

An overview of research

Updated
March 2026

Robotics and Intelligent Systems group



Robotics and Intelligent Systems (ROBIN)



Kai Olav Ellefsen
Group leader/ Assoc. Prof.



Jim Tørresen
Professor (sabbatical leave)



Kyrre Glette
Professor



Mats Høvin
Assoc. Prof.



Yngve Hafting
Ass. Prof.



Vegard D Søyseth
Principal Engineer
(ROBIN lab)



Adrian Bergflødt
Assistant Engineer (Sonen)

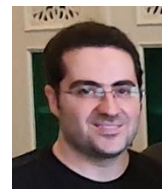
**Postdoktor /
forsker:**
Benedikte Wallace
(RITMO)



**Diana Saplacan
Lindblom** (VIROS)



Adel Baselizadeh
(PIRC)



Adjunct positions (20%):

Alexander Wold (assoc.prof.)
Ole Jakob Elle (Prof.)
Roar Skogstrøm (lecturer)
Ståle Skogstad (assoc.prof.)
Tønnes Nygaard (lecturer)

PhD students

(ROBIN main superv.):

Bjørn Thor Jonsson (RITMO)
Ege du Bruin
Emma H Stensby
Ivar-Kristian Waarum (NGI)
Katrine Nergård
Marieke van Otterdijk
Mateusz Wasiluk (BioAI)
Pedro Lucas (RITMO)
Shin Watanabe
Tobias Lømo

Students: Bachelor ~200; Master: ~55
Robotics and Intelligent Systems program

Students hired on hourly basis

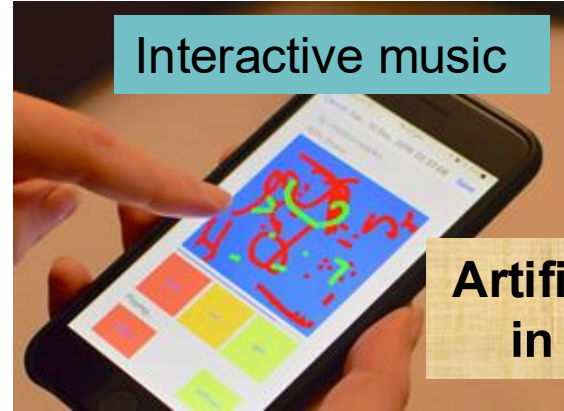
Visiting researchers

<https://www.mn.uio.no/ifi/english/research/groups/robin>

Robotics and Intelligent Systems (ROBIN) research group



Artificial Intelligence in industrial applications



Interactive music



Adaptive and autonomous mental health treatment

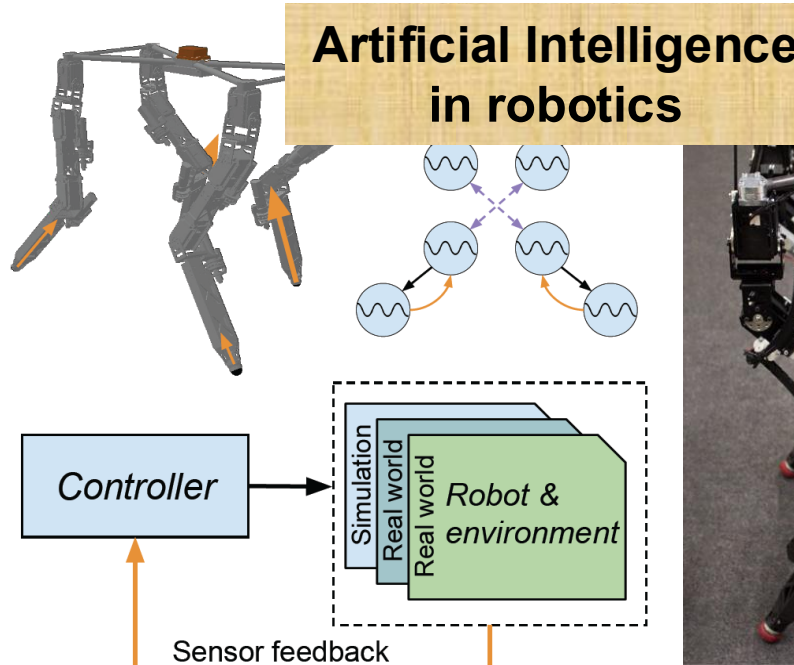
Artificial Intelligence in smartphones



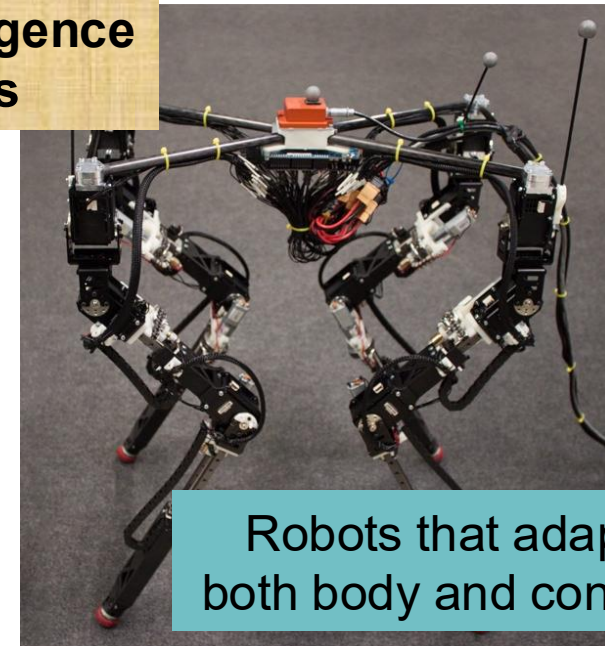
PAL TIAGo



Robots that look after and assist older people living at home



Artificial Intelligence in robotics



Robots that adapt both body and control





RITMO Centre of Excellence for Interdisciplinary Studies in Rhythm, Time and Motion grant 262762 (2017-2027)

- The center study human and robot rhythm **mechanisms** in **perception, cognition** and **acting**.
- Interdisciplinary **collaboration** between **musicology, psychology, computer science** and **robotics**.
- Machine learning and robotics to be applied

<https://www.uio.no/ritmo/english>



The Research Council
of Norway



Norwegian
Centre of
Excellence





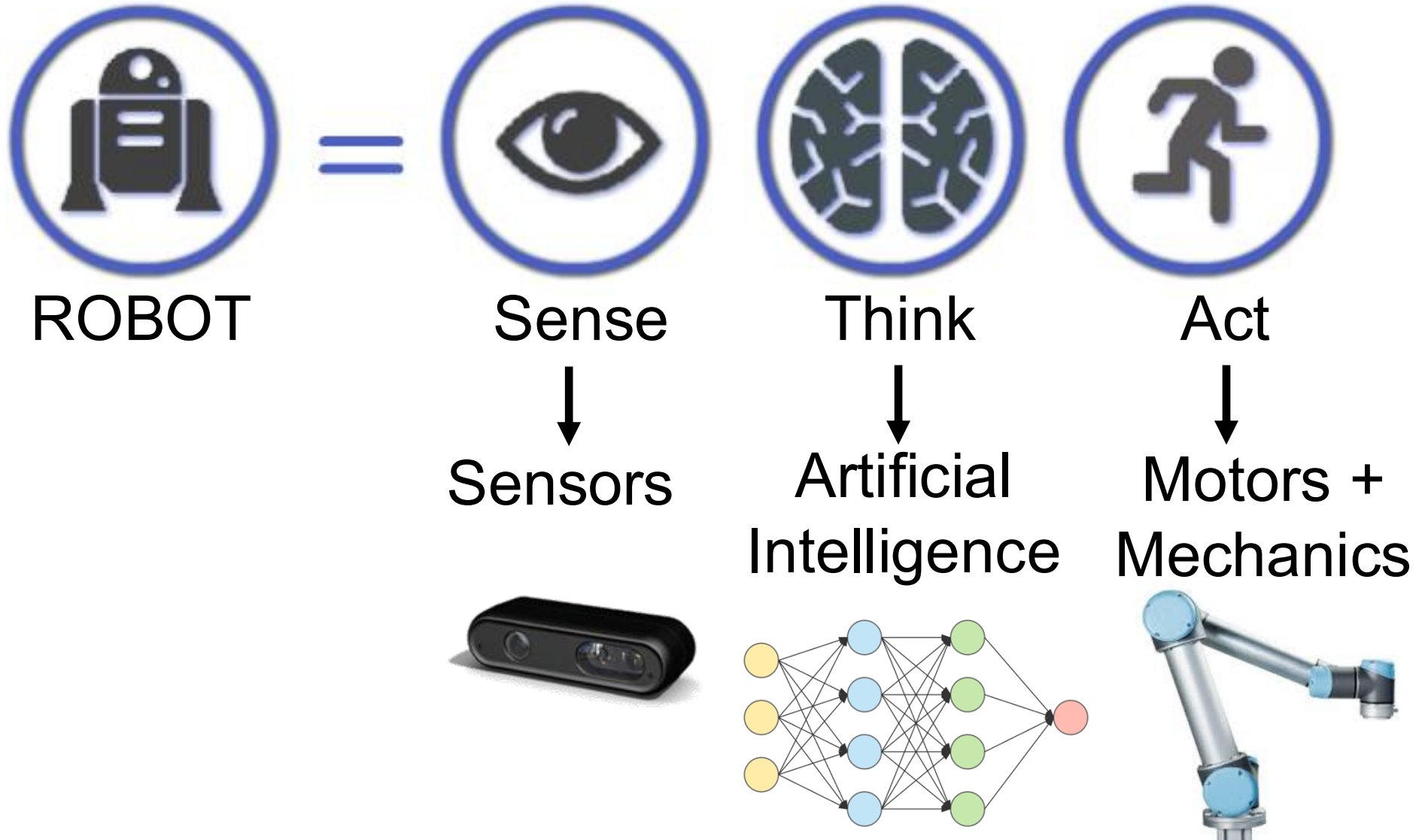
Benedikte Wallace PhD thesis (2023): ***AI-generated Dance and The Subjectivity Challenge***

1. **Collect dance movement** using full-body motion capture data.
2. Train models using those data to **generate dance motions.**
3. **Explore** how such models might benefit the creative practice of dancers.



More information (papers, video etc)

What is a Robot?



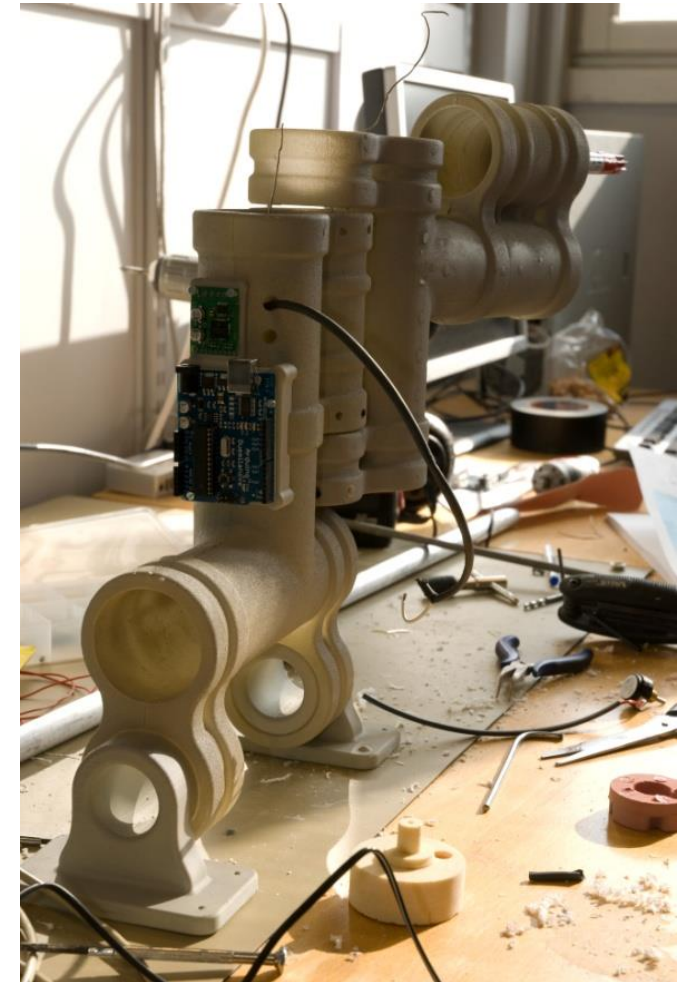
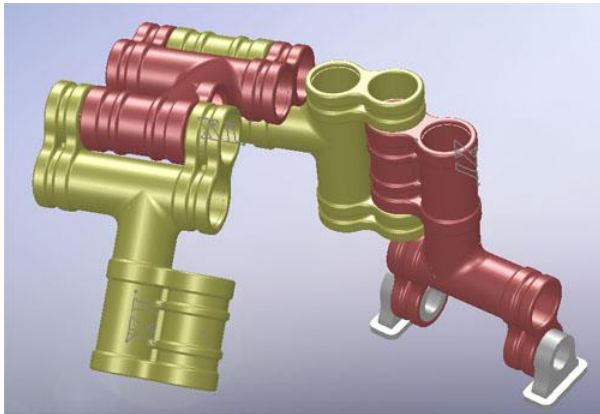
ROBIN group: AI and Machine Learning Techniques

- Feature Extraction (PCA variants, OpenPose, ++)
- Deep learning for sensing
 - Classification: CNN
 - Forecasting: RNN
- Deep reinforcement learning (robot control)
- Evolutionary computation (robot design and control, neuroevolution)
- Neuro-fuzzy systems (robot control)
- Transfer learning/user adaptive models
- Training with sparse data (oversampling)
- Vision language models (VLMs)

Rapid Prototyping Facilities (ROBIN)



- 3D printers and milling machines
- Large potential for developing innovative robot systems.



Rapid Prototyping Facilities

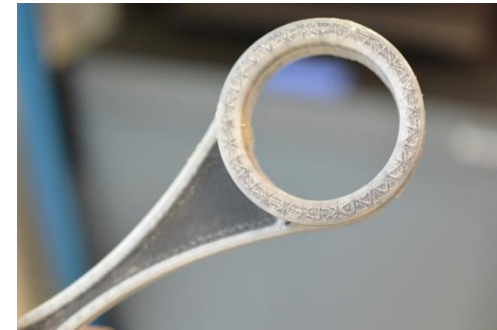
3D-printers (ROBIN)



Intamsys
Funmat pro 310

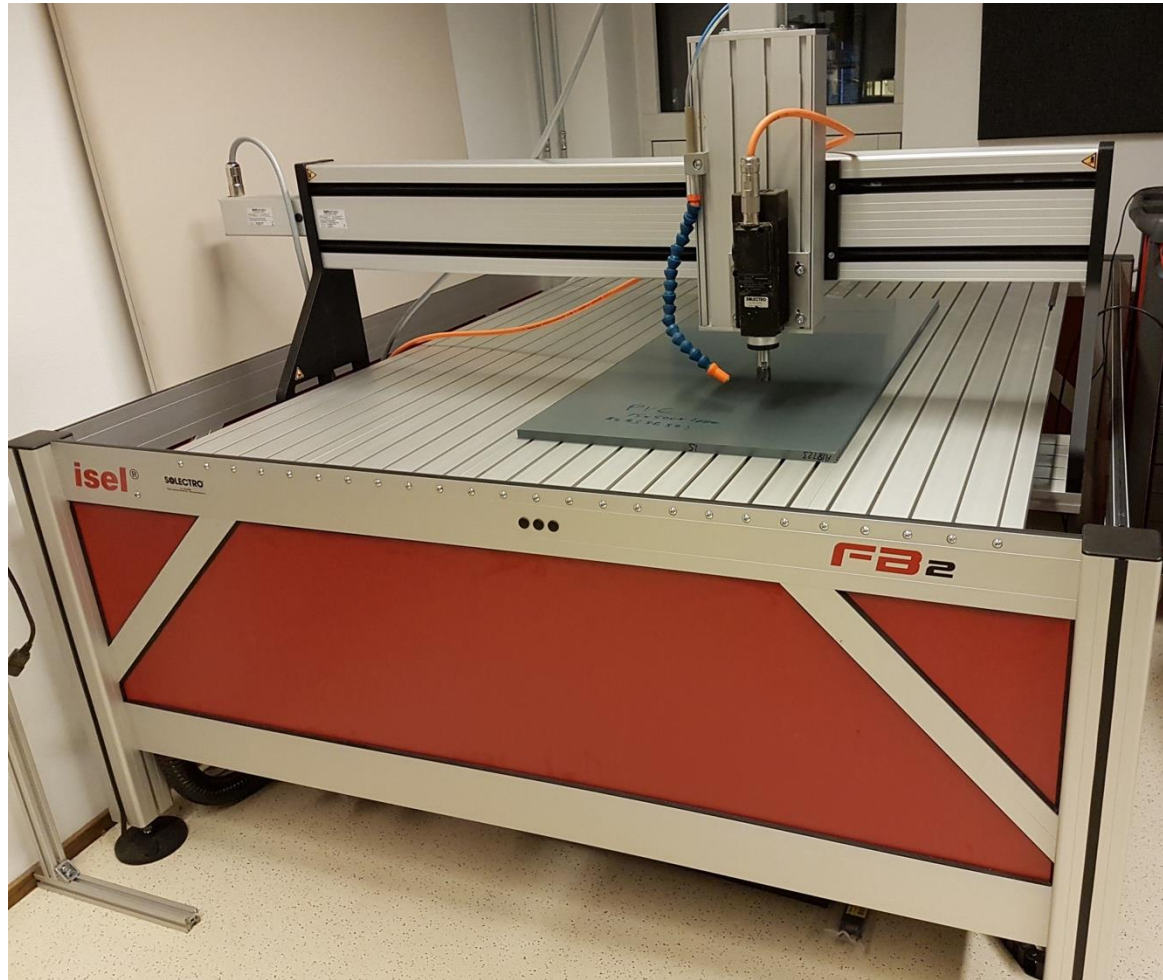


Markforged Mark X
(carbon fiber 3D printer)

