

THE NATIONAL ROBOTARIUM

PEOPLE CENTRED :: INTELLIGENCE DRIVEN

IoT, Cloud and Robotics for Ambient Assisted Living (AAL)

Dr. **Mauro Dragone**, Assistant Professor
Robotic Assisted Living Testbed (RALT, <http://ralt.hw.ac.uk>)
Institute Sensors, Signals and Systems, School of Engineering & Physical Science
Heriot-Watt University

Academic Faculty



Dr Mauro Dragone
Assistant Professor



Dr Marta Vallejo
Research Fellow

Doctoral Students



Alexandre Colle
September 2019 - Present



Scott MacLeod
June 2018 - Present



Ronnie Smith
September 2018 - Present



Thomas Gillett
October 2020 - Present

Research Assistants



Meriam Moujahid
September 2020 - Present

Research Associates



Petros Papadopoulos
September 2020 - Present

Technologies for Brain Health and Dementia Prevention Workshop 13-14 June 2022
Technology and Innovation Centre, University of Strathclyde

IoT, Cloud & Robotics for Ambient Assisted Living

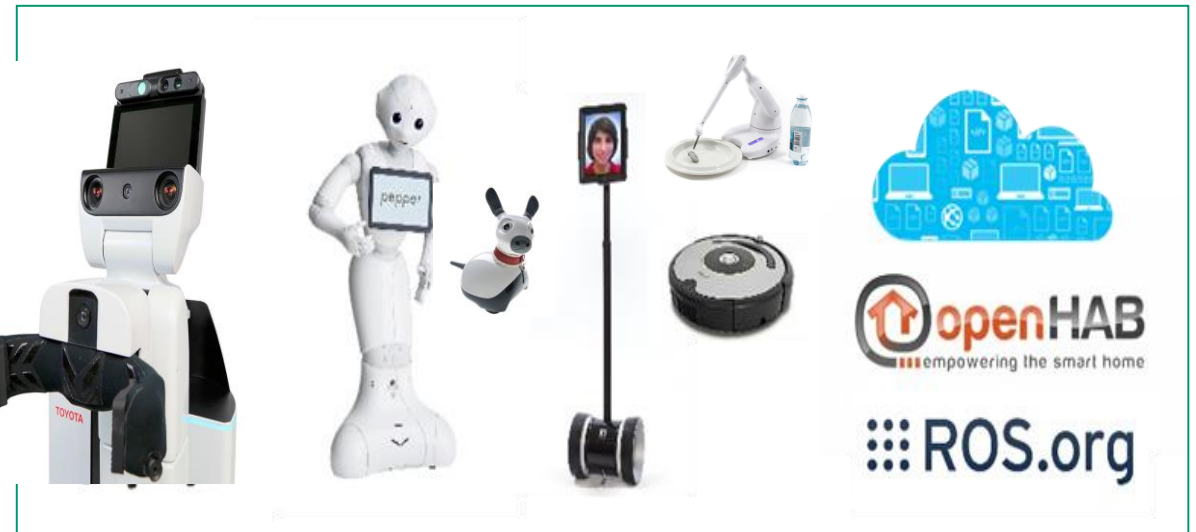
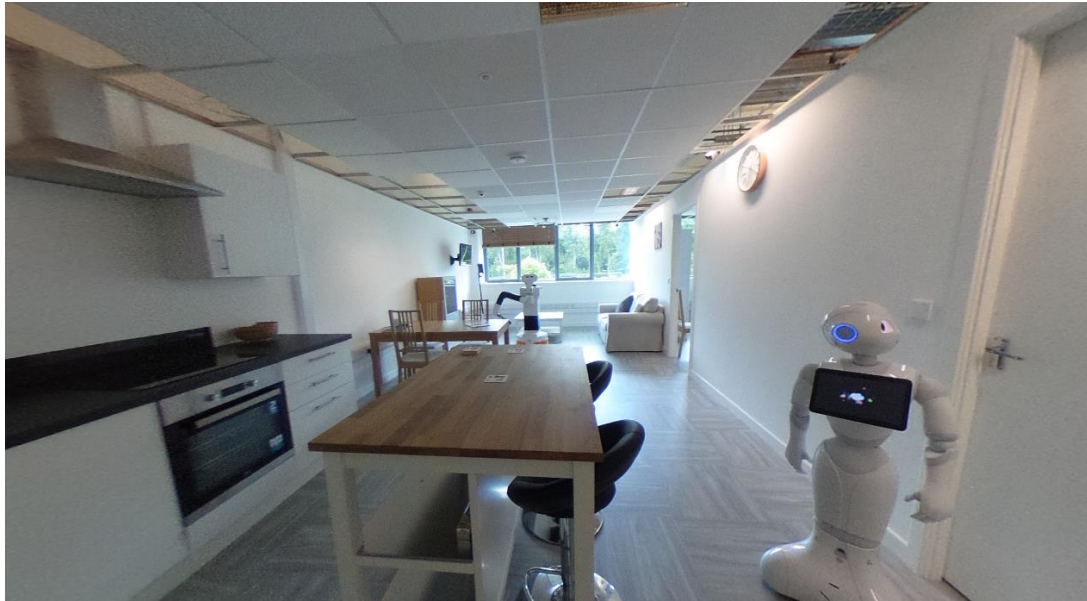
Testbed and Context

