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Interactions with Social Robots
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# Challenges and Opportunities for
Digital Companions

LITHME Cost Action Seminar
October 20, 2021

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and

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University of Tartu, Estonia

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About me…

- Background
  - BSc Physics and Mathematics, University of Helsinki
  - MA Linguistics and Psychology, University of Helsinki
  - PhD Computational Linguistics, University of Manchester
    Thesis: *Response Generation in Information-seeking Dialogues*

  - Post-doc (JSPS) at NAIST and Invited Researcher at ATR, Japan
  - Research fellowships at Cambridge, Stanford, Doshisha
  - Life Member of Clare Hall, Cambridge
  - Project Director and Adjunct Professor of Language Technology, University of Helsinki
  - Extraordinary Professor of Intelligent Interfaces, University of Tartu

- Current position
  - Senior Researcher, AI Research Center, National Institute for Advanced Industrial Science and Technology (AIST) Tokyo Waterfront
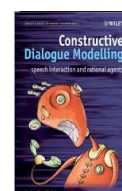
WikiTalk
Jokinen and Wilcock
2012-2017

AI Research Center (AIRC)
AIST Tokyo Waterfront

Energy and Environment

Life Science and Biotechnology

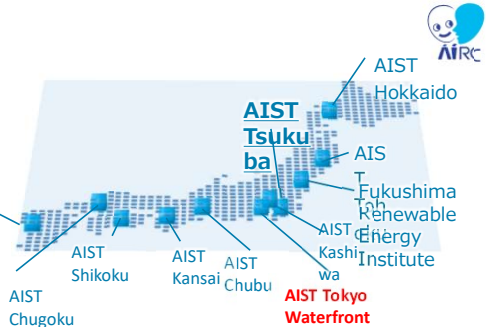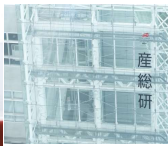Information Technology and Human Factors

Materials and Chemistry

Electronics and Manufacturing

Geological Survey of Japan

AIST Kyushu
National Metrology Institute of Japan

AIST Hokkaido

AIST Tsukuba

AIST Fukushima Renewable Energy Institute

AIST Tohoku

AIST Kashiwa

AIST Chubu

AIST Kansai

AIST Shikoku

AIST Chugoku

AIST Tokyo Waterfront

http://www.airc.aist.go.jp/en/

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.

Exploration of methods to combine the two types of intelligence in order to solve problems more effectively, and improve the quality of services and life in general

- AI that can be embedded in the real world
- AI that solves problems through cooperation with humans
- AI that can explain things.

Rapid development of robot technology

⇒ Natural interaction with humanoid robots has become important

⇒ However, natural communication still difficult

⇒ Technical aspects related to integration of various devices

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Talk structure

- Social robots
  - Characteristics
  - Examples
- Applications for everyday life
  - Coaching for elderly (e-VITA)
  - Long term interaction
  - Challenges
- Digital Future for All
  - Sustainability

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Situated Communicative Agents

- Industrial robots
- Service robots

Social Robots

- Engage you in interaction
- Communicate with you using Natural Language
- Observe your behaviour to react proactively
- Affect, cooperation
- Autonomous decisions what to do next
- Move Independently in the environment

Dual characteristics of social robots

- Robot as a computer
  - Elaborated processing capability
  - Mobility / accurate movement
  - Can receive and share information from Internet
- Robot as an agent
  - Dialogue capability
  - Ability to observe the environment

Human-Robot Dialogues

- Nao, Pepper (Softbank)
- Furhat (Furhat Robotics)
- Android ERICA (Ishiguro et al. 2012; Kawahara et al. 2017)
- WikiTalk, MoroTalk, SamiTalk (Wilcock and Jokinen 2013)
- Intelligent speakers – chat-bots

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In use...

- Sushi Restaurants
- Department Stores
- Bank assistants
- Hotel receptionists

AquaCity Shopping
Centre in Odaiba
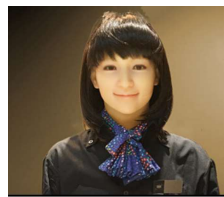
Exciting customer service
by robots!
Henna Hotel website

Welcome to a restaurant
in Central Tokyo

Hamazushi sushi
restaurant assistant

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Finnish, Japanese & English WikiTalk

The robot gets information about Shakespeare
directly from Wikipedia via its wifi network

G. Wilcock, K. Jokinen, *Multilingual WikiTalk: Wikipedia-based talking robots that switch languages,* SIGDIAL 2015

Would you like an expensive, medium,
or cheap hotel?