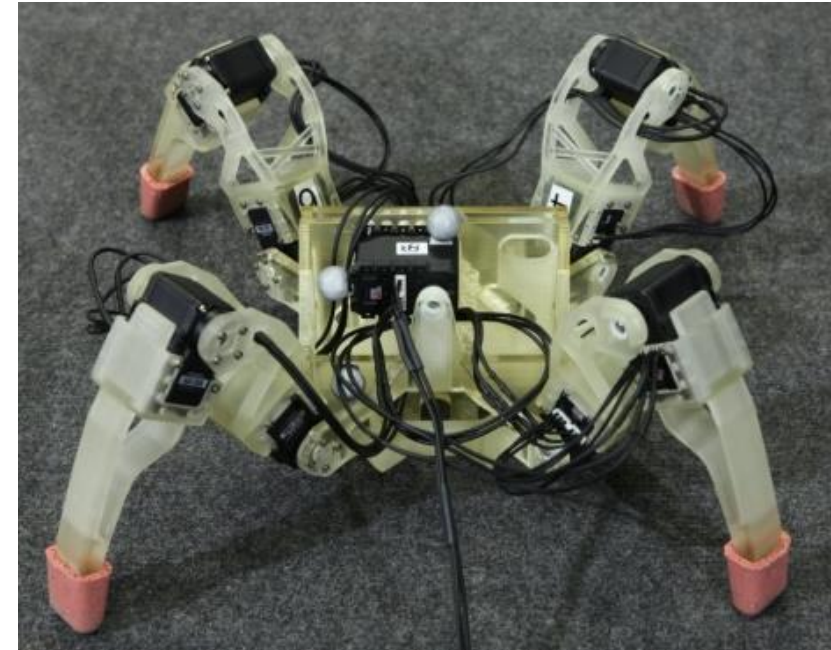
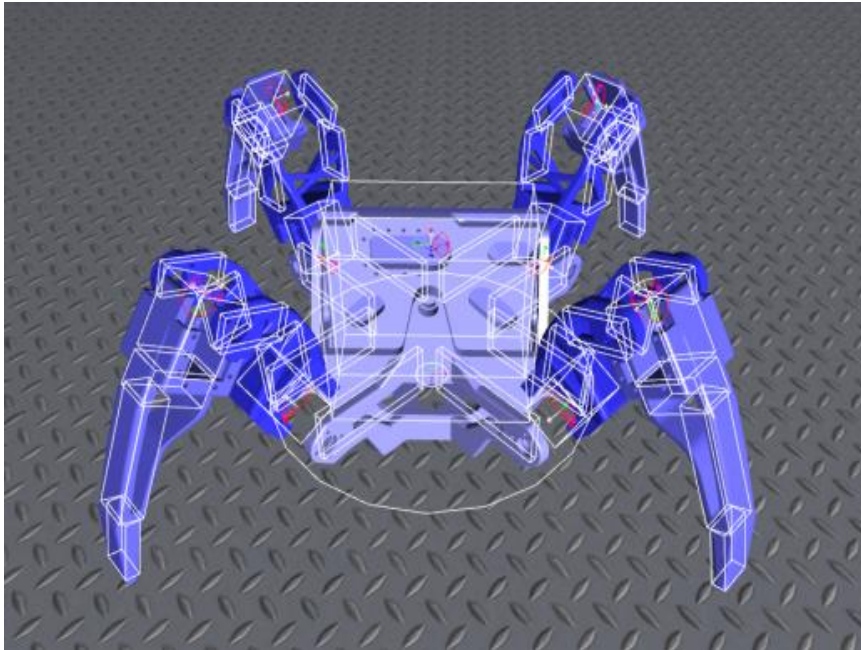


Rapid Prototyping Facilities

Milling Machines (ROBIN)



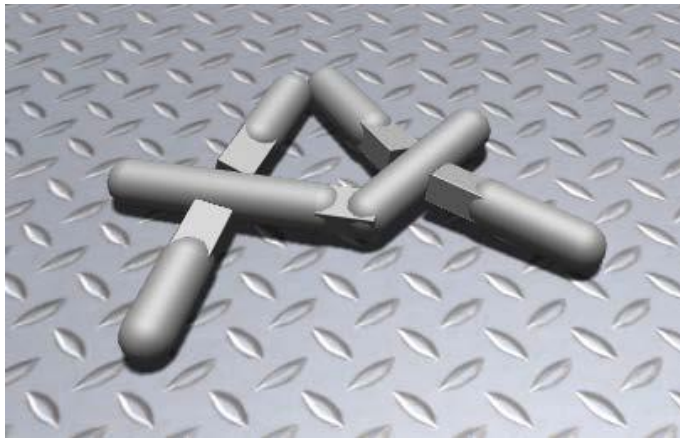
Robot Design, Simulation, Assembly and Evaluation



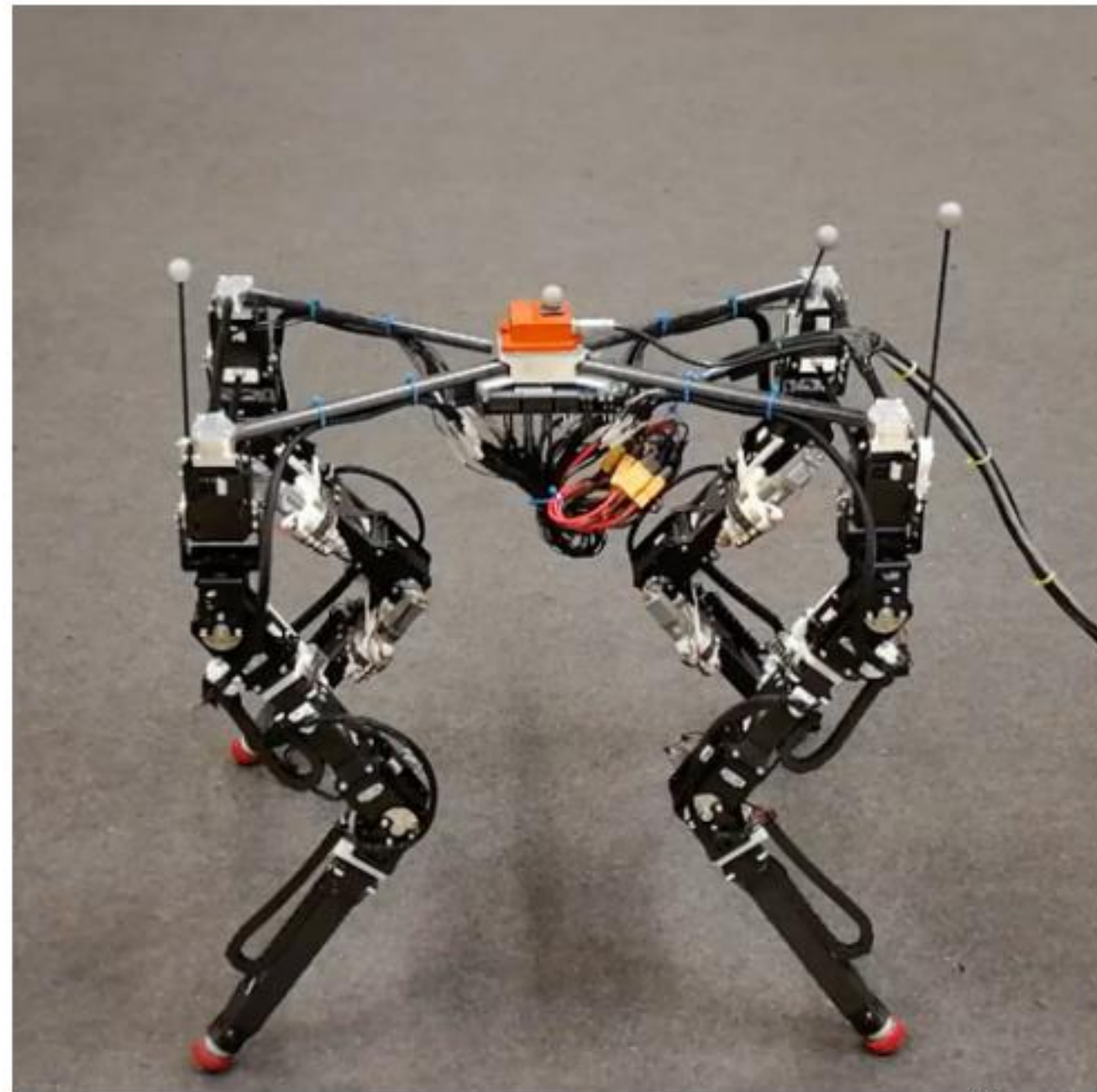
- Work with real robots and simulations.
- Reduce gap between simulation and reality.
- Create novel methods for design (e.g., evolution) and dynamic body shapes (morphology).

Evolved Robot Design

- Robot bodies could be difficult to design by hand.
- We use evolutionary algorithm to evolve both body and control system simultaneously.



Real-World Adaptive Robot: Dynamic Robot for Embodied Testing (DyRET) (Norwegian for "the animal")



Nygaard, T.F., Martin, C.P., Torresen, J. et al. Real-world embodied AI through a morphologically adaptive quadruped robot. *Nat Mach Intell* **3**, 410–419 (2021). <https://doi-org.ezproxy.uio.no/10.1038/s42256-021-00320-3>

A Morphologically Adaptive Quadruped in the Wild



<https://www.youtube.com/watch?v=Oug9pkZMUnc>

Mojtaba Karbasi PhD thesis (2024): **The Zrob Drum Robot** – an interactive robotic system for learning playing a drum

The Zrob-thesis is about a mechanical design of a robotic arm, prototyping, control, and artificial intelligence used for learning drumming tasks.

Mimics human hand capabilities.

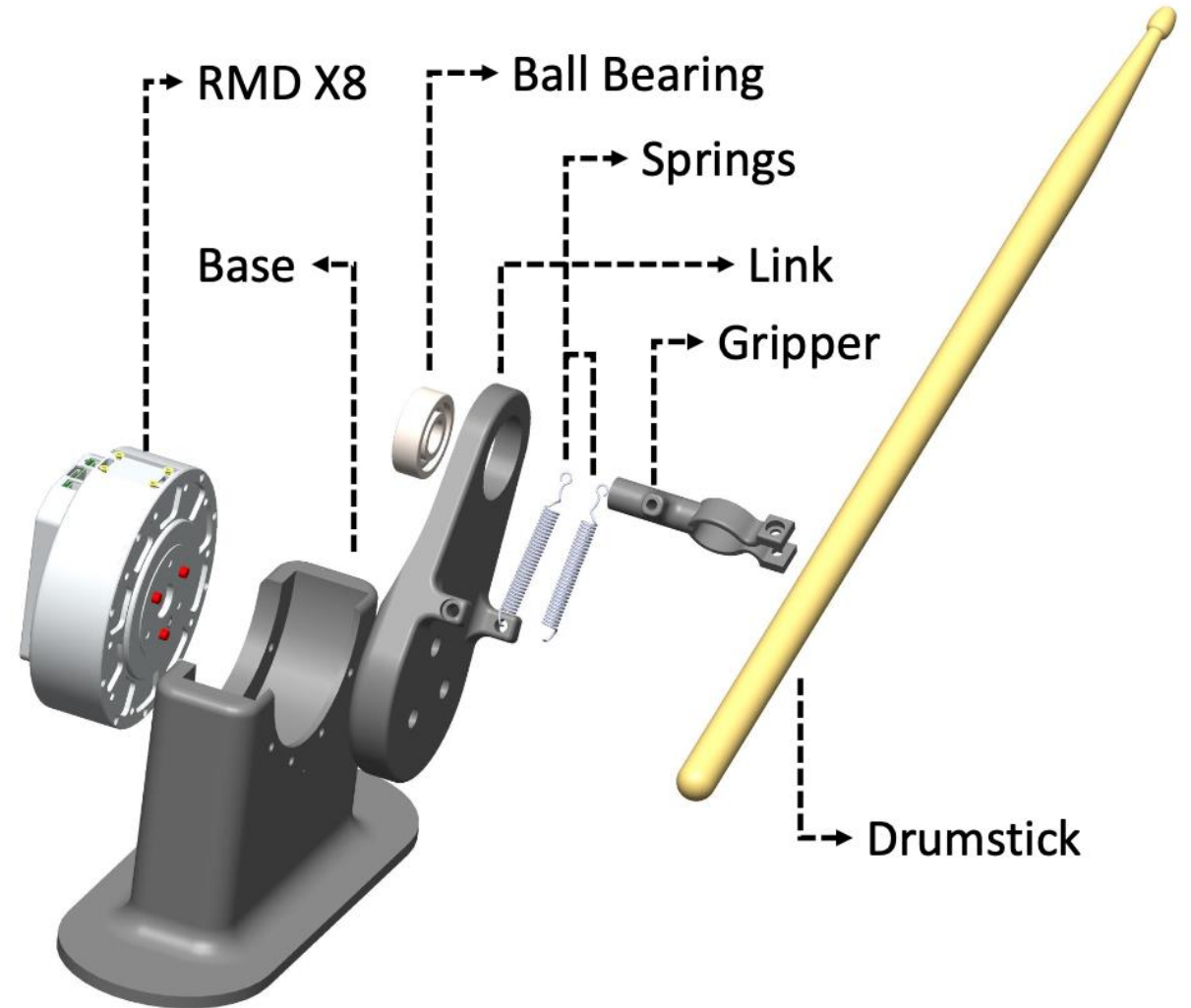


<https://www.uio.no/ritmo/english/projects/ZRob>

Mimic human: Wrist joint and the grip similar to ZRob

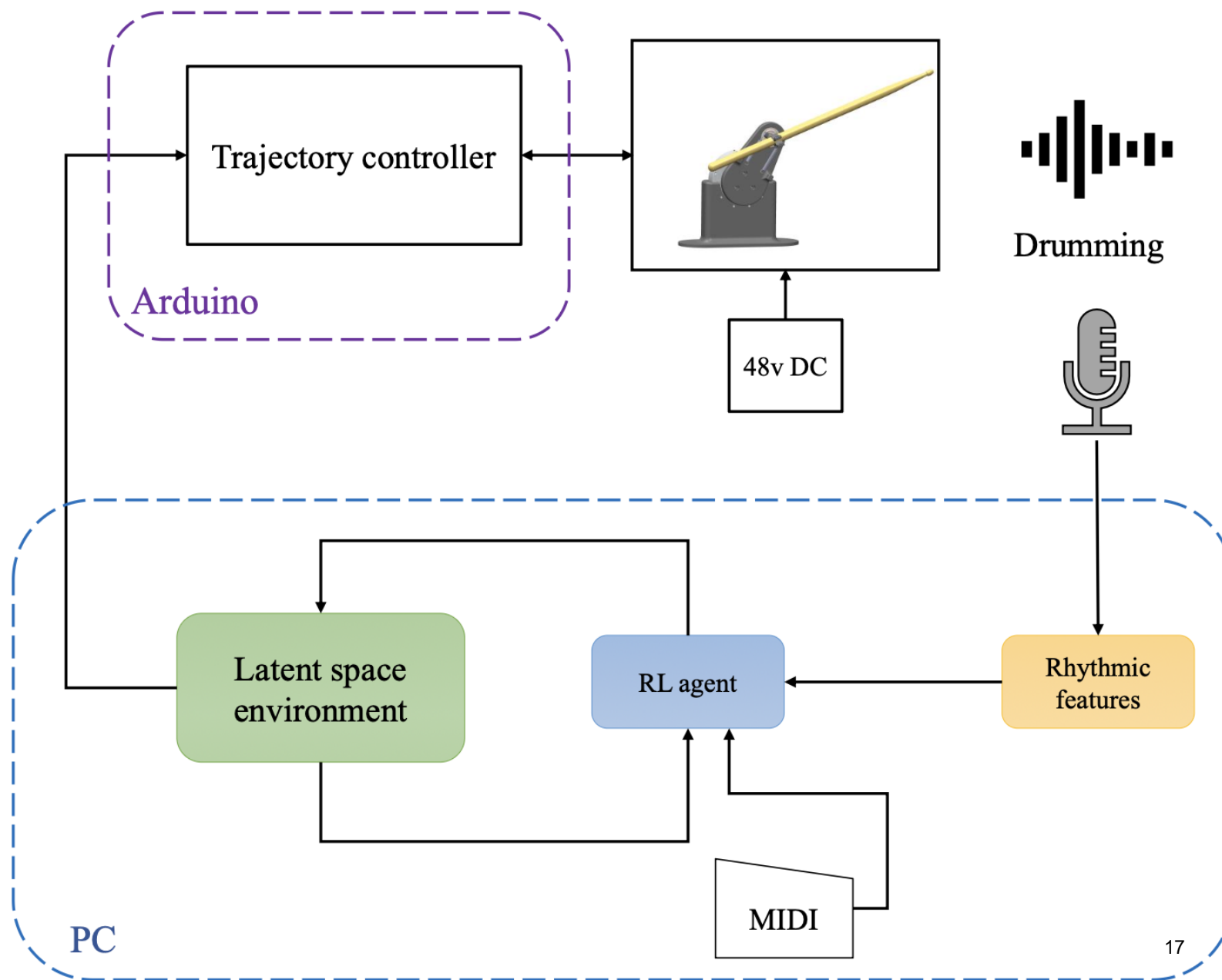


Embodied intelligence approach, intelligent behaviour emerges due to dynamic interactions between the body, brain, and environment.