R&D Overview

**OpenAAL
(Open AAL Lab)**

Robotic Assisted Living Testbed @ Heriot Watt University

A smart home showcasing examples of (semi-)autonomous, interactive and **connected** robotic devices.



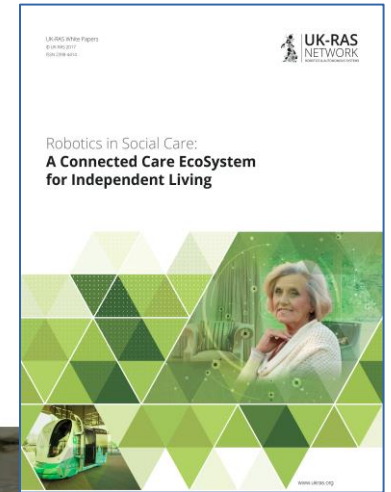
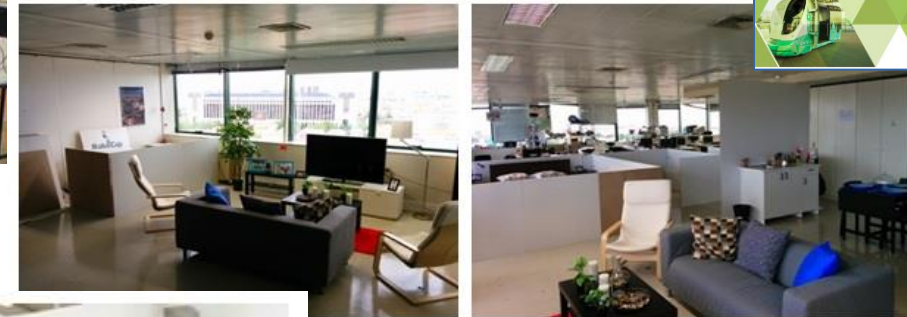
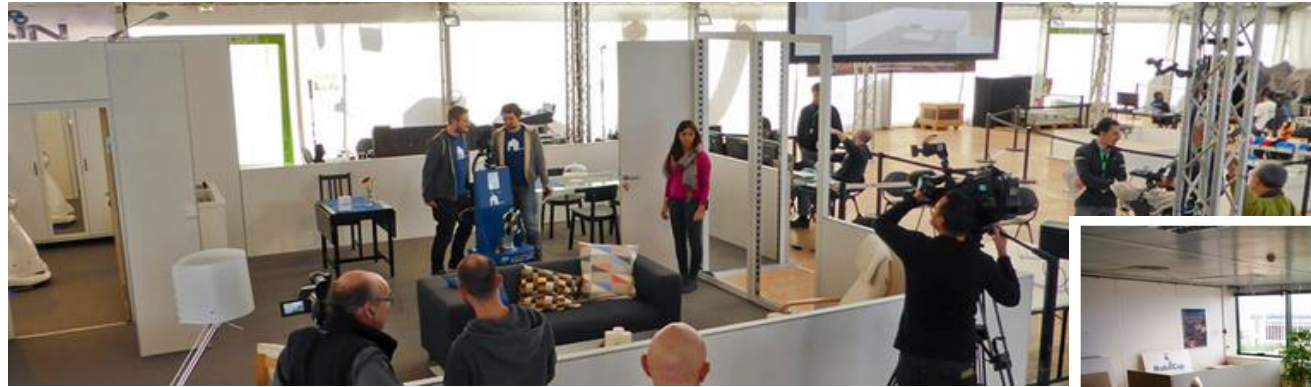
- Evaluation & Benchmarking
- Research & Datasets
- Co-Design

