

**Keynote**  
**Robots by our side—  
interacting with the  
robots amongst us**

**Dr. Iina Aaltonen**  
**February 26<sup>th</sup>, 2019**  
**ACHI 2019**  
**Athens, Greece**

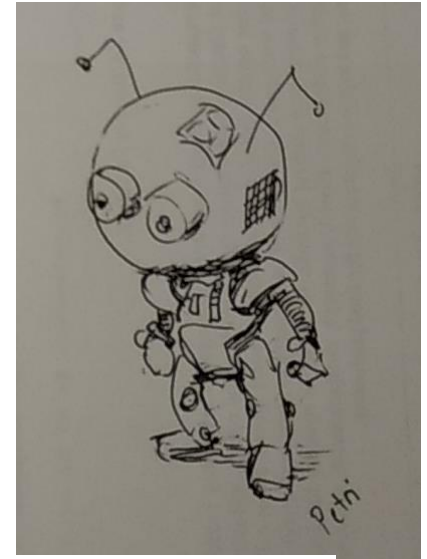
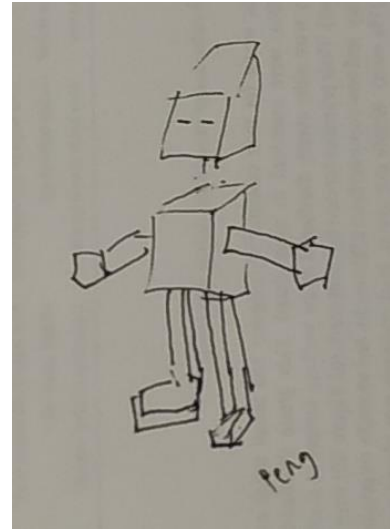
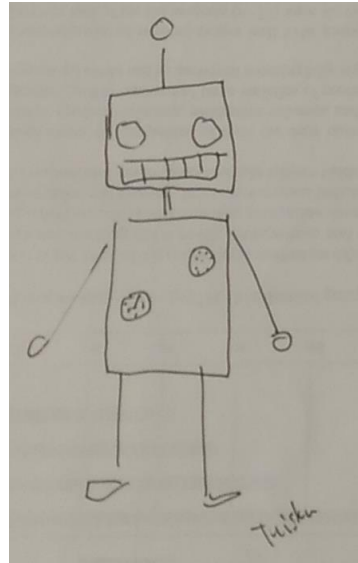
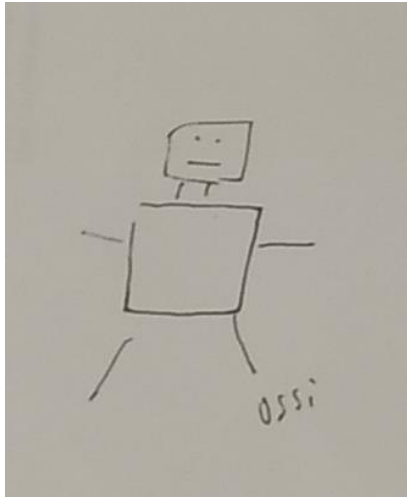
# First, I want you to think about a robot

- Picture the robot in your mind
- You can close your eyes if you want to
- Now, does everybody have a picture of a robot in their mind?

# What does your robot look like?

- Please keep the image of your robot in your mind
- Next, I'm going to show you some pictures that my (random) colleagues drew

# Please raise your hand, if your robot was anywhere close to one of these



However, these are not really the kind of robots that you can expect to interact with in your everyday lives in the near future (unless they are toys)

# Brief introduction

# Who am I?

## Ilina Aaltonen

- Human factors researcher
  - Specialized on robotics and emerging technologies
  - Human-robot interaction studies with industrial, collaborative, social and teleoperated robots
- Research Scientist at VTT Technical Research Centre of Finland Ltd
- D.Sci. (Tech.) in Cognitive Science, Aalto University, Finland



# VTT – beyond the obvious

VTT is one of the leading research, development and innovation organizations in Europe. We help our customers and society to grow and renew through applied research. The business sector and the entire society get the best benefit from VTT when we solve challenges that require world-class know-how together and translate them into business opportunities.

## Our vision

A brighter future is created through science-based innovations.

## Our mission

Customers and society grow and renew through applied research.