Embodied Intelligence for Drumming

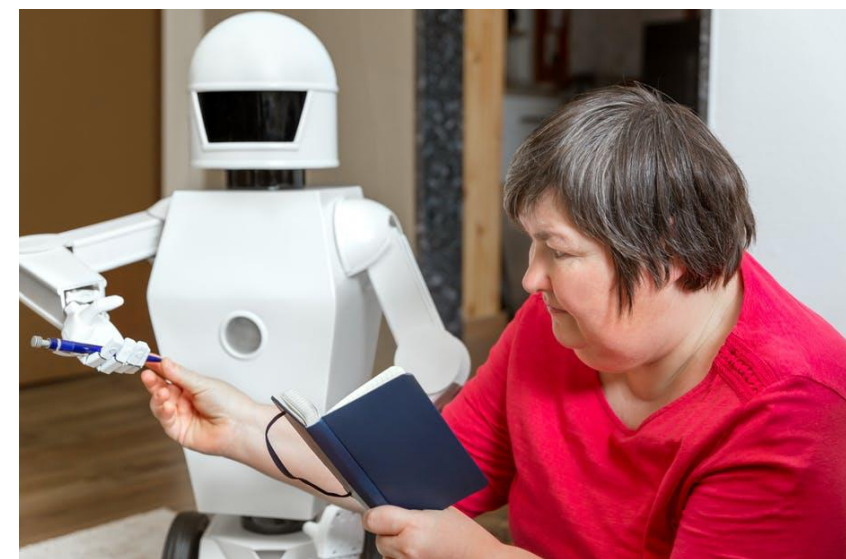
Karbasi SM, Jensenius AR, Godøy RI, Torresen J. Embodied intelligence for drumming; a reinforcement learning approach to drumming robots. Front Robot AI. 2024 Nov 18;11:1450097. doi: 10.3389/frobt.2024.1450097.



Recent and ongoing ROBIN Research Projects and Centre Funded mainly by the Research Council of Norway

- Norwegian Centre for Embodied AI (NCEI, 2025-2030)
- MishMash Centre for AI and Creativity (MishMash, 2025-2030)
- Robot as Welfare Technologies and Actors for Elderly Care (ROBOWELL, 2025-2029)
- Ethical risks assessment of Artificial intelligence in practice (ENACT, 2023–2026)
- Vulnerability in the Robot Society (VIROS, 2019-2026)
- Collaboration on Intelligent Machines Norway (COINMAC, 2017-2026)
- Predictive and Intuitive Robot Companion (PIRC, 2020-2028, IKTPLUS)
- Robust additive manufacturing of polymer composites for optimal part production (RAMP-OPP, 2024-27)
- Centre of Excellence for Interdisciplinary Studies in Rhythm, Time and Motion (RITMO, 2017-2027, CoE)

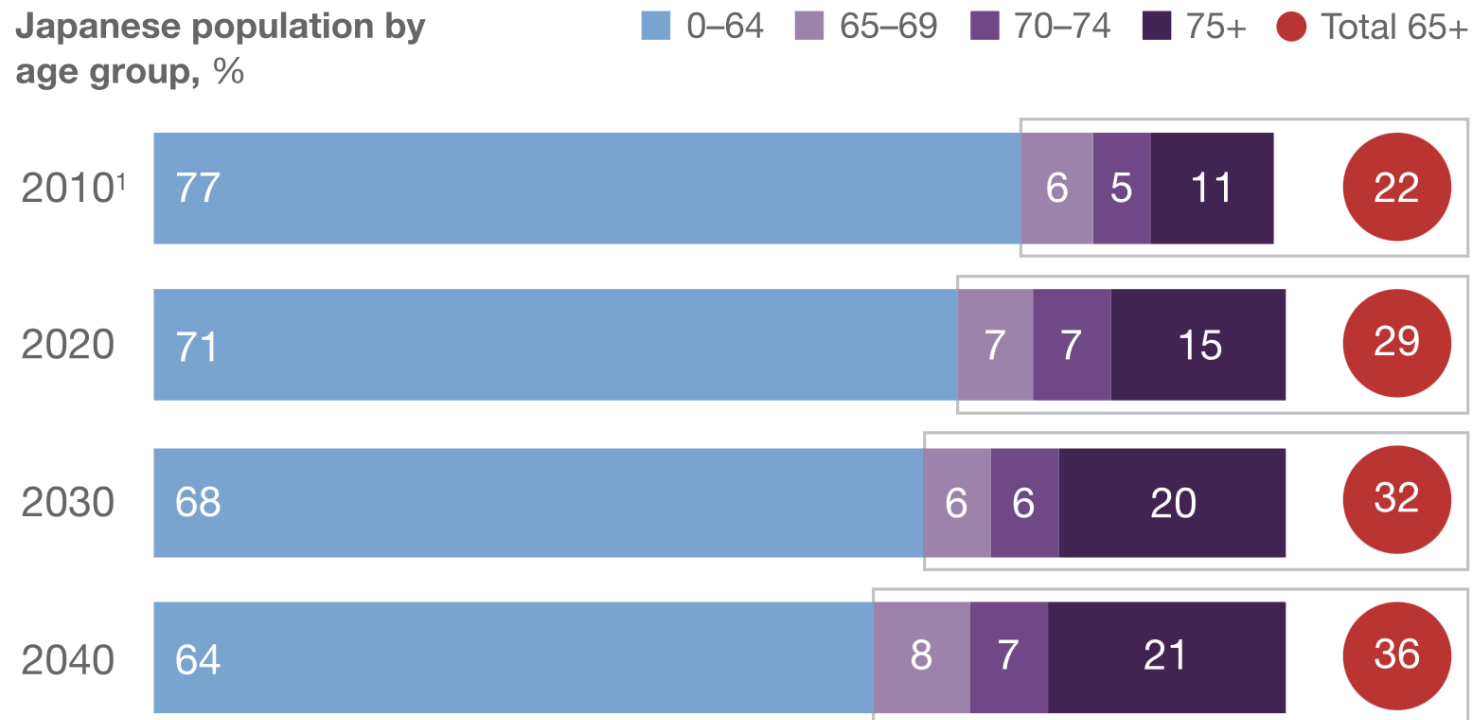
Robots Getting Closer to Human



Time

By 2040, estimates suggest, more than a third of Japan's population will be 65 or over

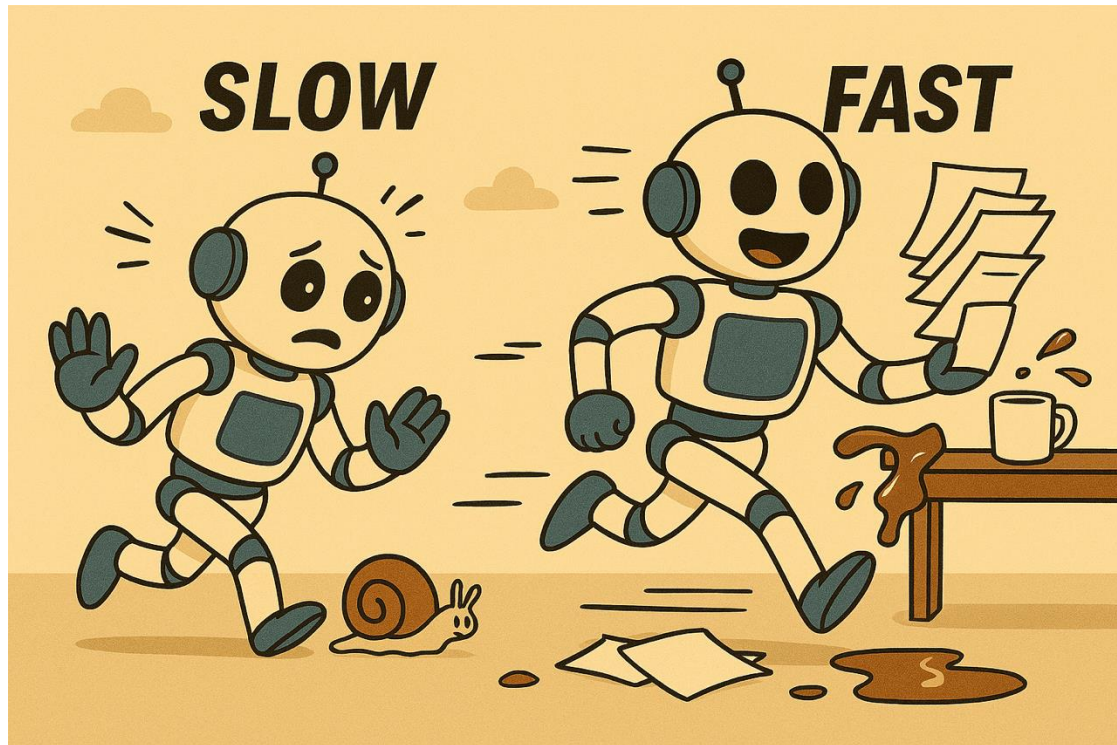
By 2040, estimates suggest, more than a third of Japan's population will be 65 or over.



Human – Robot Interaction – Slow Versus Safe Robot

Trustworthy robot assistant trade-offs:

- too slow vs sloppy
- must have a number of capabilities vs quality in task performance



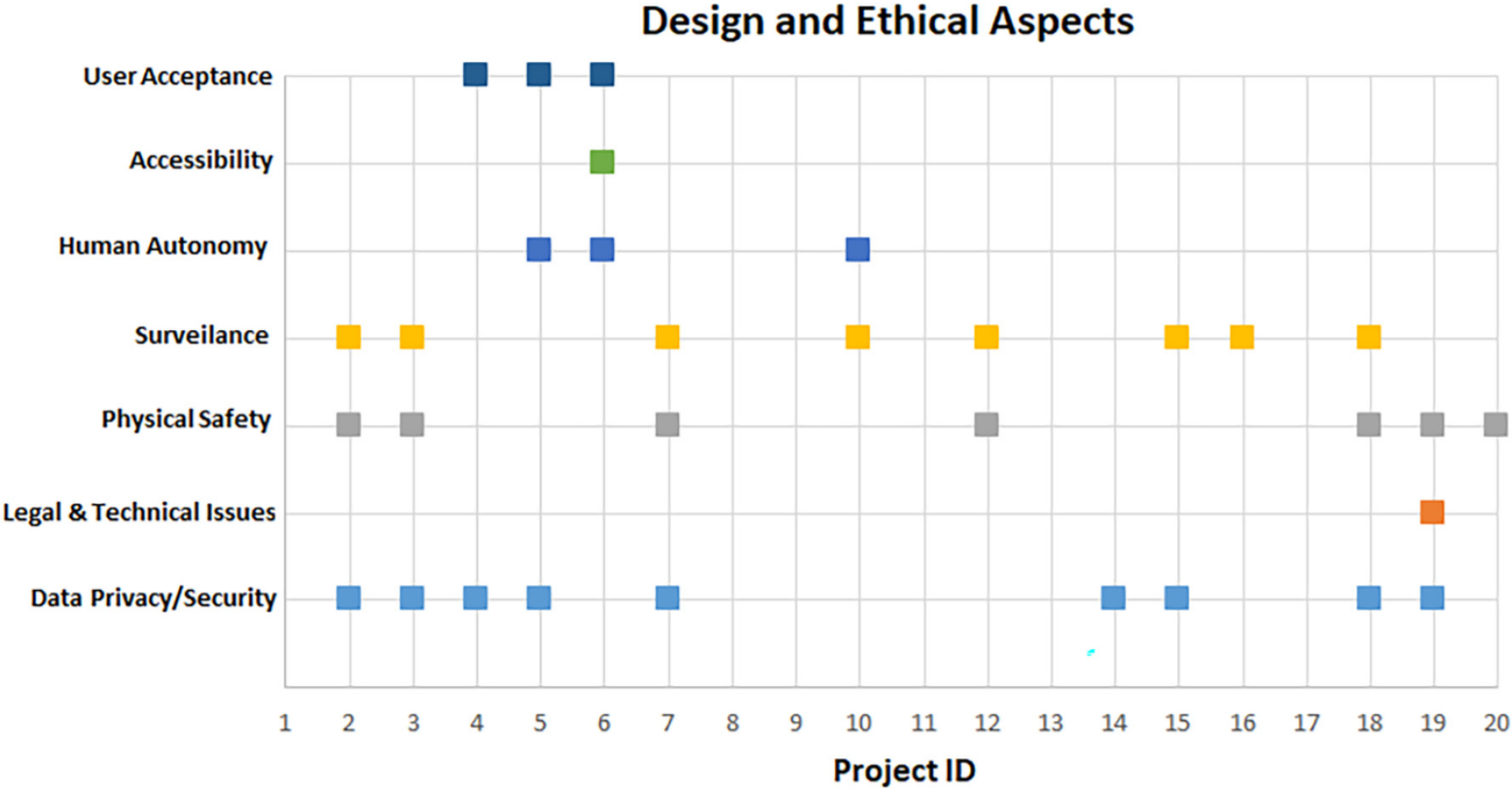
Generated with MicroSoft Copilot



Problems still to be solved for increased robot deployment in environments with humans

- Understanding and addressing human concerns:
 - Privacy
 - Security
 - Safety
- Robots need human skills like:
 - forecasting
 - knowing what its skills are and ability to generalise and learn new skills effectively
- Robots need to be trained in the real-world and not only in simulators

Robotics in Elderly Healthcare: A Qualitative Analysis of 20 Recent European Research Projects



CompanionAble
DOME0
MOBISERV
ExCITE
ACCOMPANY
HOBBIT
GiraffPlus
Robot-Era
SILVER
VictoryaHome
TERESA
RAMCIP
ENRICHME
GrowMeUp
MARIO
RADIO
SocialRobot
HIRo
MECS
VIROS

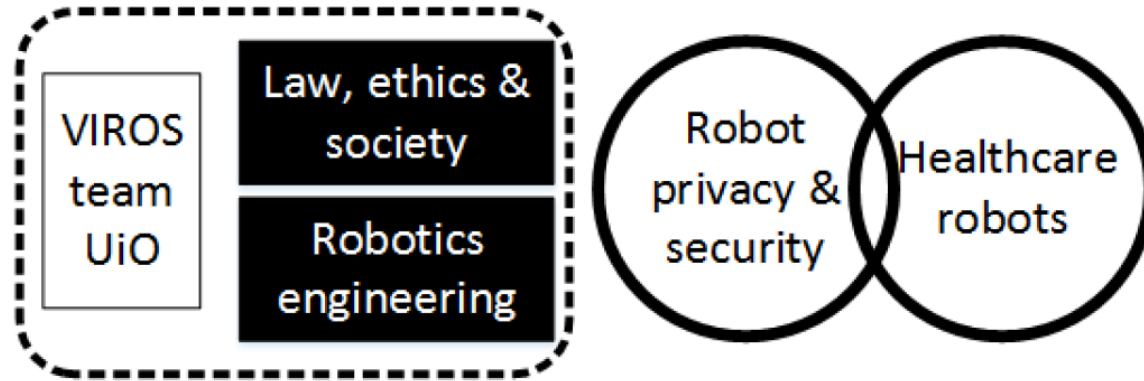
Robotics in Elderly Healthcare: A Qualitative Analysis of 20 Recent European Research Projects

- Most projects have a strong bias towards care robots' functionalities:
 - robots are often seen as outsiders in care settings
 - there is an emphasis on robots as commercial products
 - there is some limited attention to the design and ethical aspects of care robots, but very little attention to their legal aspects

CompanionAble
DOME0
MOBISERV
ExCITE
ACCOMPANY
HOBBIT
GiraffPlus
Robot-Era
SILVER
VictoryaHome
TERESA
RAMCIP
ENRICHME
GrowMeUp
MARIO
RADIO
SocialRobot
HIRo
MECS
VIROS

VIROS: Vulnerability in the Robot Society (2019-2026)

Research Council of Norway grant 288285



Dep. of Private Law (below)
Dep. of Informatics (left)



Goal:

Develop technology and proposals for regulatory measures to reduce vulnerabilities regarding robotics.