EPSRC



UK-RAS
NETWORK
ROBOTICS & AUTONOMOUS SYSTEMS

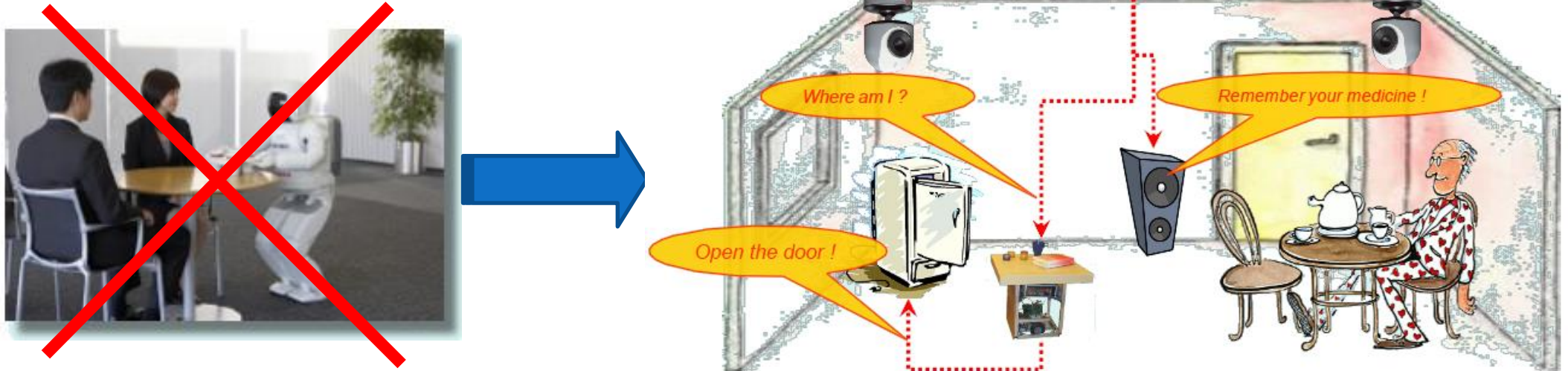
An International Network of Research Laboratories for Assistive Robotics



Prescott, T. J., and Praminda Caleb-Solly. "Robotics in social care: a connected care Ecosystem for independent living." (2017).

Inspiration: “Robotic Ecology”

- Build a highly competent, general purpose robot assistant —
- Build an ecosystem of robotic devices around the human



Embedding sensors and specialized “robotic devices” around the home

The ecology grows and adapts to each user to suit their different stages in life and care needs