ERICA gets the information about
Artifical Intelligence from Wikipedia.

D. Lala, G. Wilcock, K. Jokinen, T. Kawahara
ERICA and WikiTalk, IJCAI 2019
(https://www.youtube.com/watch?v=Aq4Rfwrktr0)
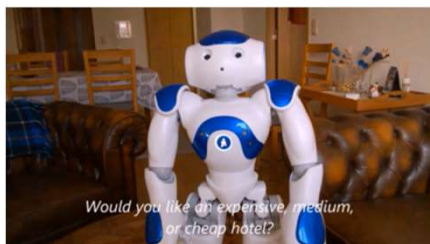
G. Wilcock, *CityTalk: Robots that talk to tourists and can switch domains during the dialogue,* IWSDS 2018
(https://www.youtube.com/watch?v=OhjIJp8XBEA)

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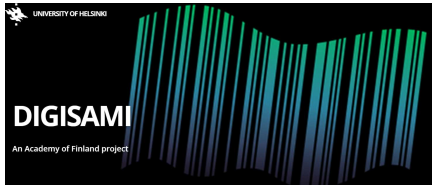
SamiTalk for endangered languages: DigiSami Project

Video: http://www.helsinki.fi/digisami/#samitalk

Website: https://blogs.helsinki.fi/digisami-project/

The robot is speaking North Sami, the most widely-spoken Sami language.

DIGISAMI
An Academy of Finland project

- Academy of Finland project 2014-2017
  - Included Finland-Hungary collaboration with Prof. T. Varadi (Hungarian Academy of Sciences)
- Support for revitalisation of smaller Fenno-Ugric languages
  - Using modern corpus linguistics methodologies and latest speech and language technologies (Wikipedia)
- First annotated spoken dialogue corpus on North Sami
  - Jokinen (2018): *Researching Less-Resourced Languages – the DigiSami Corpus.* LREC-2018. https://aclanthology.org/L18-1534.pdf
- A prototype to demonstrate SamiTalk was the world's first Sami-speaking robot.
  - Jokinen, Hiovain, Laxström, Rauhala, Wilcock (2016). *DigiSami and Digital Natives: Interaction Technology for the North Sami language*, IWSDS 2016 https://blogs.helsinki.fi/digisami-project/files/2020/02/ds-it.pdf

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Ainu speech and language technology

- Ainu is critically endangered unwritten language, spoken by the Ainu people, the native inhabitants of northern parts of the Japanese archipelago
- Language tools
  - Karol Nowakowski, Michal Ptaszynski and Fumito Masui (2021): Towards Better Text Processing Tools for the Ainu Language https://link.springer.com/chapter/10.1007/978-3-030-66527-2_10
- Ainu and robots:
  - Karol Nowakowski, Michal Ptaszynski and Fumito Masui (2021): Spicing up the Game for Underresourced Language Learning: Preliminary Experiments with Ainu Language-speaking Pepper Robot. IJCAI-2021 workshop ROBOT-DIAL
- Speech corpus for Ainu Folklore
  - Matsuura, Ueno, Kawahara (2020), LREC: https://www.semanticscholar.org/paper/Speech-Corpus-of-Ainu-Folklore-and-End-to-end-for-Matsuura-Ueno/40f092da7f5d628ba9a9e5aabbaef7f7588f0941
- End-to-end Speech Recognition for Ainu Language
  - Kawahara, T. (2021) https://www.youtube.com/watch?v=Ockx4v452Ds

Wikipedia: Ainu language. Pictue of a road sign in Japanese, Ainu (katakana transcription), English, Korean, Chinese
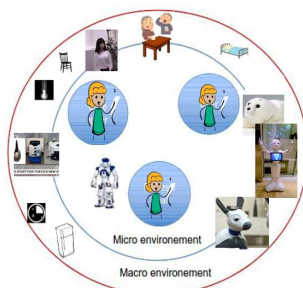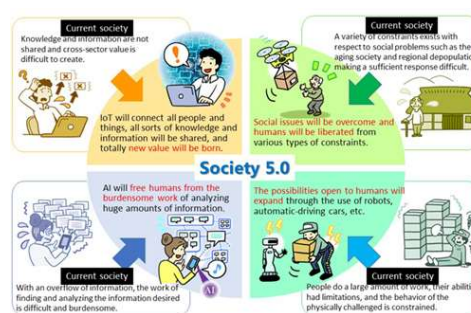
Talk structure