Focus on privacy, security and safety, particularly in healthcare contexts.

Technology partner: Robotics and Intelligent Systems (**ROBIN**) group

Diana Saplacan
Researcher



Adel Baselizadeh
PhD student



Funding: *IKTPLUS*, Research Council of Norway



**The Research Council
of Norway**

<https://www.jus.uio.no/ifp/english/research/projects/nrccl/viros/index.html>

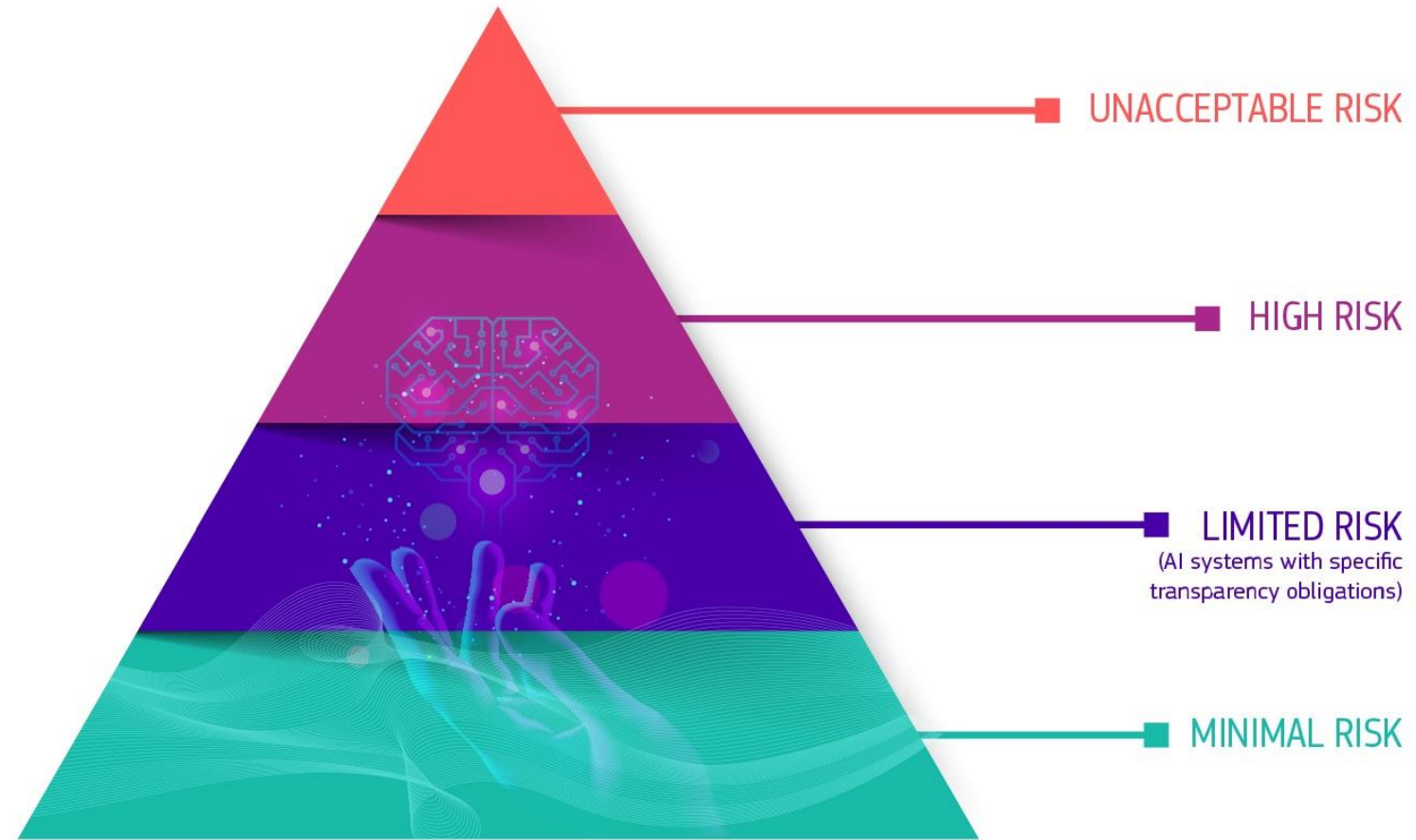


EU's risk-based approach to AI

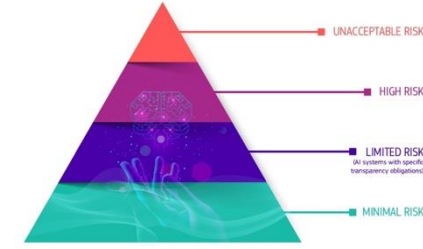
- EU has adopted harmonised rules regarding AI applications:



table AI



<https://artificialintelligenceact.eu/high-level-summary/>



EU AI Act Proposal – Prohibited AI practices

AI systems with an unacceptable level of risk to people's safety will be strictly prohibited, including

- systems that deploy subliminal or **purposefully manipulative techniques**
- **exploit people's vulnerabilities** or are
- **used for harmful treatment based on social scoring** (classifying people based on their social behaviour, socio-economic status, personal characteristics); or
- **emotion recognition** systems in workplace and educational institutions.

VIROS focus areas

1. Privacy 2. Security 3. Safety



ROBOT

=



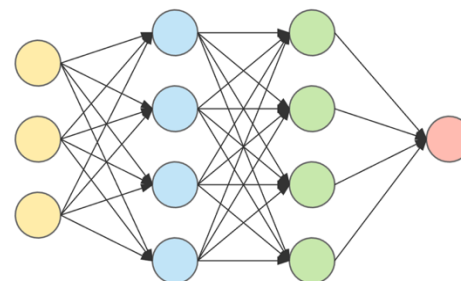
Sense

↓
Sensors



Think

↓
Artificial
Intelligence



input layer hidden layer 1 hidden layer 2 output layer



Act

↓
Motors +
Mechanics



+



Top image: www.robotpark.com

Image by rawpixel.com

Paper examples of work – VIROS at the ROBIN group

Human – Robot
relation
Sensing
Control

- On **Ethical Challenges Raised** by Care Robots: A review of the regulatory, theoretical, and research gaps (ARSO 2021) (Diana Saplacan et al)
- **Robots as Welfare Technologies** to Reduce Falls Amongst Older Adults: An Explorative Study from Norway (HCII 2022) (Diana Saplacan and Jim Tørresen)
- Generation **Differences in Perception** of the Elderly Care Robot (ROMAN 2021) (Weria Khaksar et al)
- **Ultra-Wideband Radar-Based** Activity Recognition Using Deep Learning (IEEE Access journal 2021) (Farzan M Noori et al)
- **Motion Planning and Obstacle Avoidance** for Robot Manipulators (SMC 2022) (Adel Baselizadeh et al)
- **Adaptive Real-time Learning**-based Neuro-Fuzzy Control of Robot Manipulators (ICCMA 2021) (Adel Baselizadeh et al)

Ethical Countermeasures

- **Designers, procurers and users need to be aware of possible ethical challenges that should be considered**
 - e.g. avoiding misuse and allowing for human inspection of the functionality
- **The systems should themselves be able to do ethical decision making** to reduce the risk of unwanted behavior
 - Decide when a human is to be contacted or the machine should stop

Jim Torresen (2018). A Review of Future and Ethical Perspectives of Robotics and AI. *Frontiers in Robotics and AI*.



**Jim is corresponing
chairs for:**

**TECHNICAL COMMITTEE FOR
ROBOT ETHICS**



Robot ethics is a growing interdisciplinary research effort situated in the intersection of applied ethics and robotics with the aim of understanding the ethical implications and consequences of robotic technology, in particular, autonomous robots.

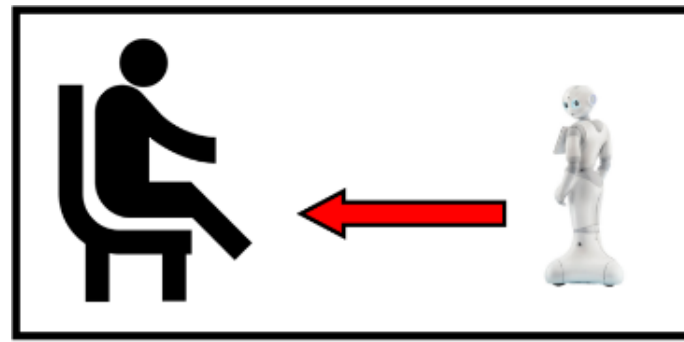
Interested in getting involved?

Please register for the committee

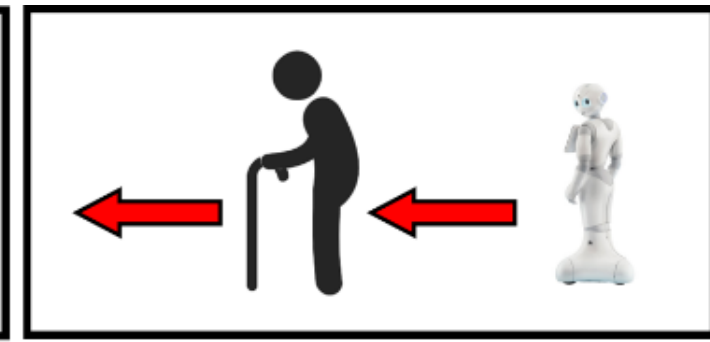
here: <https://www.ieee.org/membership-catalog/productdetail/showProductDetailPage.html?product=CMYRAS039&tcType=IEEE Robotics and Automation Society Membership&searchResults=Y>



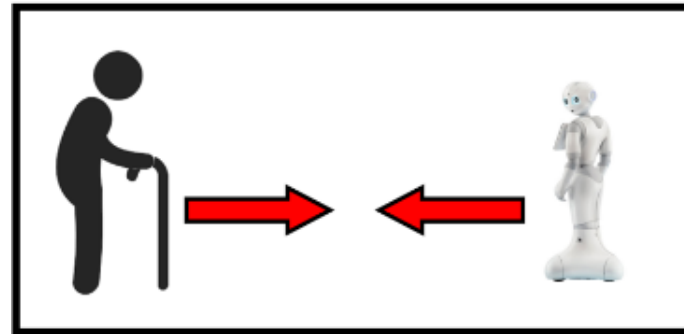
User studies on robot and user encounters



(a)



(b)



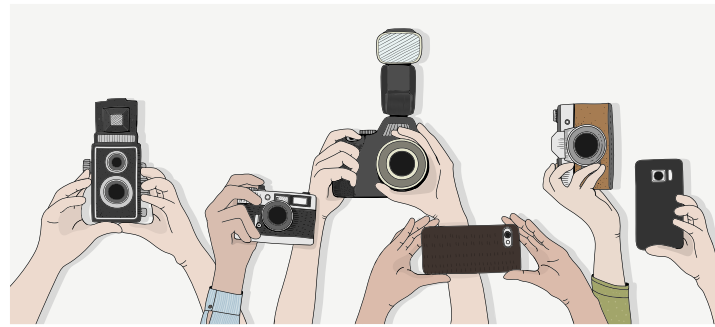
Ethical Concerns: Security – Safety Challenge



Generated with Microsoft co-pilot

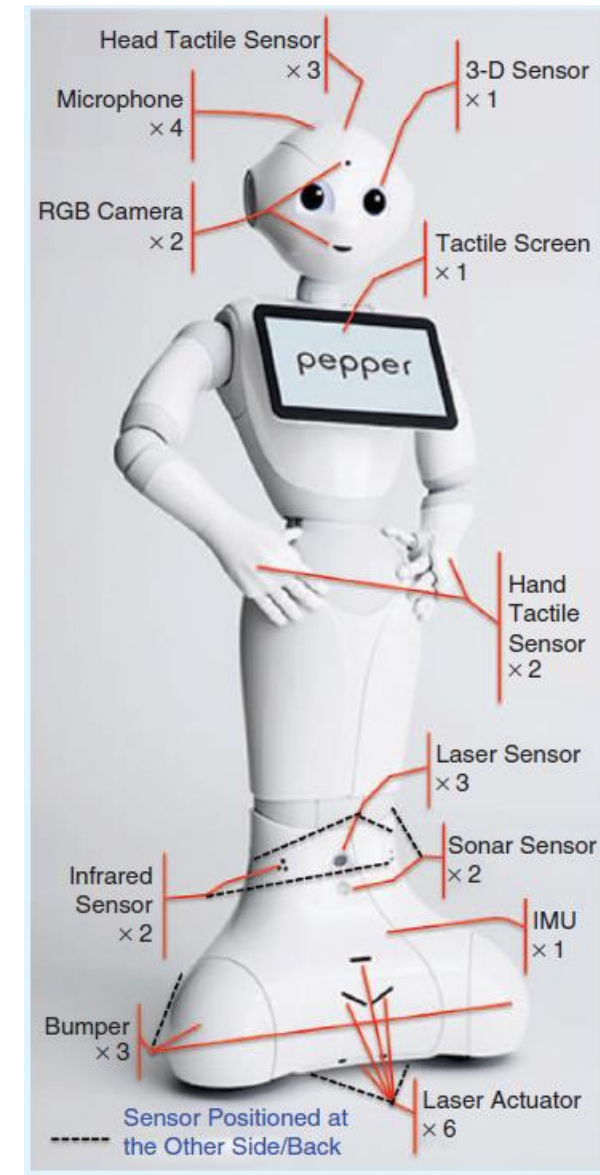
- **Safety:** Teleoperation of robots will make deployment possible earlier than if they should operate fully autonomous.
- **Privacy:** The goal is to keep the human "out of the loop" as much as possible to preserve privacy.
- **Machine ethics:** Who should have access to the sensors and control of the robot at what time?

Privacy challenges / paradoxes



- **How much data to collect:** The more data that are used during research and development, the less data is needed when a system is to be applied.
- **What kind of sensors:** The more sensors, the more accurate and safer the robot will be.
- **Consent:** A personalised robot will act better and safer: the more you know about a friend, the more you tend to adapt to the person. (ref. web page cookie preferences will give easier use and more personalised web page view)

J. Torresen, D. Saplacan, A. Baselizadeh and T. Mahler, "Machine Excellence Tradeoffs to Ethical and Legal Perspectives," 2023 IEEE Conference on Artificial Intelligence (CAI), Santa Clara, CA, USA, 2023, pp. 237-240, <https://doi.org/10.1109/CAI54212.2023.00109>



THE JAPAN NEWS

BY THE YOMIURI SHIMBUN

AZABU INTERIOR
pre-renovation
Clearance Sale
New & Used Furniture from 10% to 90% off
Oct. 24 to Nov. 8, 2025

marie claire
marieclairejapon.com
Instagram WEB Site

Giant Godzilla statue to hit Tokyo's Haneda Airport



Page 3

Tokyo umbrella shop weathers decades of change



Page 16

Editorial: Grounds for reducing seats in lower house unclear

Page 6

From the Post: At least some Democrats are trying to reflect

Page 13

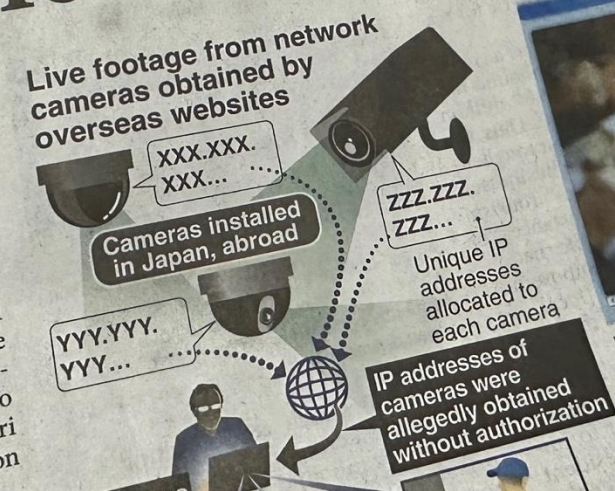
WEDNESDAY, NOVEMBER 5, 2025

japannews.yomiuri.co.jp

Footage from security cameras accessible on overseas websites

The Yomiuri Shimbun

About 500 pieces of live footage taken from network cameras installed indoors or on a property's premises in Japan and connected to the internet have been publicly accessible on overseas websites, according to an investigation by The Yomiuri Shimbun.