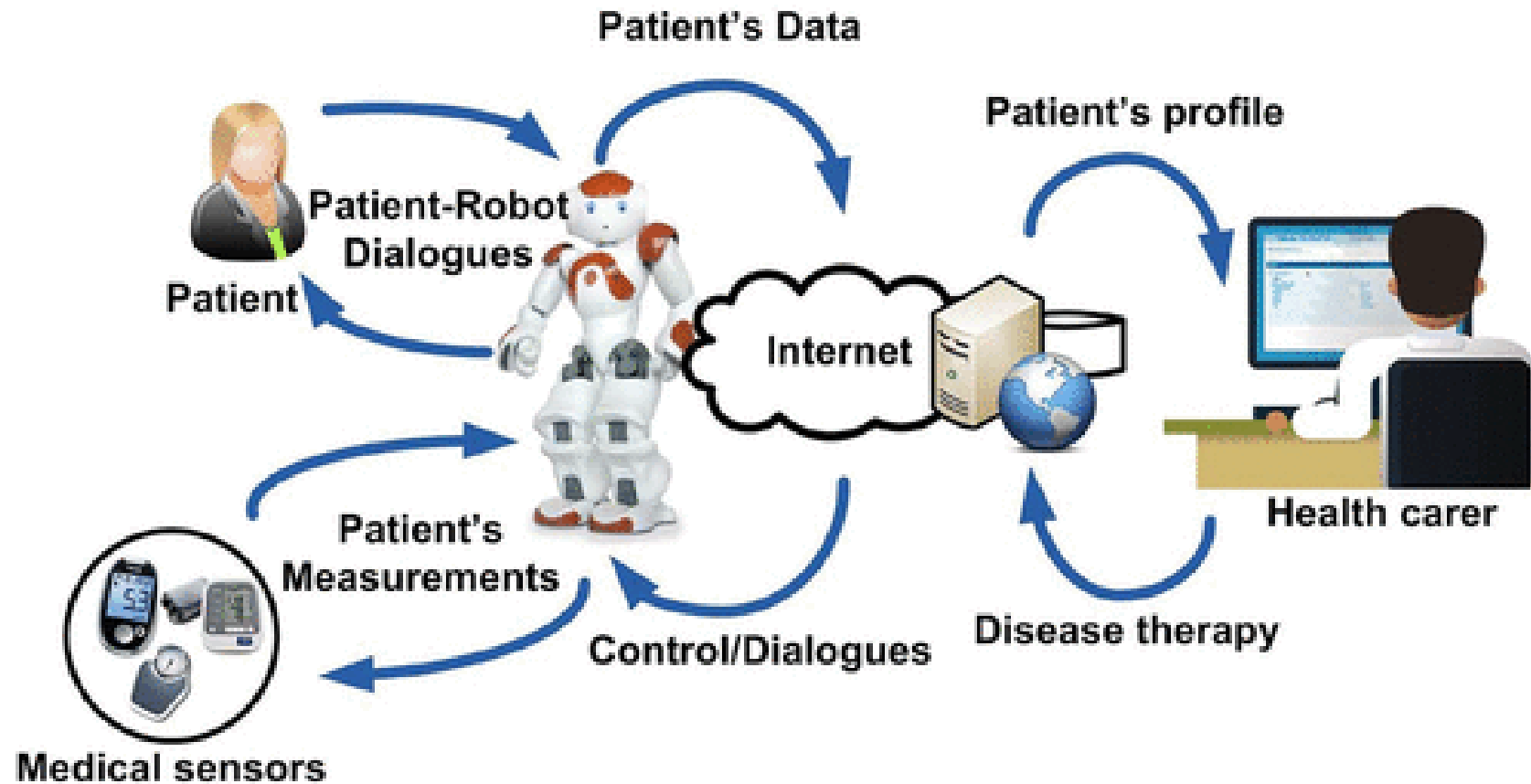
Saffiotti, Alessandro, et al. "The PEIS-ecology project: vision and results." 2008 IEEE/RSJ International Conference on Intelligent Robots and Systems. IEEE, 2008.

Dragone, Mauro, et al. "A cognitive robotic ecology approach to self-configuring and evolving AAL systems." *Engineering Applications of Artificial Intelligence* 45 (2015): 269-280.

“Robotic Devices”



Internet of Robotic Things (IoRT)



Simoens, Pieter, Mauro Dragone, and Alessandro Saffiotti. "The Internet of Robotic Things: A review of concept, added value and applications." International Journal of Advanced Robotic Systems 15.1 (2018): 1729881418759424.