## Strategy

Impact through scientific and technological excellence.

Established in

**1942**

Owned by

Ministry of  
Economic  
Affairs and  
Employment

**258 M€**

Net turnover and  
other operating  
income (VTT  
Group 2017)

**2,368**

Total of personnel  
(VTT Group  
31.12.2017)

**27%**

Doctorates and  
Licentiatees  
(VTT Group  
2017)

**36%**

Net turnover  
from abroad  
(VTT Group  
2017)

# Opportunities in the world of huge challenges





# Some definitions

# What is a robot?

- Some standard definitions
  - An (industrial) robot is an “actuated mechanism programmable in two or more axes with a degree of autonomy moving within its environment, to perform intended tasks” (ISO 13482)
  - A service robot is a “robot that performs useful tasks for humans or equipment excluding industrial automation applications (ISO 13482)
- The distinction to industrial and service robots is quite vague and not very practical
  - Other features that are used to distinguish robots include appearance, mobility, level of autonomy, application area etc.

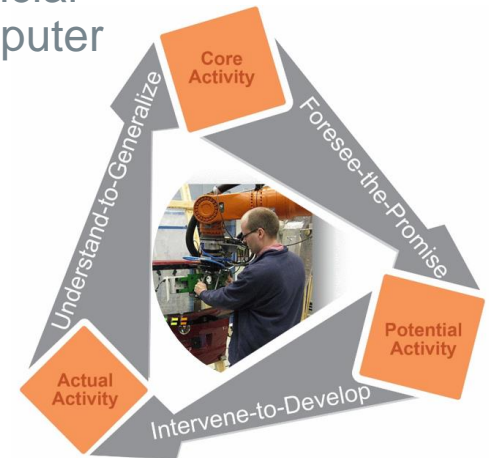
# What is a robot? (simplified)

My simplified definition:

- A robot *physically acts* on its environment based on its *programming* and the *sensory feedback* it receives from its environment and/or its users
  - A robot can learn but it is not a requirement -> an artificial intelligence agent is not a robot if it's not a physical entity interacting with the real world
  - The user can be many things, an operator, a supervisor, a co-worker, a passerby, any human -> one word does not cover all roles

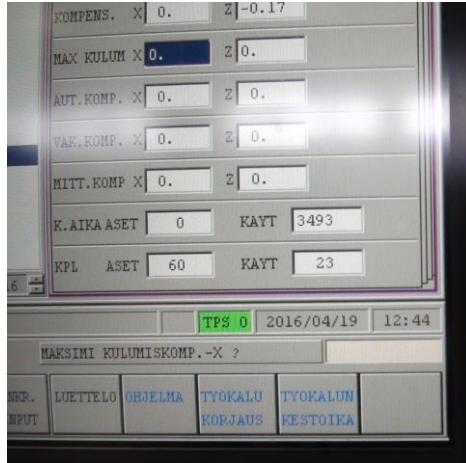
# Human–Robot Interaction (HRI)

- HRI is “a field of study dedicated to understanding, designing, and evaluating robotic systems for use by or with humans.” (Goodrich & Schultz, 2007)
- Multidisciplinary field including robotics, teleoperation, artificial intelligence, natural language, human factors, human-computer interaction, psychology and cognitive sciences.
- Research questions
  - What is good human-robot interaction?
  - How to design HRI in a user-centred manner?
  - How to measure human-robot interaction?



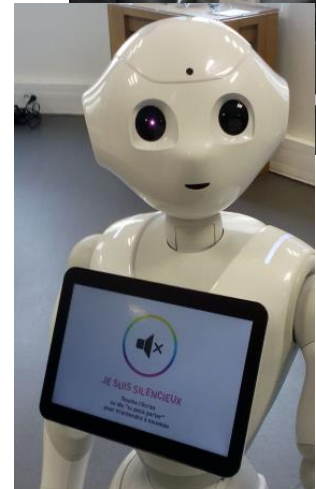
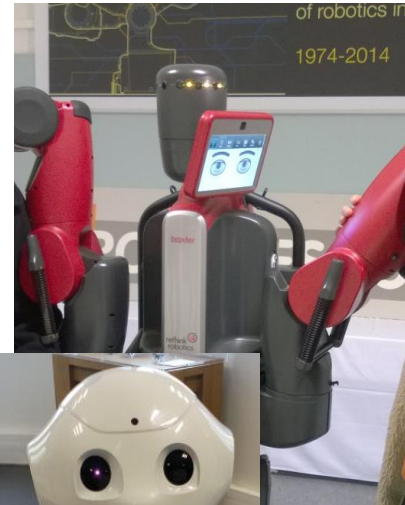
# The traditional way of interacting with robots