Live footage within a facility in Japan is publicly accessible on an overseas website, as seen in this screenshot. (This photo has been partially modified.)

The people took measures such as reviewing their settings. The indoor footage also showed locations that appeared to be a supermarket, a

net Protocol addresses assigned to each camera. It is possible for someone to use specialized programs to collect and make public the IP addresses of vulnerable cameras, according to Narita. "It is surprising that there were so many vulnerable cameras, which reflects a lack of security awareness," said. "With improvements in abilities, for example, to identify the

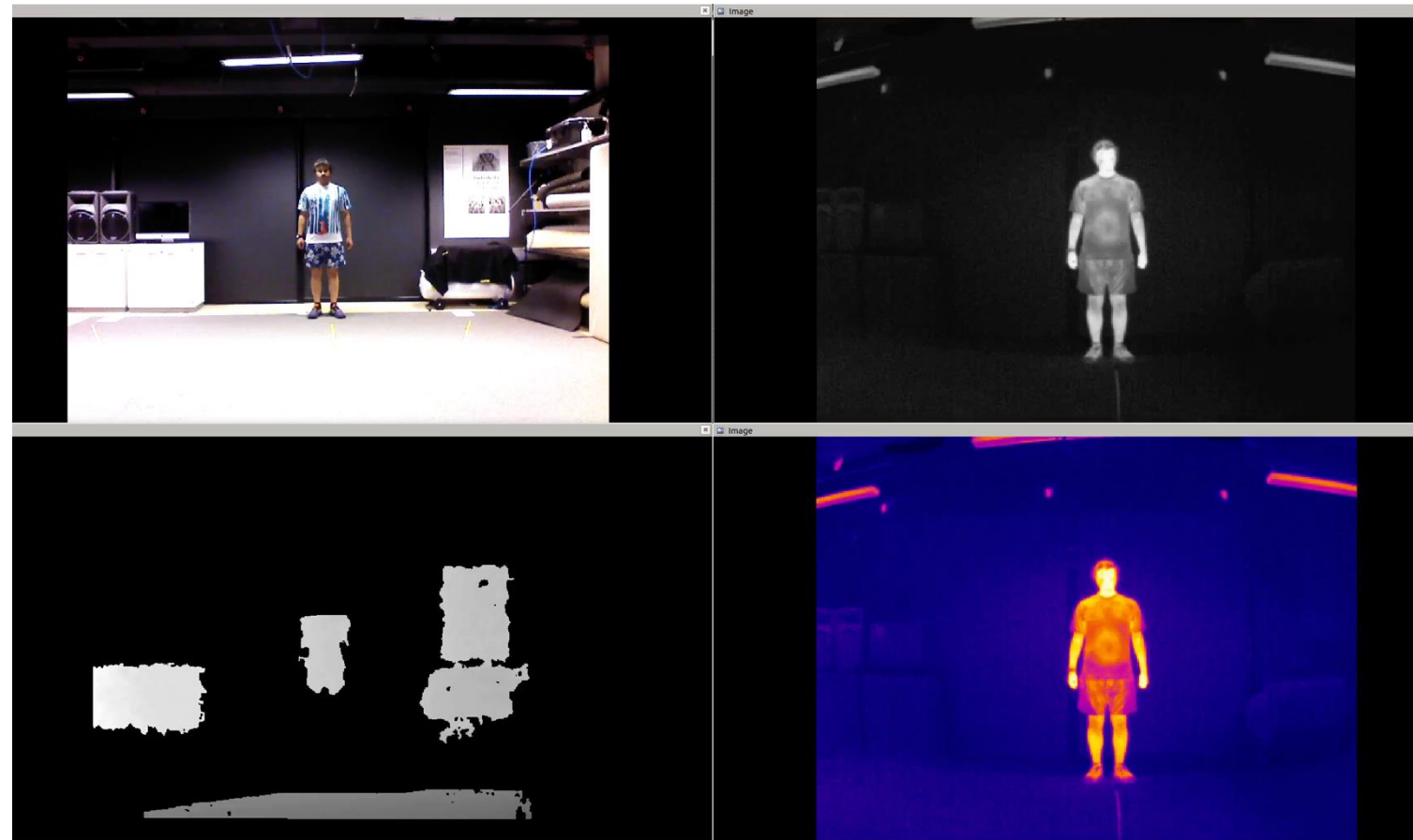
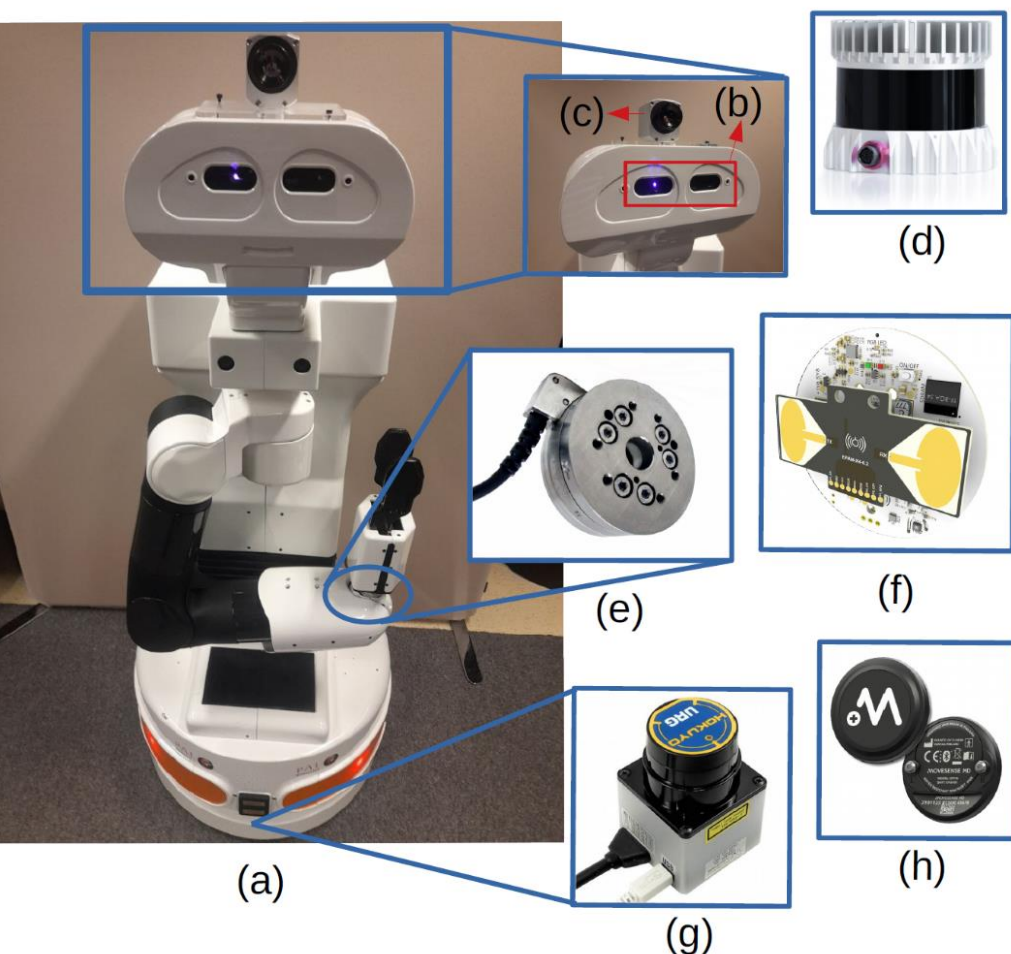


Prime Minister Sanae Takaichi speaking at a podium on Tuesday.

Ethical Concerns: 1. Privacy

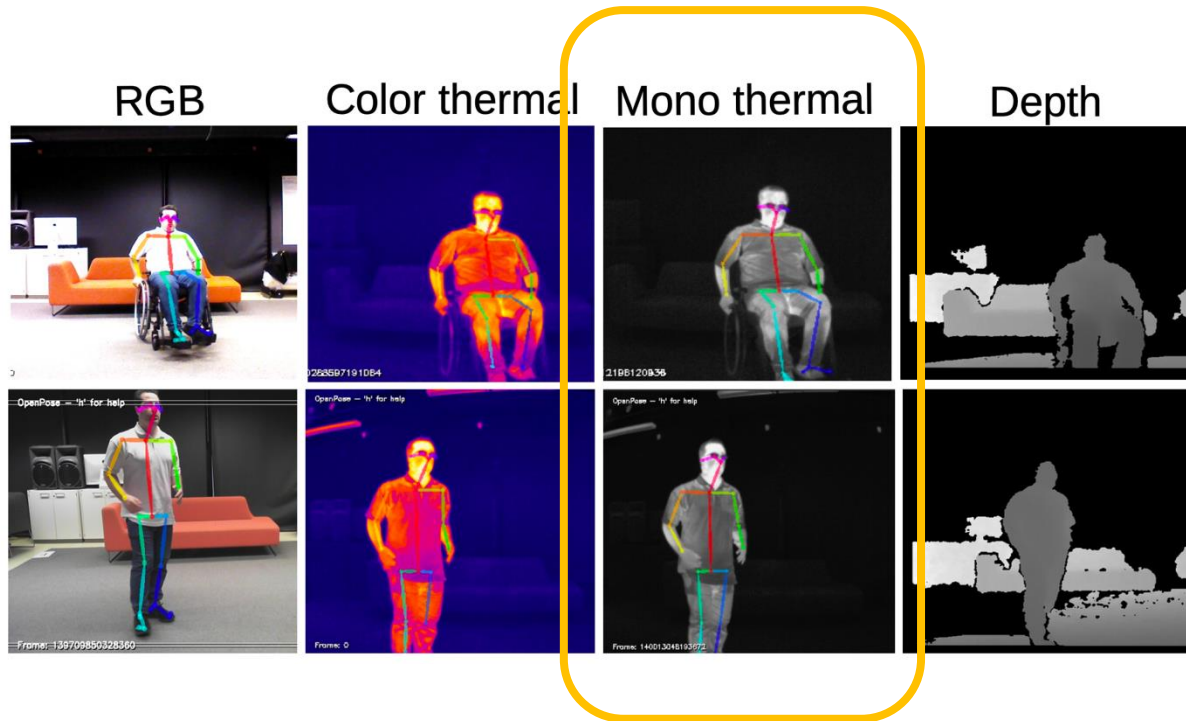
- Challenge 1: Balance the **privacy of the elderly** against the **needs for data** collection for having an efficiently functioning and safe elderly care robot.
- Challenge 2: Protection of sensitive data to **avoid unwanted distribution and misuse** of such data.
- Mitigation:
 - **Sensor type:** Use sensors collecting less privacy related information (person identifiable vs bio-signals/medical diagnostic)
 - **Sensor data processing:** Process data locally rather than sending sensor data over Internet

PriMA-Care: Privacy-Preserving Multi-modal Dataset for Human Activity Recognition in Care Robots



The employed robot during data collection and the various sensors utilized in the process. a: TIAGo robot and its manipulator's internal encoders, b: RGB-D camera, c: Thermal camera, d: 3D Lidar, e: Torque/force sensor, f: Ultra-wideband, g: 2D Lidar, h: Wearable sensor.

Vision-Based Sensors for Human Monitoring in Care Robots – Utility-Privacy Trade-off



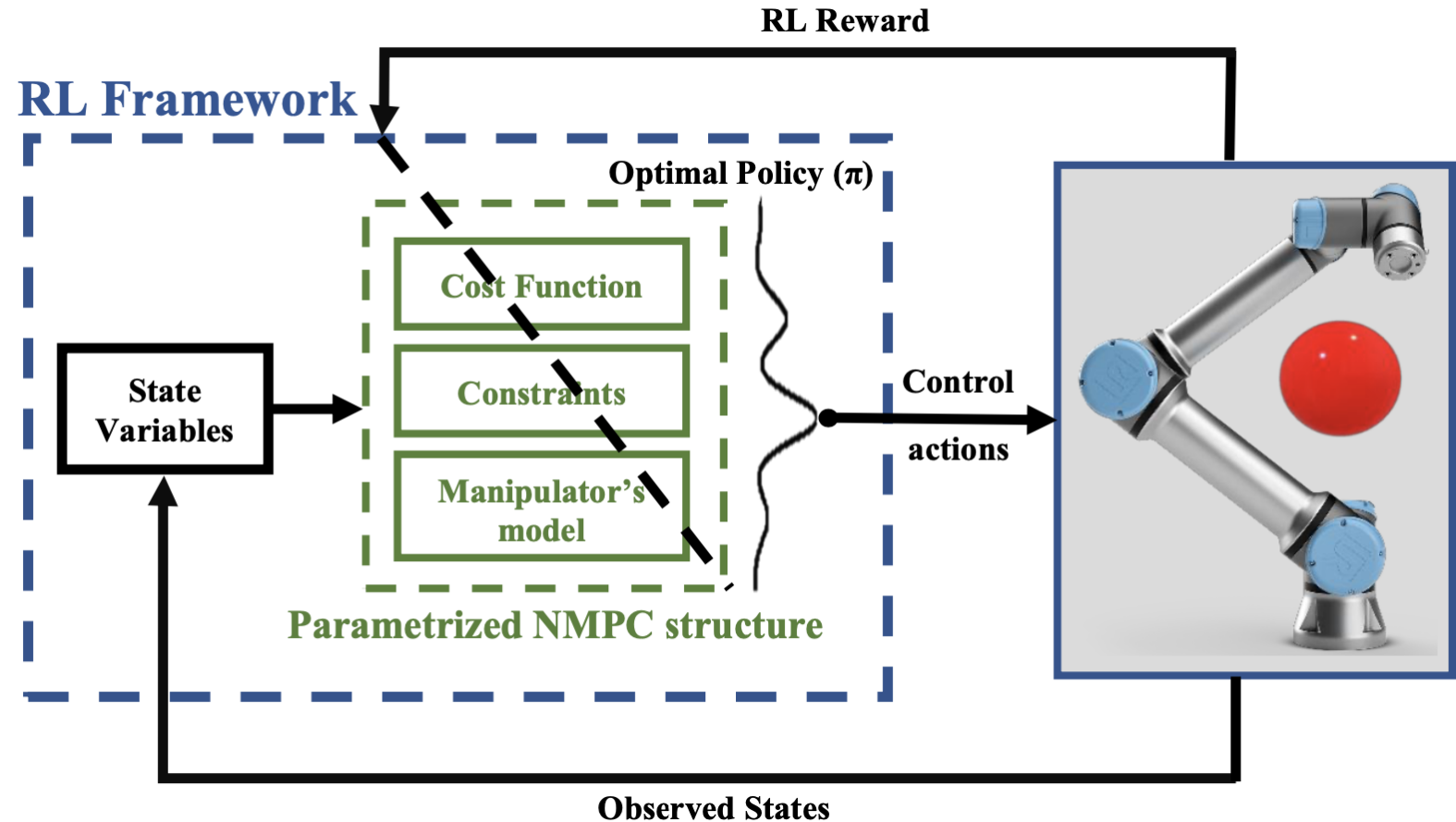
- Mono-color thermal cameras as the optimal choice for human monitoring.
- Displaying vision sensor outputs doesn't significantly impact users' perceived privacy.
- Participants' age doesn't significantly influence perceived privacy.