Mauro Dragone, The next great leap forward? Combining robots with the Internet of Things, The Conversation, 2019

Evaluation & Benchmarking: Robotics and Smart Home



Horizon2020
European Union Funding
for Research & Innovation



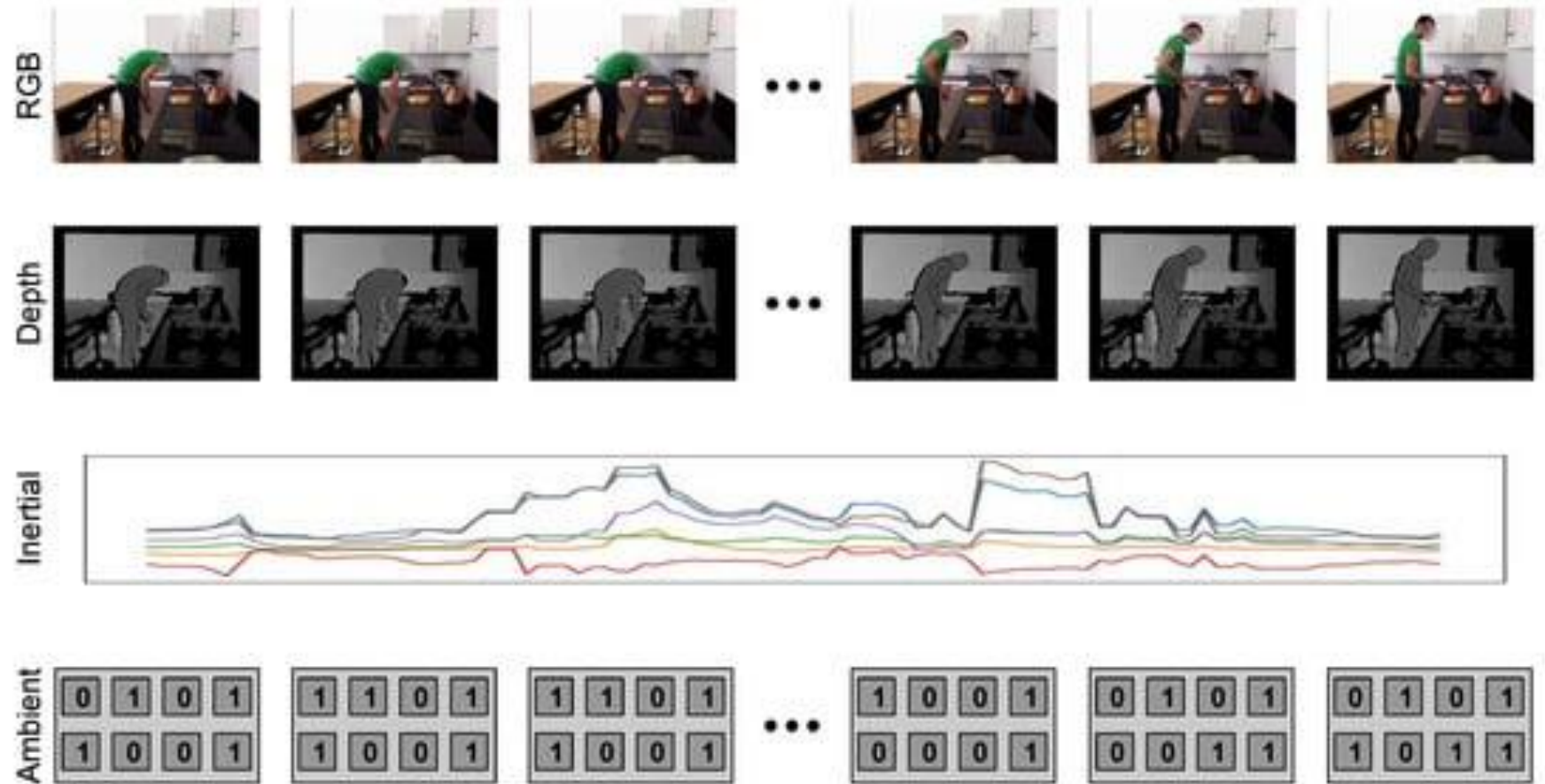
Robotic competitions for consumer (domestic) robots



Evaluation of smart home and home activity monitoring kits.
R&D and consultancy on data analytics / trend analysis / anomaly detection.