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- Digital Future for All
  - Sustainability

Applications for everyday life

- Society 5.0
  - Proposed in the Japanese 5th Science and Technology Basic Plan as a future society
  - "A human-centered society that balances economic advancement with the resolution of social problems by a system that highly integrates cyberspace and physical space."
- Assistive robotics
- Active Healthy Ageing
- Social robotics and conversational interactions
  - Explain tasks and actions
  - Talk about experiences
  - Learn new knowledge

https://www8.cao.go.jp/cstp/english/society5_0/index.html

Jokinen, K. (2018). Dialogue Models for Socially Intelligent Robots. 10th International Conference on Social Robotics (ICSR), Qingdao, China.

Some projects at AIST

- Develop and explore innovate new paradigms, platforms and services, especially for senior citizens
  - NEDO Future AI and Robot Technology Research and Development Project (2015-2020)
    - Develop core technology for next generation artificial intelligence and robotics, and on "social implementation
  - AASD: AI Assisted Systems Design
  - METI/AMED Project to promote development and introduction of robotic devices for nursing care: *Robotic Devices for Nursing Care (2013-2017)*
  - E-VITA (2021-2023)
    - A European (H2020) and Japanese (MIC) funded project on Smart Living Support for the Ageing Society
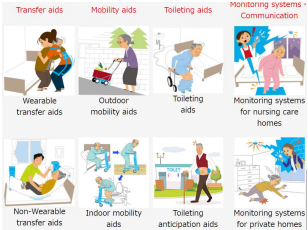
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Some H2020 projects in Europe

- EMPATHIC - Empathic, Expressive, Advanced Virtual Coach to Improve Independent Healthy-Life-Years of the Elderly
  - https://www.empathic-project.eu/
- NESTORE - Novel Empowering Solutions and Technologies for Older people to Retain Everyday life activities
  - https://nestore-coach.eu/home
- CAPTAIN - Coach Assistant via Projected and Tangible Interface
  - https://www.captain-eu.org/
- SAAM - Supporting Active Ageing Through Multimodal Coaching
  - https://www.saam2020.eu/
- CARESSES (Culture Aware Robots and Environmental Sensor Systems for Elderly Support)
  - addressed how robots can be culturally aware and answer user specific needs in the user's connected environment by managing sensor equipment
  - funded by MIC (Japan) and EU

https://www.e-vita.coach/
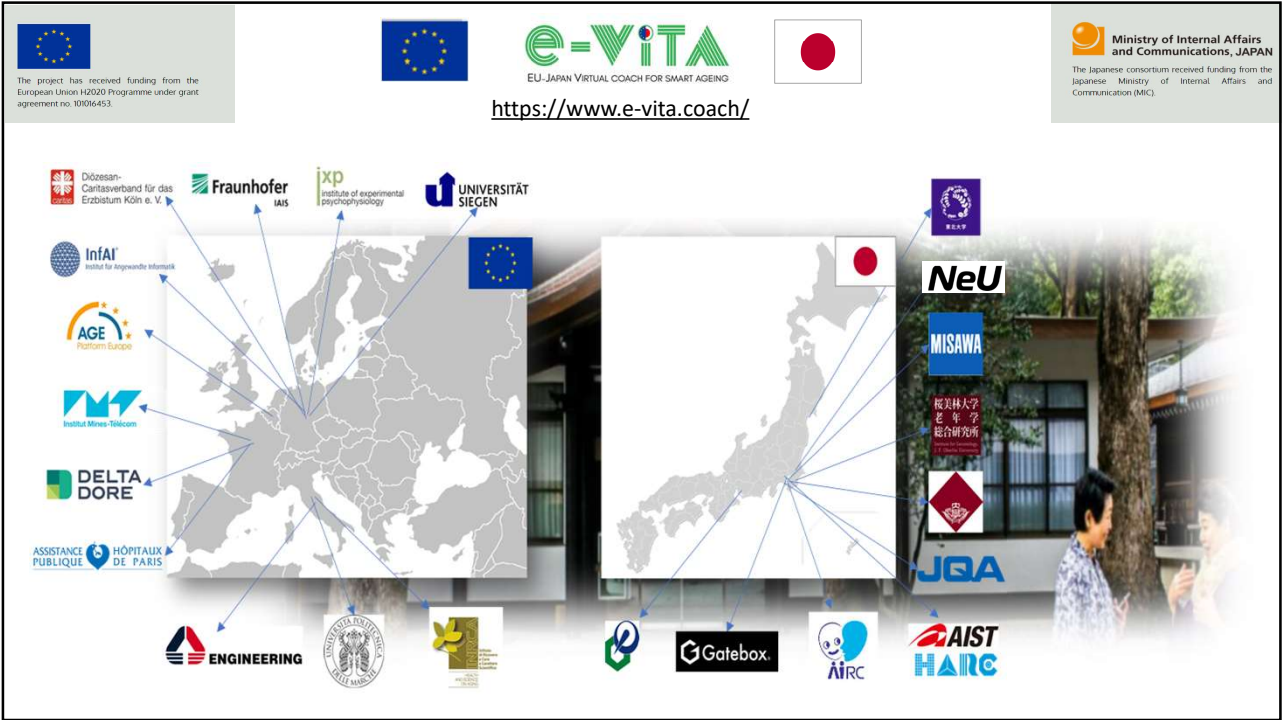
Virtual Coaching