Ethical Concerns: 3. Safety

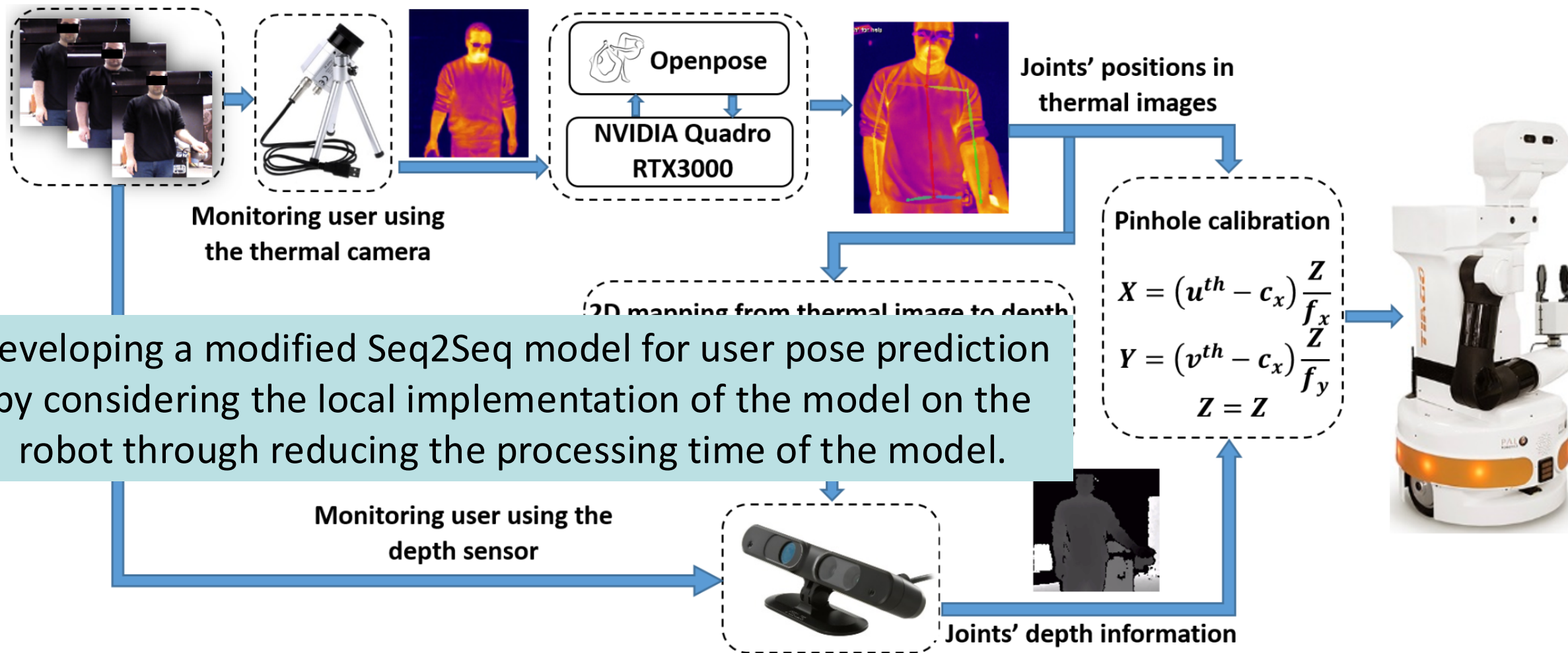
- Challenge: Robots getting **physically much closer to humans** than what we are used to. => Can hit us unintentionally or hurt us through un-authorized access
- Trade-off between robot size, performance and safety
- Mitigation:
 - Equip robots with **soft material**
 - Provide a self/user-aware adaptable system that can **learn about the user's daily activities** and preferences
 - **Explainable AI/transparent systems** to be able to correct for unwanted or harming behavior

Motion Planning and Obstacle Avoidance Using Non-lin. Model Predictive Control-based Reinforcement Learning

- Controller can effectively control the end-effector's pose in such a way as to avoid any collisions
- NMPC parameters are tuned using a learning strategy according to the RL reward



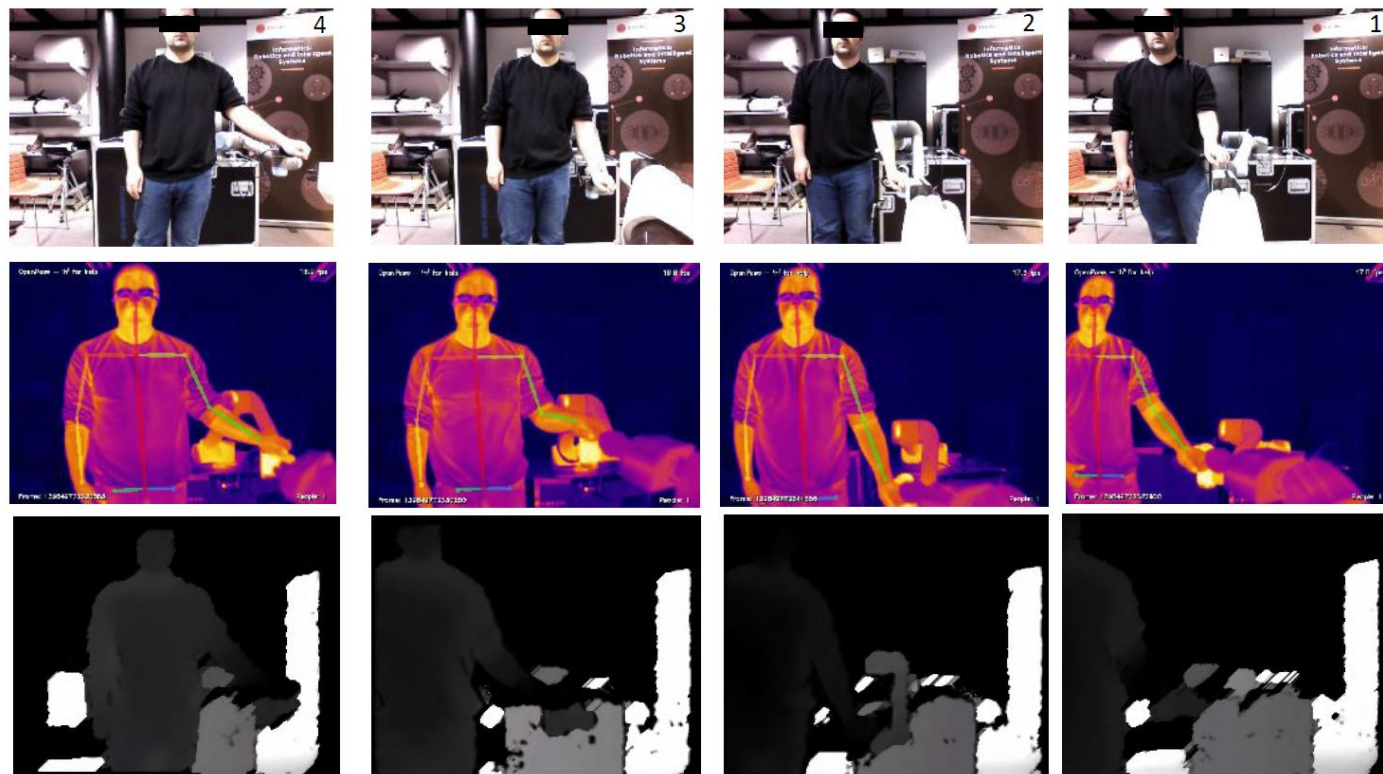
Privacy-Preserving User Pose Prediction for Safe and Efficient Human-Robot Interaction



Privacy-Preserving User Pose Prediction for Safe and Efficient Human-Robot Interaction

- User moved their hand in front of the robot (supported by a UR-5 arm for repeatable trajectories).
- The robot's end-effector was programmed to detect the user hand and follow it.
- Once the current and once the predicted user's hand positions were sent to the robot as the desired trajectories to follow.

13.8 % improvement
in the robot reaction
time was obtained



Robots in elderly facilities



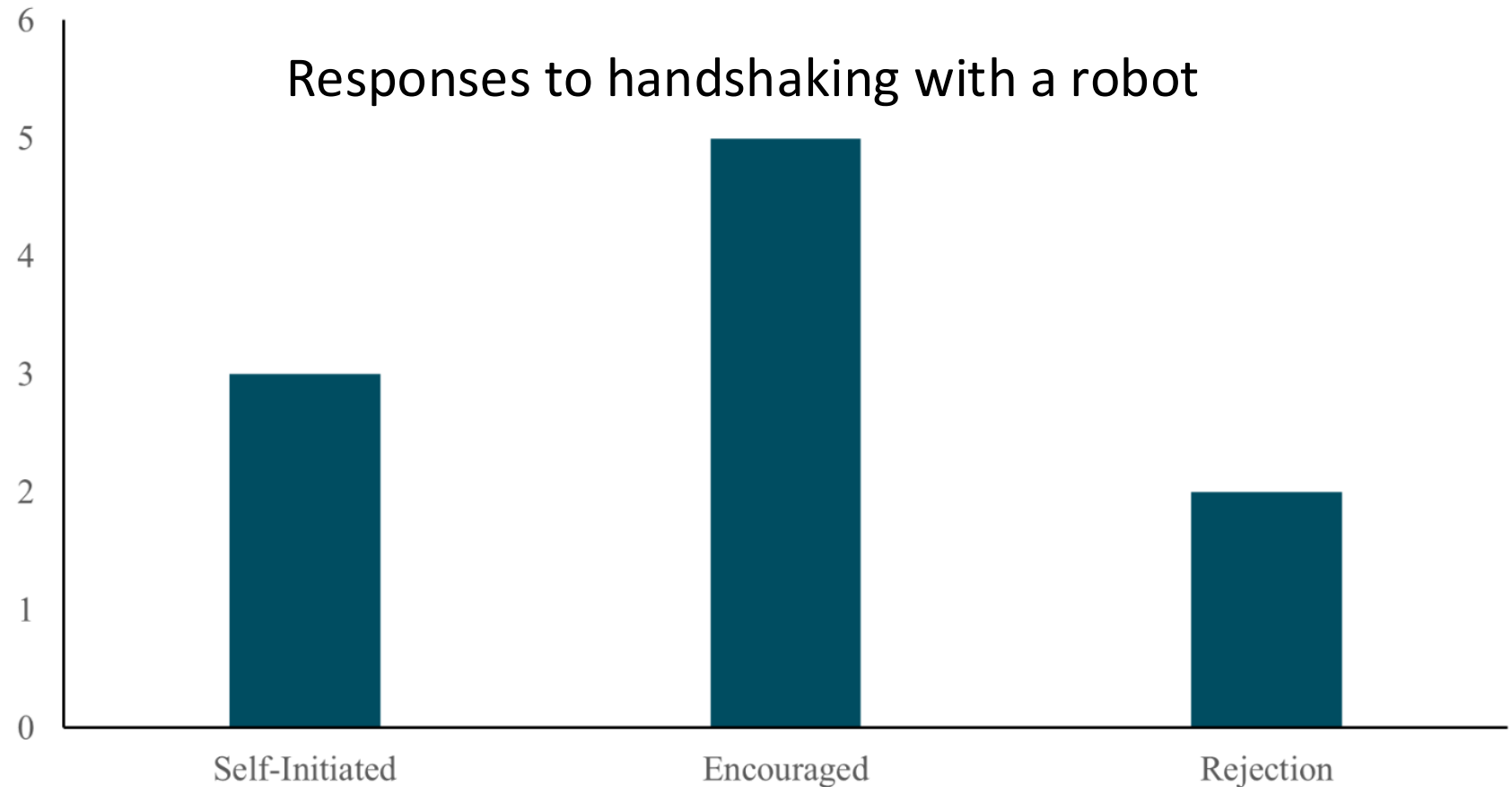
Photos: Diana Saplacan

To Shake or Not to Shake: Intuitive Reactions of Senior Adults to a Robot Handshake

Explores the role of intuition in understanding social cues from a robot in a social context



To Shake or Not to Shake: Intuitive Reactions of Senior Adults to a Robot Handshake



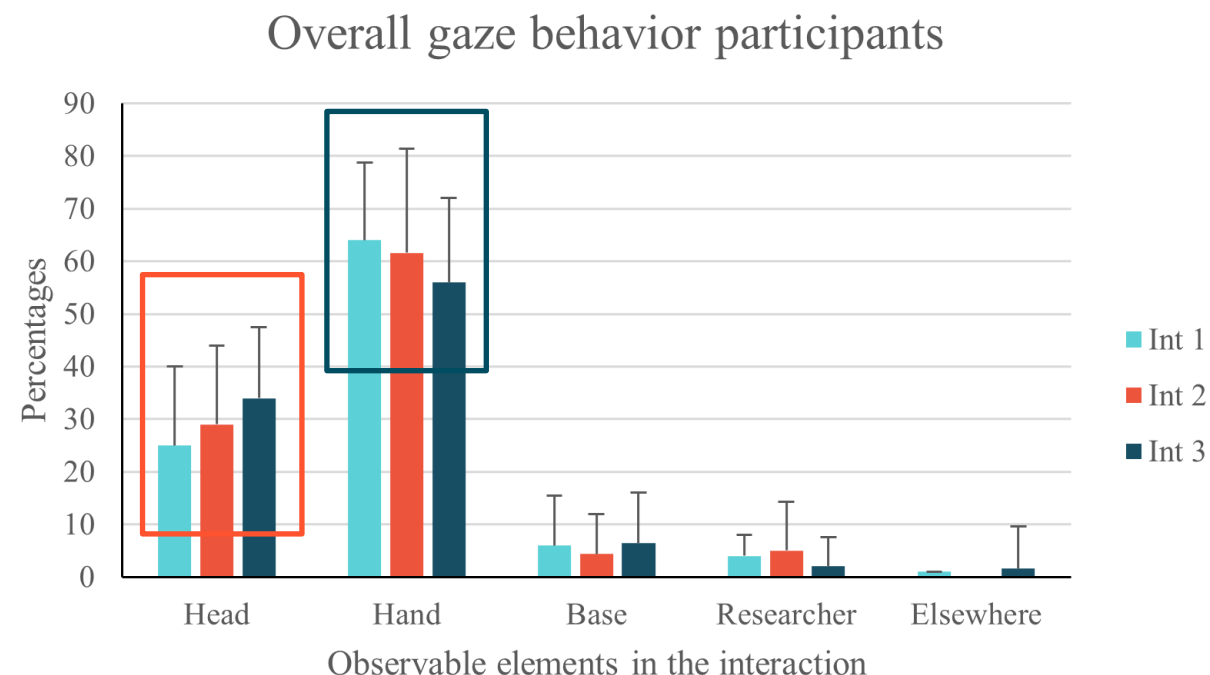
The gaze fixation of the user moves from the robot's hand to its head

Fixation on the robot's hand

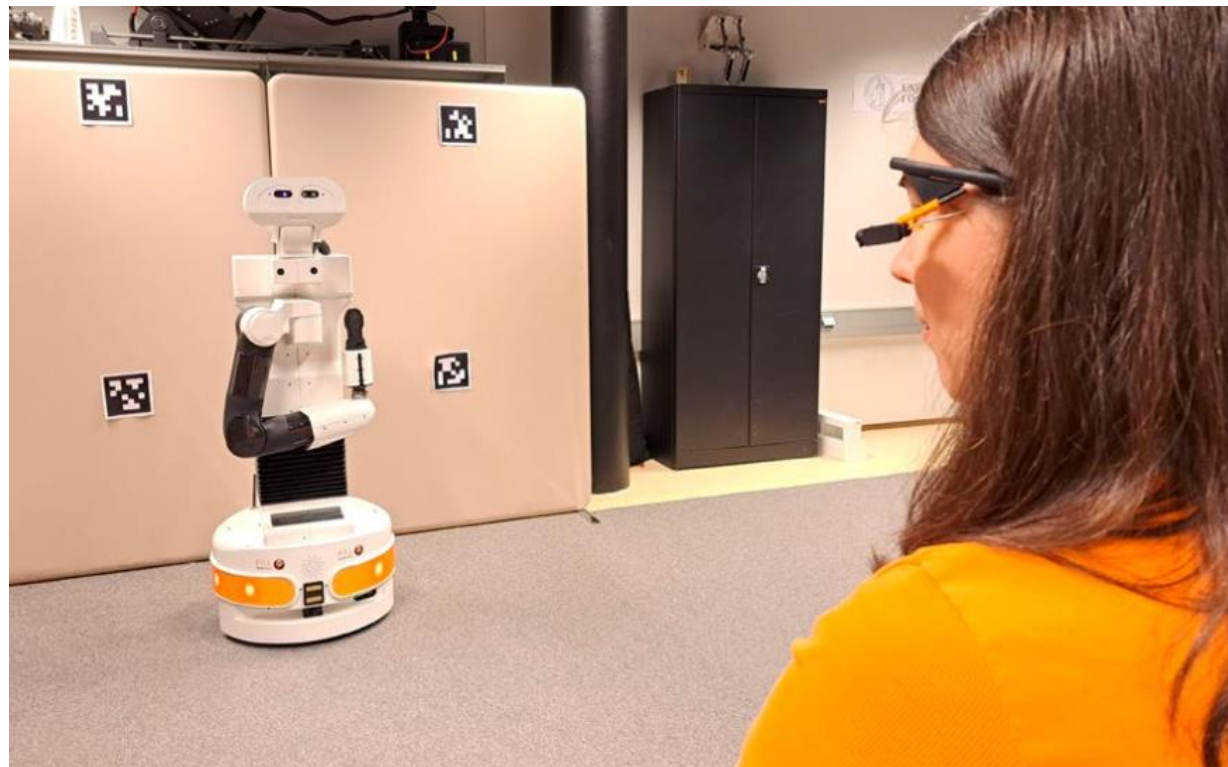
Decreases with 8%

Fixation on the robot's head

Increases with 10%



How Consistent Robot Speech and Gestures Impact Human Intuitive Understanding of Robot Intentions



- Pupil Core headset from Pupil Labs
- Measured mental effort and processing time by observing the pupil change.
- Large pupil size means high mental effort

van Otterdijk, M., Laeng, B., Saplacan-Lindblom, D. *et al.* Seeing Meaning: How Congruent Robot Speech and Gestures Impact Human Intuitive Understanding of Robot Intentions. *Int J of Soc Robotics* (2025).

<https://doi-org.ezproxy.uio.no/10.1007/s12369-025-01271-0>

How Consistent Robot Speech and Gestures Impact Human Intuitive Understanding of Robot Intentions



Examples:

Verbal prompt

Gesture

You have been sitting here for quite some time.