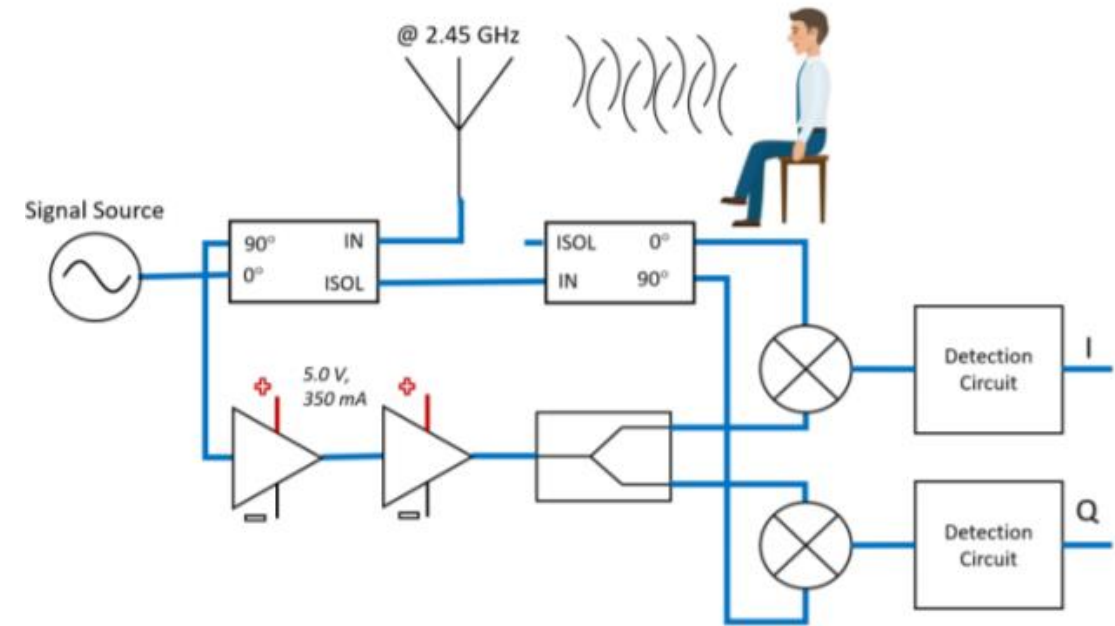


ADL monitoring with heterogeneous sensors



Ranieri, Caetano Mazzoni, et al. "Activity recognition for ambient assisted living with videos, inertial units and ambient sensors." *Sensors* 21.3 (2021): 768.