Coaching: to support people's learning, growth, wellness, self-awareness, career management and behavioural change

e-coaching system (Kamphorst, 2017):

"a set of computerized components that constitutes an **artificial entity** that can **observe reason about learn from** and **predict a user's behaviors**, in context and over time, and that **engages proactively in an ongoing collaborative conversation with the user** in order to aid planning and promote effective goal striving through the use of persuasive techniques."
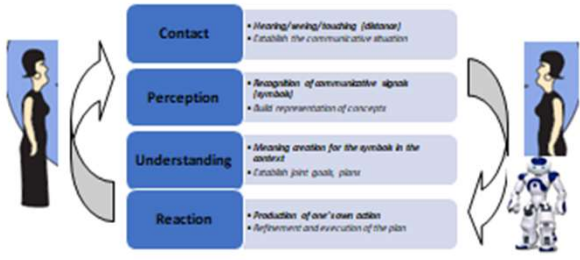
Minimal set of features:

- Social ability
- Credibility
- Context-awareness
- Learning ability
- Data gathering
- Proactivity
- Model of Behaviour Change
- Planning

Socio-technology approach in e-VITA

reworked from MIC (2007)

System Overview
Socio-Informatic System

Smart Devices
Usability and UUX
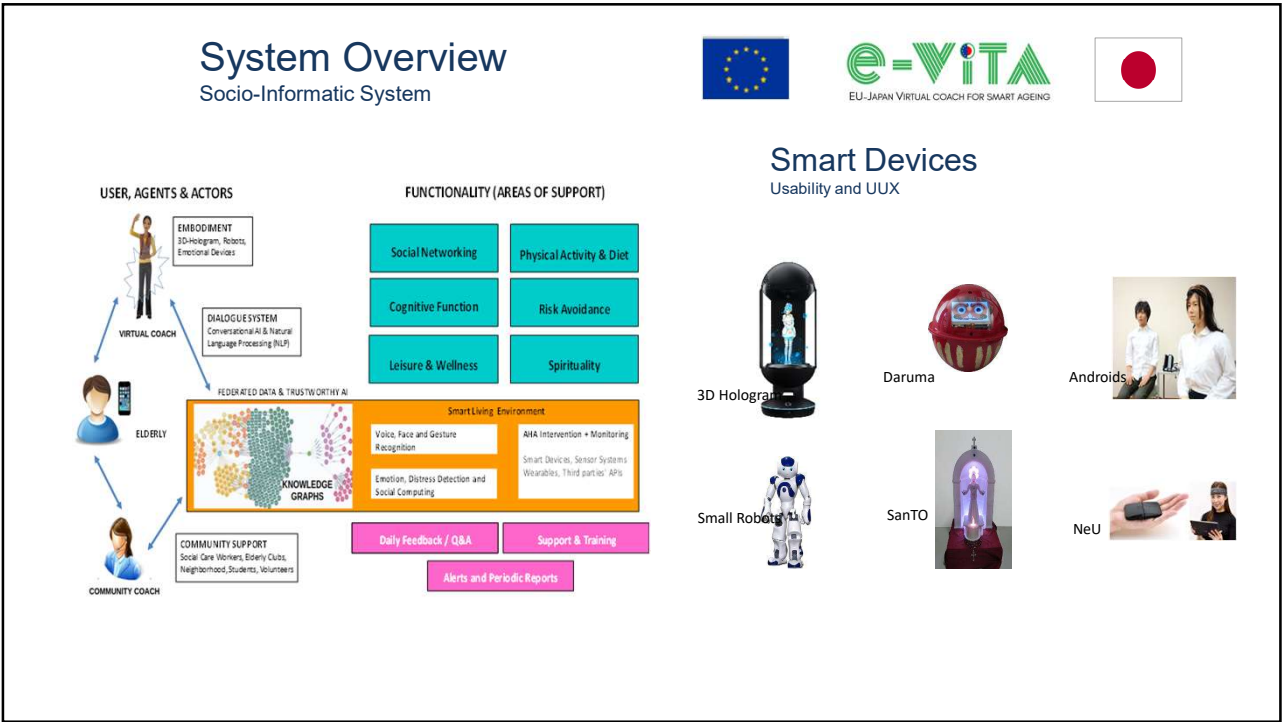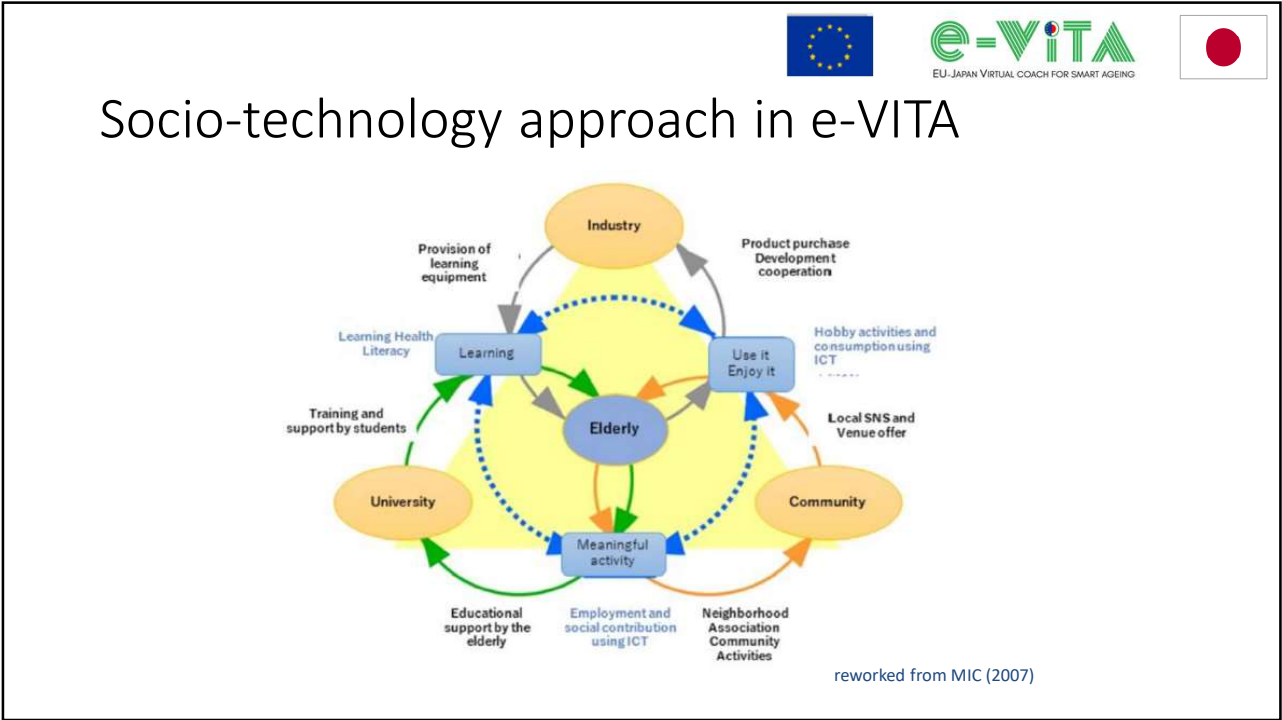
Constructive Dialogue Modelling (CDM)
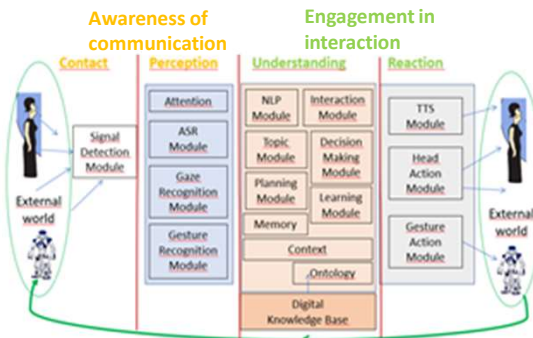
Based on Jokinen (2009, 2019), Jokinen & Wilcock (2014)