Drinking from
a cup*

Proper hydration is important so do not forget to

My name is TIAGo. It is nice to meet you.

Hand shaking

There is something wrong in the kitchen.

Come here

I need your help to fix it. I need you to...

I finally found the book you were looking for. It
is lying right there on the table.

Pointing at
something

The participant's pupil change was not influenced by the gesture the robot was performing, the congruency between speech and behavior, or whether the person was able to identify the gesture.

We found significant differences in human processing time for the correct understanding of the robot's behavior.

van Otterdijk, M., Laeng, B., Saplacan-Lindblom, D. *et al.* Seeing Meaning: How Congruent Robot Speech and Gestures Impact Human Intuitive Understanding of Robot Intentions. *Int J of Soc Robotics* (2025).

<https://doi-org.ezproxy.uio.no/10.1007/s12369-025-01271-0>

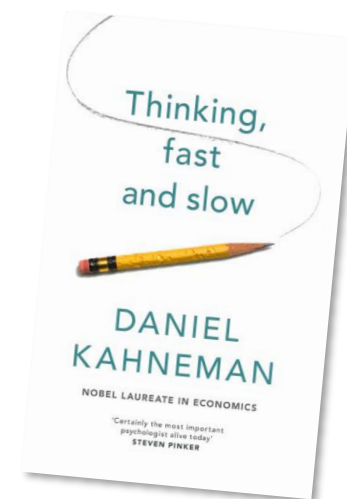
Predictive and Intuitive Robot Companion (PIRC) (2020-2028)

Research Council of Norway grant 312333



Goal: Build **models** that **forecast** future events and **respond dynamically by psychology-inspired computing:**

- Apply recent models of **human prediction** to perception-action loops of future intelligent robot companions.
- Include mechanisms for **adaptive response time** from quick and intuitive to slower and well-reasoned
- **Applications:** Physical rehabilitation and home care robot support.



Funding: IKTPLUS, Research
Council of Norway



**The Research Council
of Norway**

Predictive and Intuitive Robot Companion (PIRC)

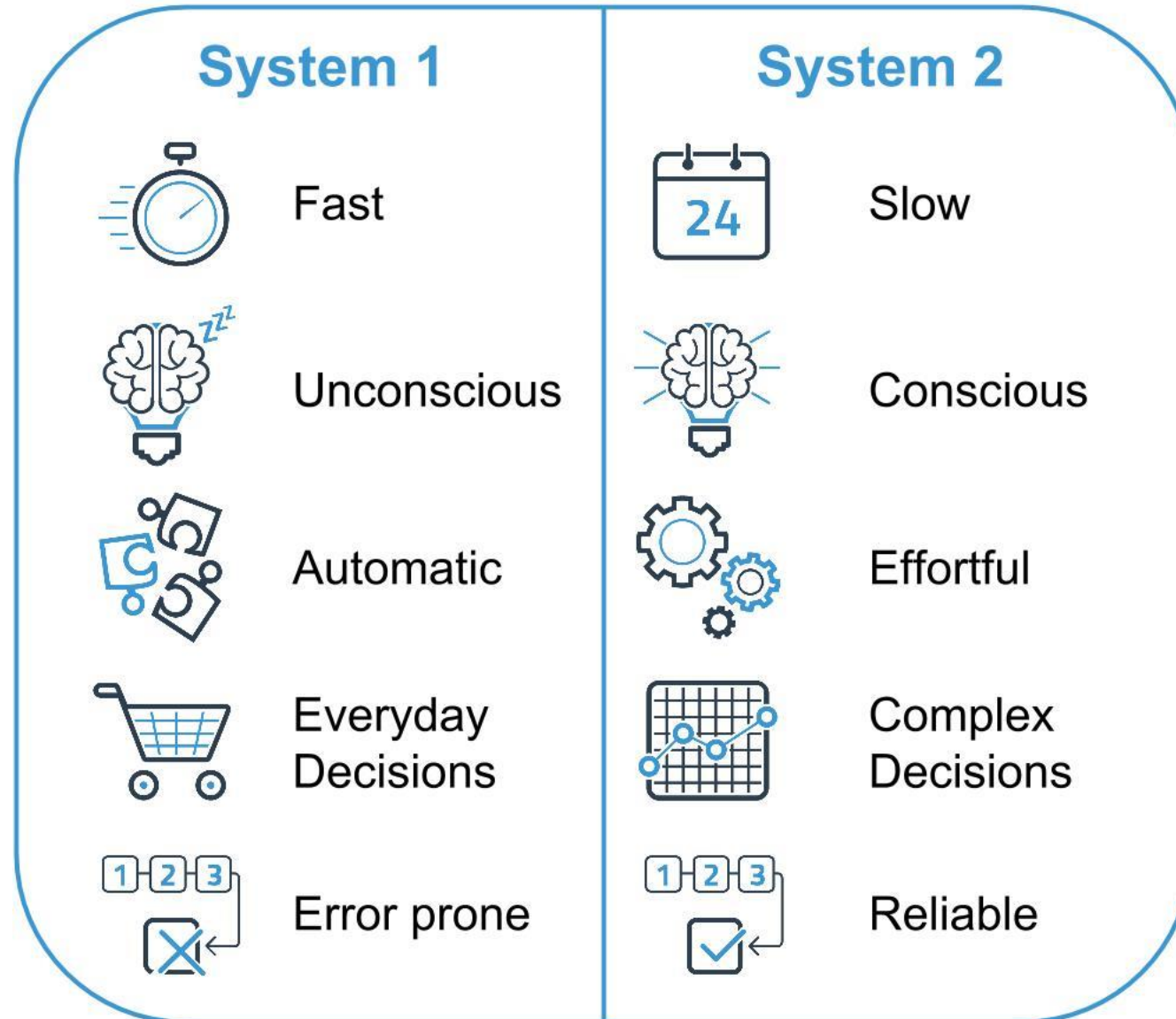


Most of human actions are intuitive

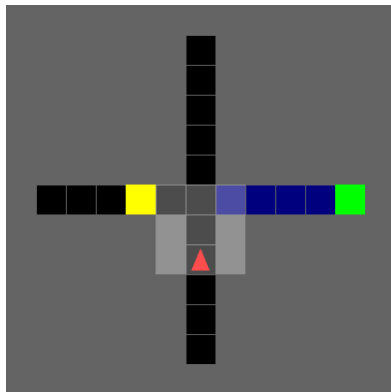
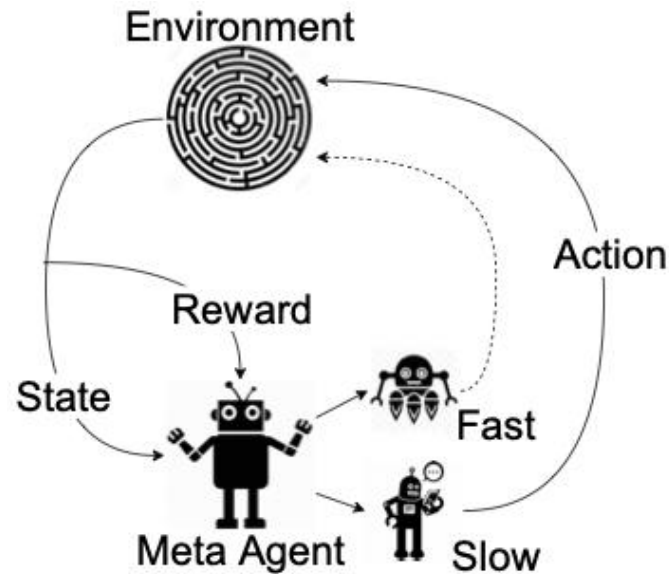


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...but we still have to think where we want to go or what to say...

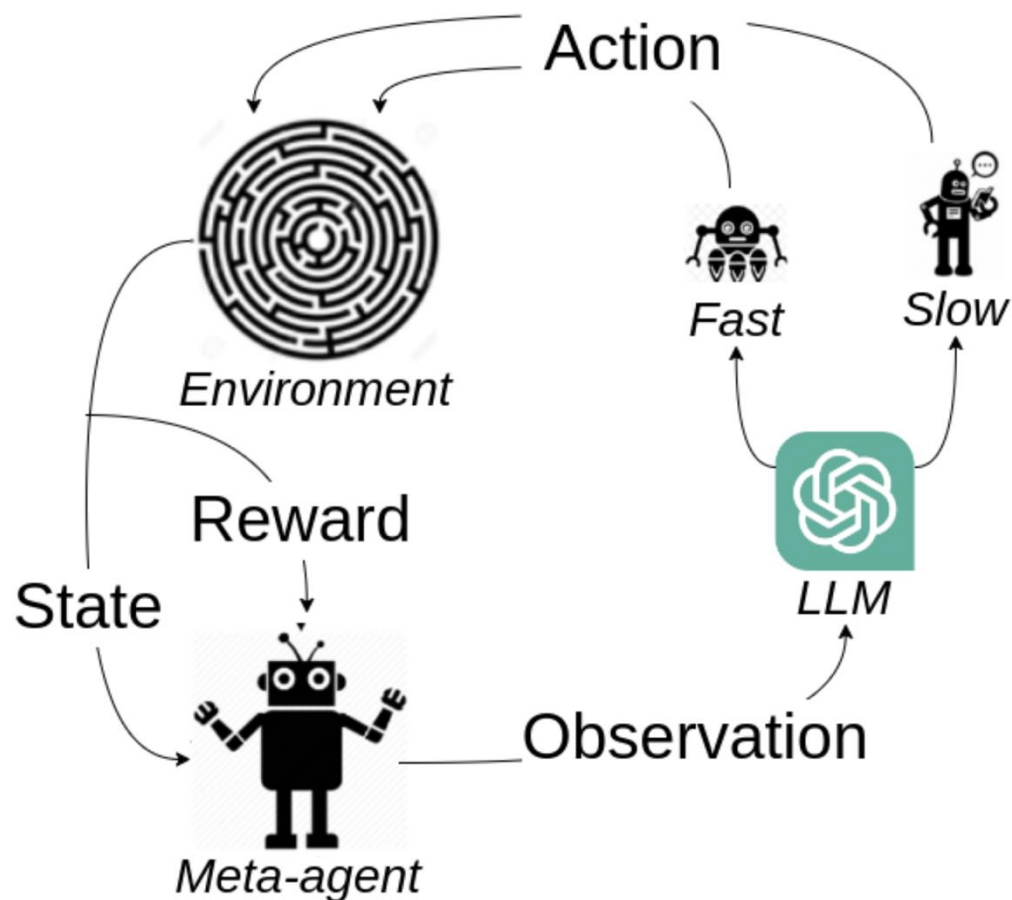


RADAR: Learning When to Think Fast and When to Think Slow

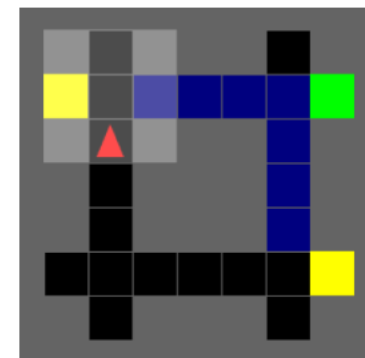
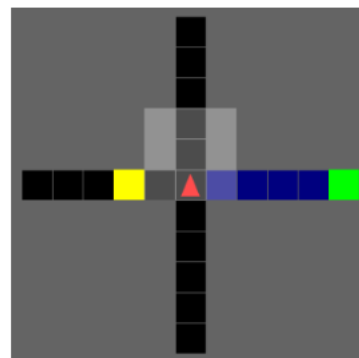


- In reinforcement learning (RL), the **discount factor** parameter, $\gamma \in [0, 1]$, determines **how much agents care about rewards in the distant future** in relation to those in the **immediate future**.
- We train separate “**fast**” ($\gamma=0.1$) and “**slow**” ($\gamma=0.9$) policies for a Reinforcement Learning problem.
- Then, we train a **higher-level meta-agent** to select between the “fast” and “slow” thinking depending on its **current state**.
- We show how this enables it to **react intuitively when possible**, and to **plan ahead when necessary**.

Adaptive Decision-Making in Reinforcement Learning with Pre-Trained LLMs

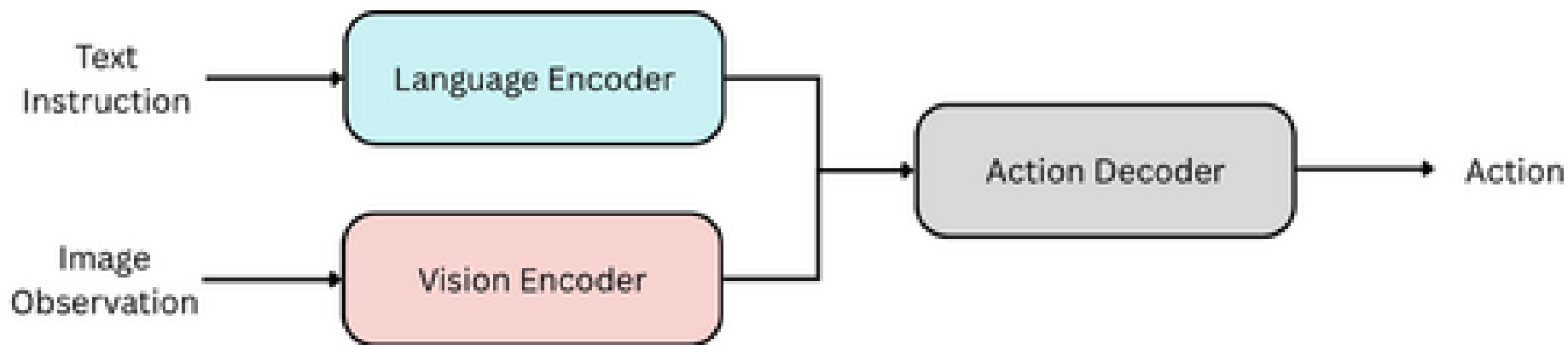


LLM's has the ability to dynamically select the appropriate mode for varying situations in a custom grid-world environment, without requiring additional training or fine-tuning.



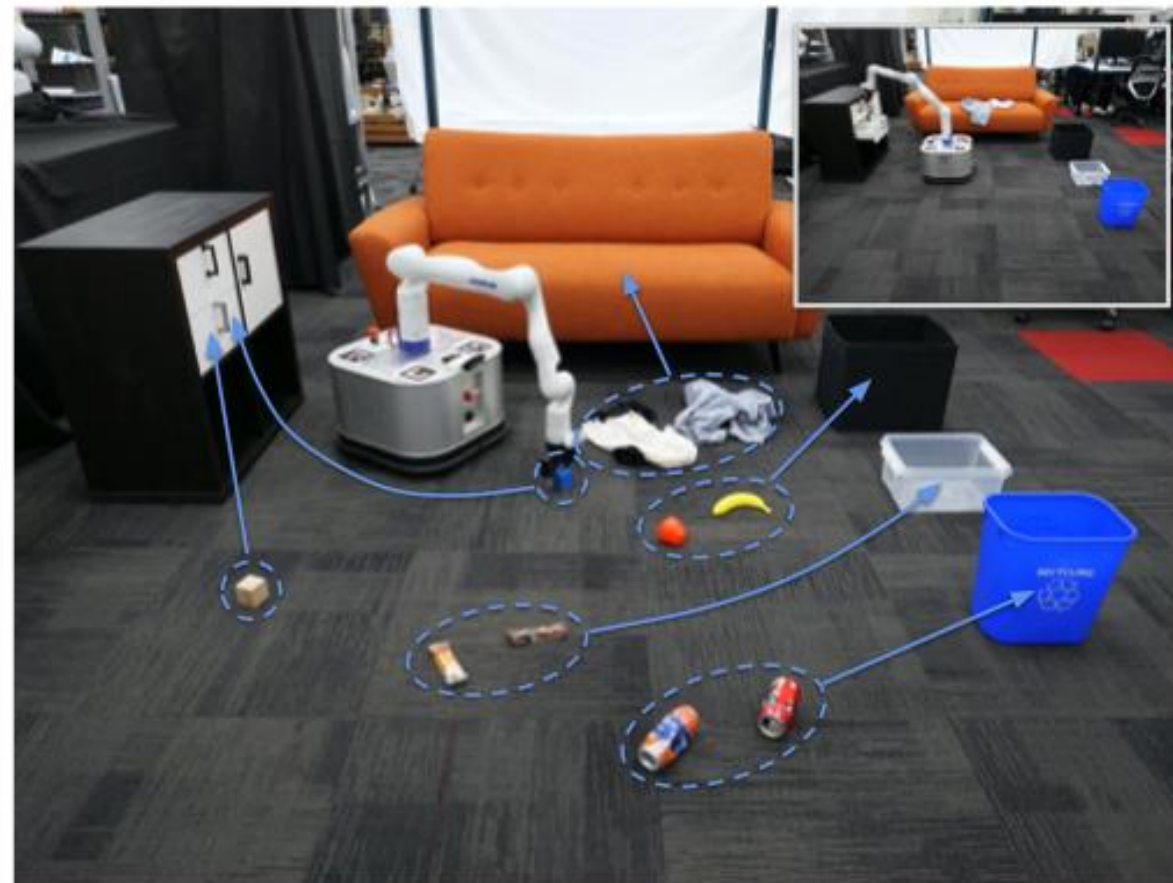
Multimodal language models

- Vision-language model (VLM)
 - bridge the gap between human instructions and robot actions
 - make robots able to understand their environment
 - high-level use due to VLM response time (applications in training and planning rather than direct real-time control)
- Vision-language-action model (VLA)



Robotics + Large/Vision Language models for tidy-up task

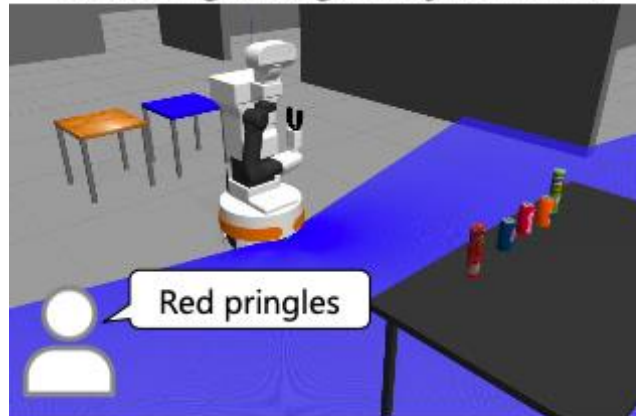
- Reduce the need for a robot to communicate with a user for new objects found
- ROBIN-work builds on: J. Wu, R. Antonova, A. Kan, M. Lepert, A. Zeng, S. Song, J. Bohg, S. Rusinkiewicz, and T. Funkhouser, "Tidybot: Personalized robot assistance with large language models," arXiv preprint arXiv:2305.05658, 2023.