Device Free Wireless Sensing for behavioural and bio-vital monitoring



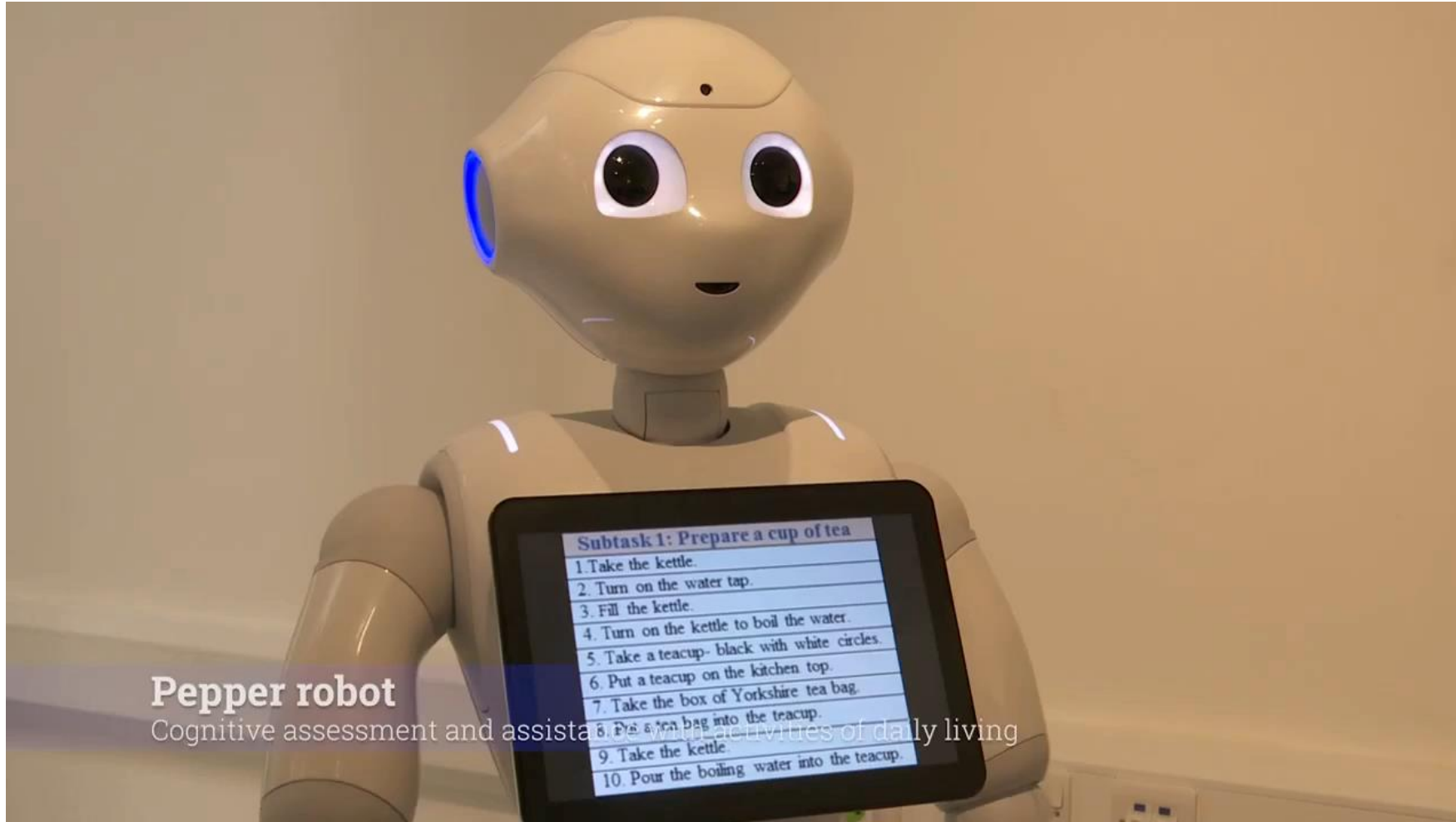
[1] COTS (UHF) RFID for Indoor localisation / home activity monitoring

[2] Radar for Heartbeat and Respiration Detection

[1] Smith, Ronnie, et al. "A COTS (UHF) RFID floor for device-free ambient assisted living monitoring." *International Symposium on Ambient Intelligence*. Springer, Cham, 2020.

[2] Kontou, P., Smida, S. B., Daskalakis, S. N., Nikolaou, S., Dragone, M., & Anagnostou, D. E. (2021, January). Heartbeat and Respiration Detection Using a Low Complexity CW Radar System. In *2020 50th European Microwave Conference (EuMC)* (pp. 929-932). IEEE.