Linguistically based approach to dialogue modelling focusing on the enablements of communication:
- being in contact,
- recognizing the user's communicative signals (speech, gaze, gesturing),
- being able to understand the partner's intent and find a relevant topic
- provide an appropriate reaction.

The model is implemented in a modular fashion with the different system components realising the different enablements

Integration of CDM and RASA

https://rasa.com/docs/rasa/arch-overview

Jokinen (2009, 2019)

Issues:
Data collection: bigdata vs. small data
Knowledge graphs
Speech integration

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Long-term Relations

- From averaged users with an occasional interaction to individual users with frequent interactions
  - Proactive reactions (reminders, help in advance)
  - Adaptation to the user's typical behaviour (interaction strategy, personality)
  - Recall of previous situations (shared context)
  - Creation of affects (joint history, memories)
- Requires reliable recognition of known users
  - Face detection
  - Multimodal behaviour recognition
  - Biosensors
  - Social characteristics
- Long-term vs short-term memory

Jokinen, K. & Wilcock, G.: Do you remember me? Ethical Issues in Long-term Social Robot Interactions. ROMAN 2021.

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Privacy balancing act

Short-term memory for robots

- Robots share living space with human partners and acquire information through sensors
  - critical value data (important notification)
  - less important data (background info)
  - change in the recorded daily data (can count towards long-term monitoring)

- User awareness and agreement: robots must obtain permission to store
  - face images or face landmarks
  - video or audio recordings
  - dialogue histories
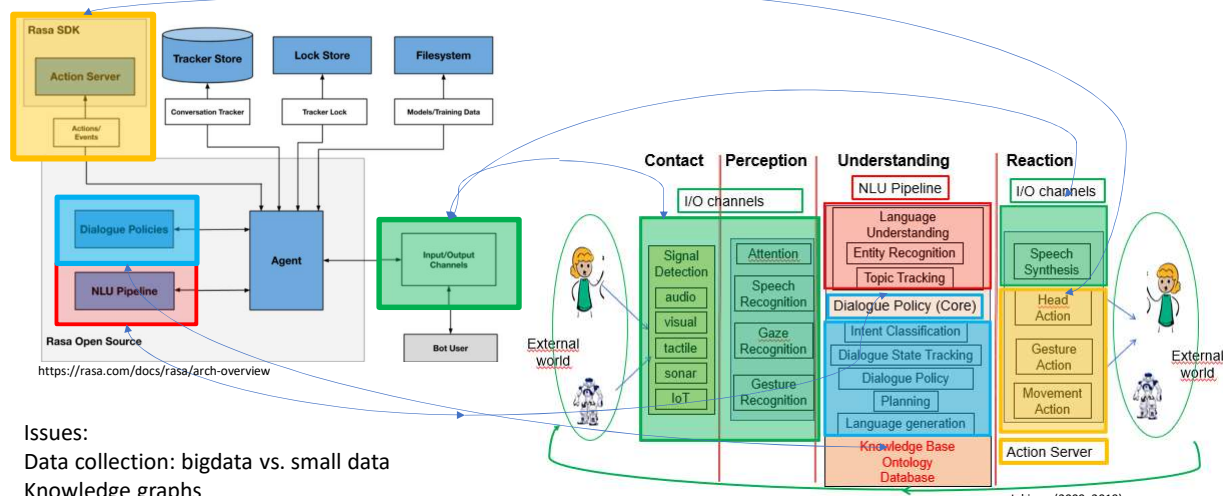 in long-term memories (cloud databases)

Jokinen, K. & Wilcock, G.: Do you remember me? Ethical Issues in Long-term Social Robot Interactions. ROMAN 2021.