- Traditional means to communicate with robots
  - Text-based or graphical user interfaces



## New ways of interacting with robots

- Natural language and speech control
- Multimodal interaction can be more than language
  - A combination of control panels, displays, speech, robot's physical parts (body, face, hands, arms)
- Social elements include gestures, facial expressions, emotions, imitation, sounds etc.
- Humans and robots share the same physical space



# Interacting with the robots amongst us

# Robots amongst us

- The main idea of this keynote is to introduce you different kinds of robots that you can expect to meet and interact with in the near future
- This presentation is about interacting with robots
  - In factories
  - In care contexts
  - At home
  - In public spaces

Today's talk is not going to go deep into societal changes influenced by robotics (e.g., losing jobs), artificial intelligence, and autonomous vehicles, which are currently hot topics.



# In factories

# Have you ever used or do you currently use a robot at work?

- Those of you who answer yes, please raise your hand
- In Europe, according to the Special Eurobarometer “Attitudes towards the impact of digitisation and automation on daily life”, in 2017

**6 %** of Europeans had used a robot at work.

# Interacting with fenced industrial robots

- Currently, most robots in industrial environments are isolated from human workers with cages
- The robots are controlled using traditional interfaces and the robots are stopped when workers enter the cage
  - The robots work autonomously, although it is possible for the workers to use a dead man's switch to run the robot manually

# Big robots adapting to humans (video)



Symbiotic project, [symbiotic-project.eu](http://symbiotic-project.eu)

T. Salmi, O. Väättäinen, T. Malm, J. Montonen, I. Marstio, Meeting New Challenges and Possibilities with Modern Robot Safety Technologies, in: M.F. Zaeh (Ed.), CARV 2013, Munich, Germany, 2013: pp. 183–188.

# Shoulder-to-shoulder work with fenceless collaborative robots



# Interacting with collaborative robots

- Human workers can touch the robots
  - To program them by demonstration
  - To stop the robot or give other commands
- The robots are allowed to bump humans
  - Safety issues are complex
- Collaboration at different levels
  - New ways of allocating tasks between human workers and robots is a future research topic

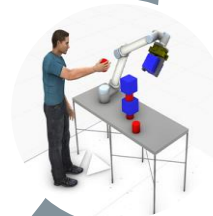


No coexistence



Coexistence

- ✓ Shared space



Cooperation

- ✓ Shared space
- ✓ Shared goal or object



Collaboration

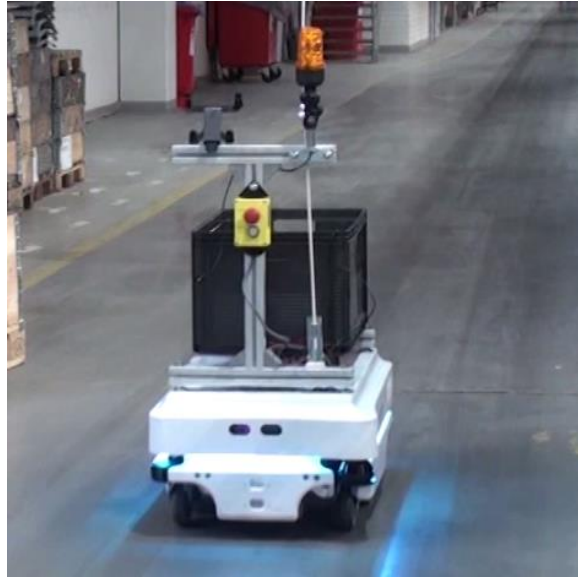
- ✓ Shared space and object
- ✓ Simultaneous work

## Gesture-control of a collaborative robot (video)



Cognitive Cooperative Robotics (CCR) project by VTT and Aalto University, partially funded by Finnish Funding Agency for Technology and Innovation and participating companies