Large Language Models Applied in Robotics – Maeda – exchange student from Japan (2023-24, 5 months)

Method: Overview

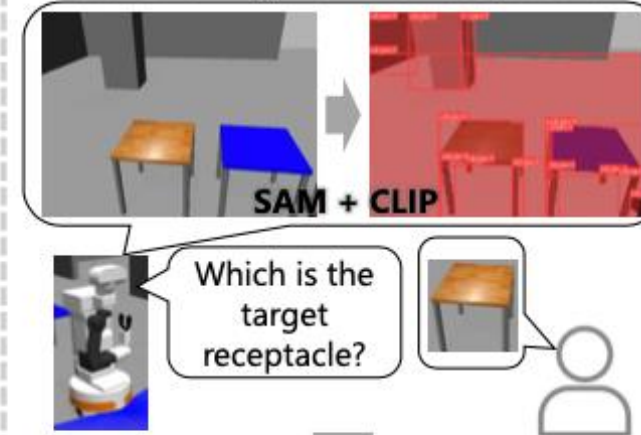
1. Getting a target object name



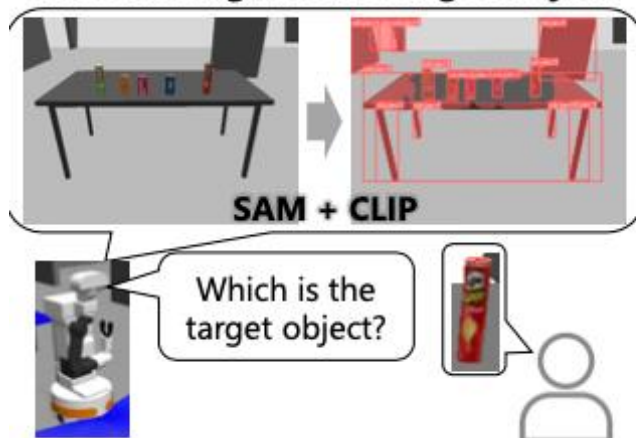
3. Planning and picking



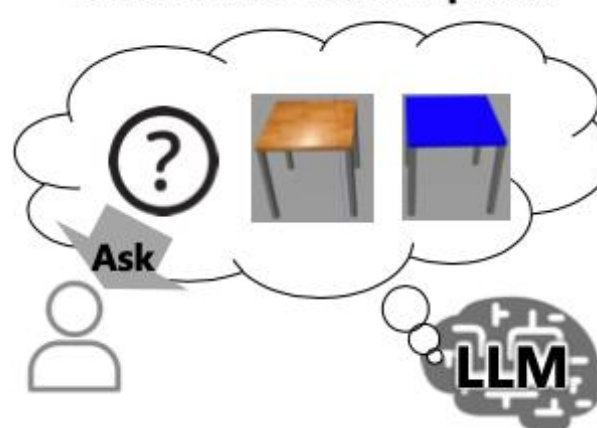
5. Searching for the receptacle



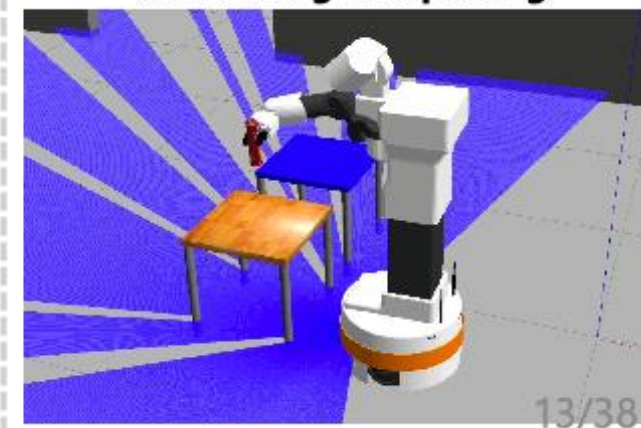
2. Searching for the target object



4. Prediction of a receptacle

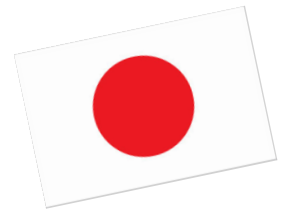


6. Planning and placing

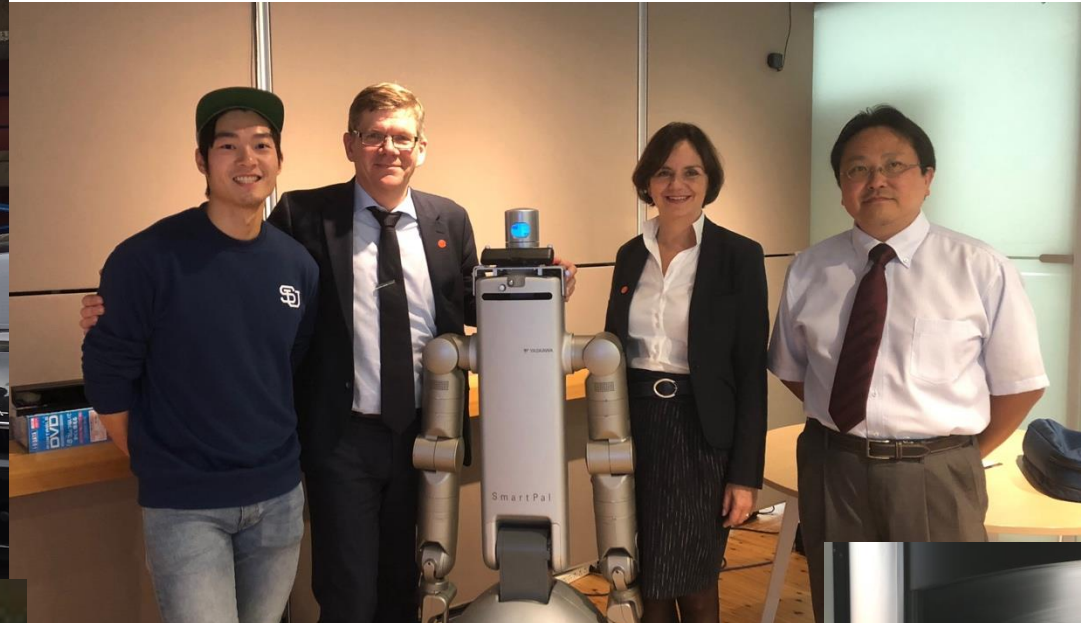


Incoming and outgoing student exchange





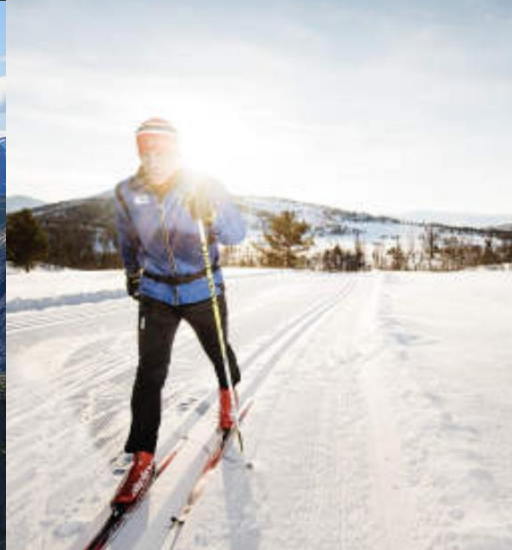
International Collaboration COINMAC grant 261645 (2017-2026)



Much to see and do in and close to Oslo



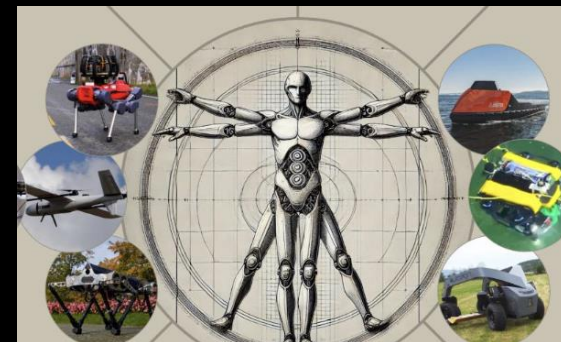
Much to see and do in Norway in any season



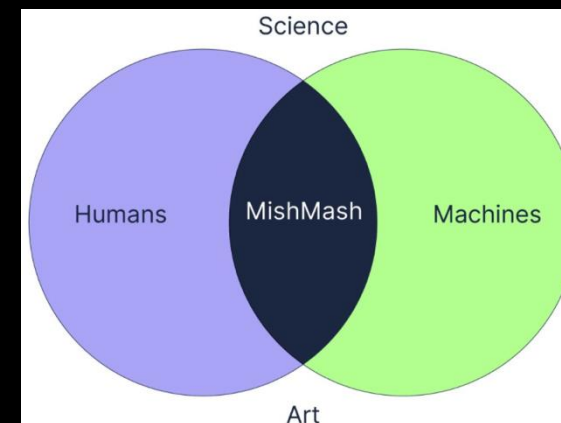
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Future work at ROBIN/UiO (2025-2030):
Involved in two national AI centres funded by
Research Council of Norway (each 20 million €)

Norwegian Centre for Embodied AI – bridges mind-and-matter that can enable physical agents – robots – to autonomously operate in our world and demonstrate unprecedented levels of physical skills and intelligence.



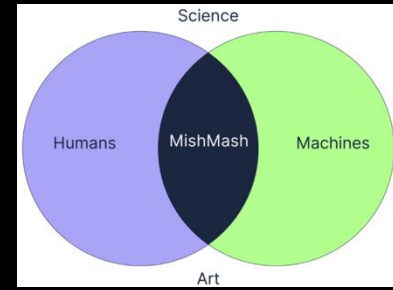
MishMash - Centre for AI & Creativity – focuses on the meeting point between humans and machines and working between artistic and scientific research.



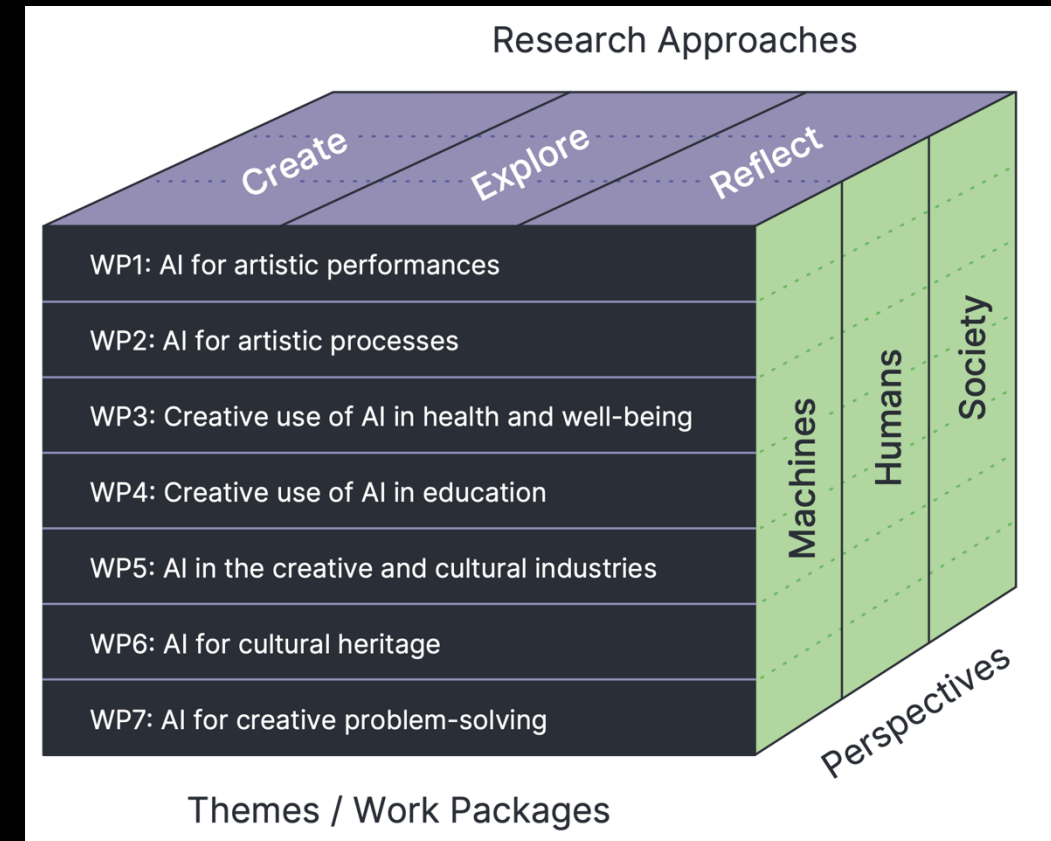


MishMash - Centre for AI & Creativity

A national AI centre funded by Research Council of Norway (2025-2030, 20 million €)



Research Question: What are the possibilities, limitations, and transformative effects of AI on creative practices, and how can we develop CoCreative AI systems that complement human creativity while addressing ethical, cultural, and societal implications?



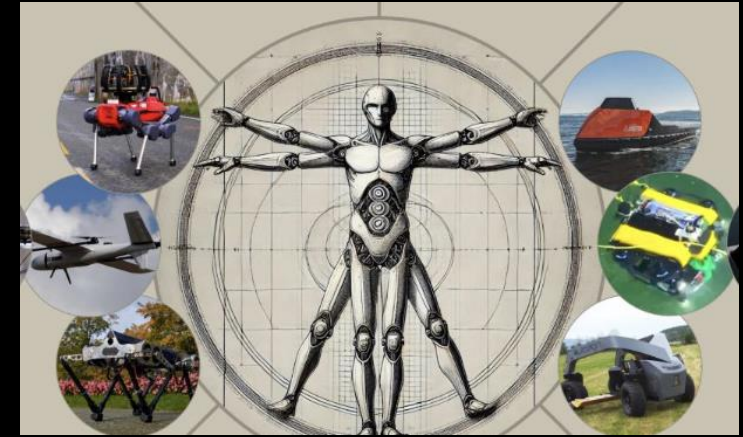
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Norwegian Centre for Embodied AI (NCEI)

A national AI centre funded by Research Council of Norway (2025-2030, 20 million €)

Norwegian Centre for Embodied AI – bridges mind-and-matter that can enable physical agents – robots – to autonomously operate in our world and demonstrate unprecedented levels of physical skills and intelligence.

The Norwegian Centre for Embodied AI (NCEI) strives to develop a **Universal Science of Embodied AI** for diverse robot morphologies and on its basis enable the **computational co-design** of a robot's autonomy (i.e., the “brain”) and morphology (i.e., the “body”).



The ROBIN group at UiO leads two work packages:

- WP3: “Body-and-Brain” Computational Co-design
- WP10: Ethics in Embodied AI



We should focus as least as much on improved
quality of life as reducing the cost by the
technology being developed

Questions, Comments or Collaborate?

Make contact: jimtoer@ifi.uio.no

www.jimtoer.no