Long-term memory for robots

- Data storing
  - Access restrictions, authentication
  - Encryption of data, periodical deletion
  - Federated data structures and edge computing in virtual ecosystems

- Legal context
  - EU's General Data Protection Regulation (GDPR)
  - The Japanese Act on the Protection of Personal Information (APPI)

- User's control over their personal data

  -Your choices of restaurant location, price range and preferred cuisine are only in my short-term memory.
  -May I keep them in my long-term memory in the cloud?
  - No, delete it, thanks.

Interactions with Social Robots - Challenges
and Opportunities for Digital Companions

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Ethics, trust, and reliability
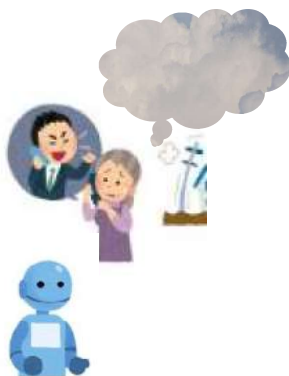
- Data storing and privacy
  - Encryption, secure identification, periodic deletion
- Issues in the development of dialogue systems
  - Unintentional biases in the data for the development of dialogue models
  - Data sharing, transfer learning, sensitive info, masking
    - Family, friends, staff, passers-by
    - Social norms
  - Delivery of sensitive information: critical vs. less important info
  - Competence and skills
    - Trust to act in an appropriate and adequate manner
  - System evaluation – participatory design
  - Acceptance and impact
  - Where can social robots make a difference?
- Legal issues
  - Awareness and conscious agreement of recording, logging
  - Ownership of the dialogue data and its use, access rights
 - Responsibility for actions and information (inaccurate, unreliable, prejudiced, …)

Jokinen, K. & Wilcock, G.: Do you remember me? Ethical Issues in Long-term Social Robot Interactions. ROMAN 2021.

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Boundary Crossing Robots

- A way to conceptualise social robot interactions:
- BCRs facilitate interaction and mutual intelligibility between different perspectives
- Conceptual re-categorization
  - Agenthood, family members, companions
- Social re-organization
  - Jobs: well-defined tasks
- Symbiotic relation between humans and robots
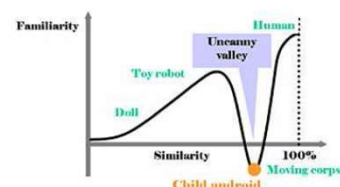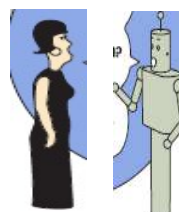
Reeves and Nass (1996): The Media Equation. he Media Equation: How People Treat Computers, Television, and New Media Like Real People and Places. Cambridge University Press.
Mori (1970): Uncanny valley https://spectrum.ieee.org/the-uncanny-valley#toggle-gdpr
Moore (2012): Bayesian explanation of Uncanny Valley: Cognitive Dissonance between conflicting categories.
https://www.nature.com/articles/srep00864

Watanabe, Jokinen (2020): Interactive Robotic Systems as Boundary-Crossing Robots – the User's View. ROMAN-2020
Jokinen, Watanabe (2019): Boundary-Crossing Robots: Societal Impact of Interactions with Socially Capable Autonomous Agents, ICSR 2019

Digital Future for All

- Issues on diversity, accessibility, and sustainability
- Allow different users to have access to digital services:
  - Elder people in Digital Society
    - Help in everyday tasks (reminders, make contacts, appointments,…)
  - Presence of different languages in digital world
    - Connect with people, rather than divide
- Education, awareness, networking
  - LITHME: facilitate long-term dialogue between linguists and technology developer
  - Sustainable Digital Life: Master's Programme at University of Tampere (Prof. Turunen et al.)
    - Educate experts who understand digital society from the view-points of both culture and ethics as well as comprehend digital system and how thy are produced
    - Study long-term structural change with the aim of maintaining social cohesion
- Sustainable Digital Languages
  - Create resources, tools, applications
  - Encourage connectivity
  - Maintain nature and culture to preserve the language
  - Use new technology to create opportunities to use (and keep using) language communication

Co-creating the environment in interaction together with other humans and robots!

User:
Thank you!

Robot:
Thank you for listening!
Do you have any questions or comments?