# Logistics robots in factories (video)

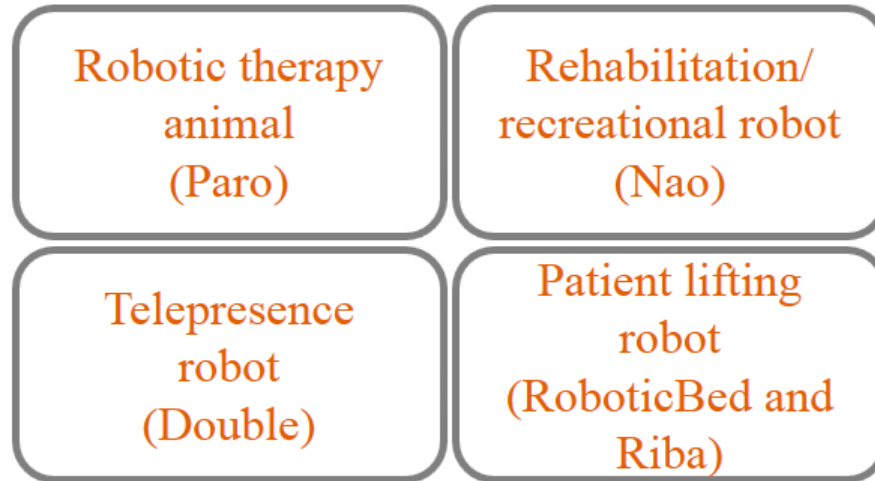


Robolog project (VTT, funded by Finnish Funding Agency for Technology and Innovation)



# In care contexts

# Nursing personnel's HRI experiences in the care context



We have a presentation in the ACHI9 session:

I. Aaltonen, T. Turja, M. Niemelä, Comparison of Nursing Personnel's User Experiences of Four Types of Assistive Robots: Challenges Include Knowledge and Safety Issues

## Logistics for care (video)

- Food delivery by a logistics robot to the residents' rooms in a care facility  
<https://www.youtube.com/watch?v=Gwy0HvcaE9Y>
- See also supply delivery:  
[https://www.youtube.com/watch?v=Uny\\_bVMdrFc](https://www.youtube.com/watch?v=Uny_bVMdrFc)



ROSE research project (Robots and the Future of Welfare Services)

<http://roseproject.aalto.fi/en/>

Funded by the Strategic Research Council at the Academy of Finland

# Exoskeletons for lifting patients

- LinkedIn post by Duncan Treffers 2/2019
- <https://www.linkedin.com/feed/update/urn:li:activity:6501383432889729024>

ROSE research project (Robots and the Future of Welfare Services)  
<http://roseproject.aalto.fi/en/>  
Funded by the Strategic Research Council at the Academy of Finland



# At home

# In your opinion, in Europe, when it will become commonplace for robots to do house work?

- Let's raise hands when I call for an option

(4 %) • It's already commonplace

(8 %) • In 5 years' time

(22 %) • In 10 years' time

(21 %) • In 20 years' time

(37 %) • Longer or never

(The parentheses show the percentages for Europeans' opinions in 2012 - Eurobarometer on Public Attitudes towards Robots)

# Have you ever used or do you currently use a robot at home?

- Those of you who answer yes, please raise your hand
- In Europe, according to the Special Eurobarometer “Attitudes towards the impact of digitisation and automation on daily life”, in 2017

**9 %** of Europeans had used a robot at home.

# Housework robots

- Besides robots that can be used for helping with the elderly and the disabled, many of you might have encountered vacuum robots such as the Roomba
- Interaction with these robots is quite passive
  - Most of these robots bump into walls and change direction randomly, and they may have some sensors to prevent them from falling down stairs
  - More advanced versions can be pre-programmed and you can set virtual barriers that delimit their operating range



## Two Roombas vacuuming (video)



# In public spaces

# Have you ever used or do you currently use a robot elsewhere than at home or at work?

- Those of you who answer yes, please raise your hand
- In Europe, according to the Special Eurobarometer “Attitudes towards the impact of digitisation and automation on daily life”, in 2017

