematic collection
  - **Awareness** of the context is crucial

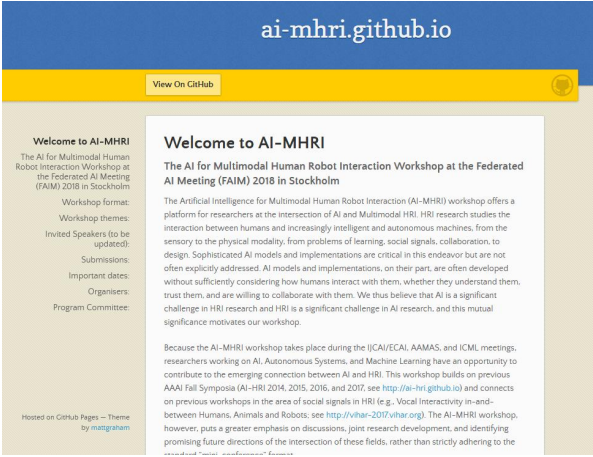


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# AI and Multimodal HRI


- Deadline May 14 + extension for 2-page extended abstracts
- IJCAI-ECAI
- Stockholm
- July 14-15, 2018




The screenshot shows the website [ai-mhri.github.io](http://ai-mhri.github.io). It features a blue header with the URL and a yellow navigation bar with a 'View On GitHub' button. The main content area is divided into two columns. The left column contains a 'Welcome to AI-MHRI' section with details about the workshop format, invited speakers, submissions, important dates, organizers, and the program committee. The right column contains a 'Welcome to AI-MHRI' section with a detailed description of the workshop's purpose and its connection to previous AAAI Fall Symposia (AI-HRI 2014, 2015, 2016, and 2017). At the bottom of the screenshot, it says 'Hosted on GitHub Pages — Theme by matgraham'.



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# Thank you!



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