**14 %** of Europeans had used a robot elsewhere.

## Room service at a hotel (video)



Redwood City Holiday Inn Express  
Video by Tommi Keränen

## Shopping mall info desk (video)

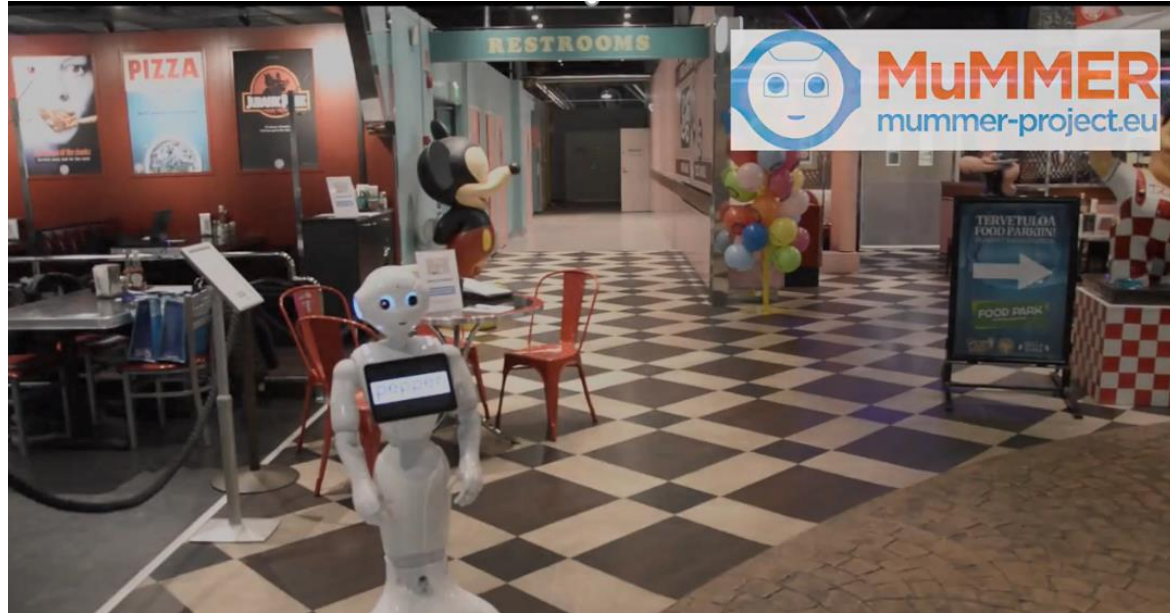
- Magokoroid robot at the Aqua City mall in Tokyo in 2018
- The robot tells about shops and train schedules
- The robot speaks, looks around and makes gestures, but does not understand speech
  - A hologram interface is used for asking the information



# Pepper the butler (video)

MuMMER (MultiModal Mall Entertainment Robot, <http://mummer-project.eu/>) is a four-year, EU-funded project with the goal of developing a robot (based on Pepper platform) that can interact in a public shopping mall, providing an engaging and entertaining experience to the general public.

VTT's role includes human-driven design and user experience research.



See, e.g., I. Aaltonen, A. Arvola, P. Heikkilä, H. Lammi, Hello Pepper, May I Tickle You? Children's and Adults' Responses to an Entertainment Robot at a Shopping Mall, in: Proceedings of the Companion of the 2017 ACM/IEEE International Conference on Human-Robot Interaction - HRI '17, ACM, Vienna, Austria, 2017: pp. 53–54.

# Conclusions and future research interests

# Conclusions

- Interaction with robots in our society will take many different forms
  - You can observe robots passing by you
  - You may speak to them and ask for guidance
  - You may encounter them at your work and maybe program them to do something or even wear them
  - The robots may entertain you or your children or they may deliver goods for you
- I hope this presentation gave you a possibility to reflect how your own life might be affected by robots in the coming years
  - Having more knowledge about robots will also make it easier to keep an open mind and to seek new possibilities for HRI



# Future research interests for HRI

- In factories
  - Design and evaluate new ways of allocating work between humans and collaborative robots, also with mobile collaborative robots
- In the care context at home or care facilities
  - Train the care personnel to understand HRI and support them in keeping an open mind on what robotics could bring to their work
    - (We have a paper on nursing personnel's experiences in the ACHI 9 session)
- In public spaces
  - Co-design robot's tasks and behaviour together with the general public to ensure they are usable and can gain the general acceptance



**Let's venture  
beyond the obvious**