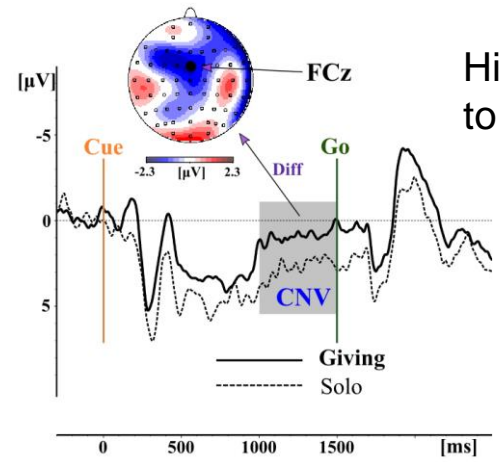
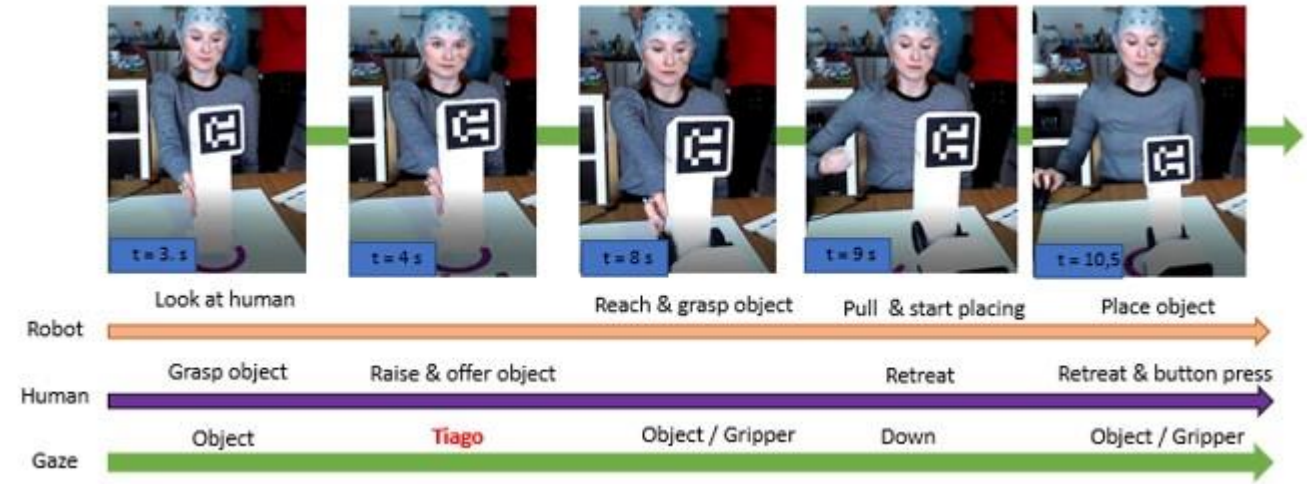
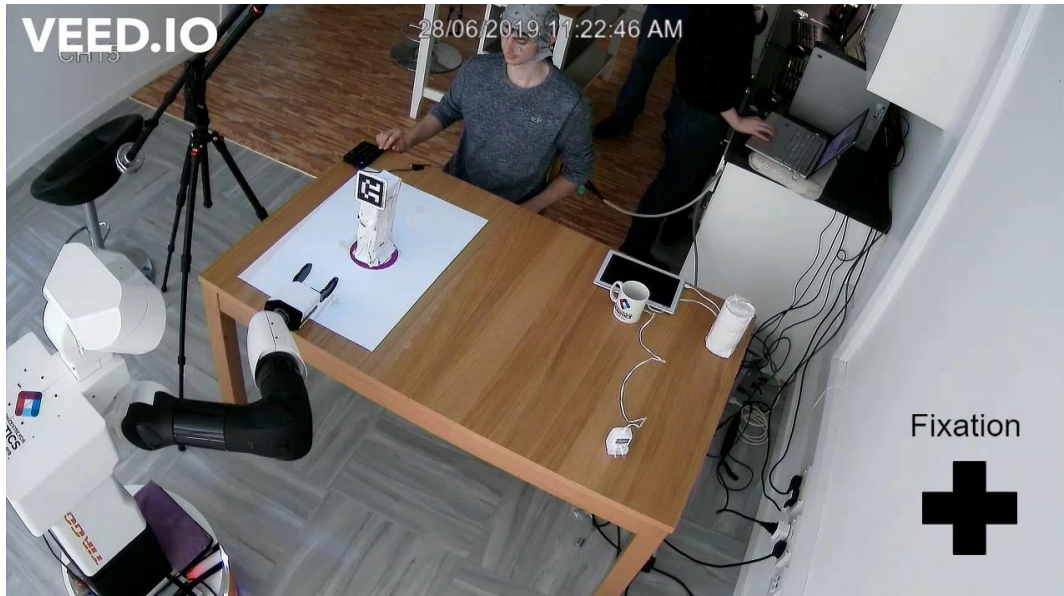
Examples of Assistive Robotic Applications



Pepper robot

Cognitive assessment and assistance with activities of daily living

Hybrid HRI/EEG study of Human-Robot Joint Action

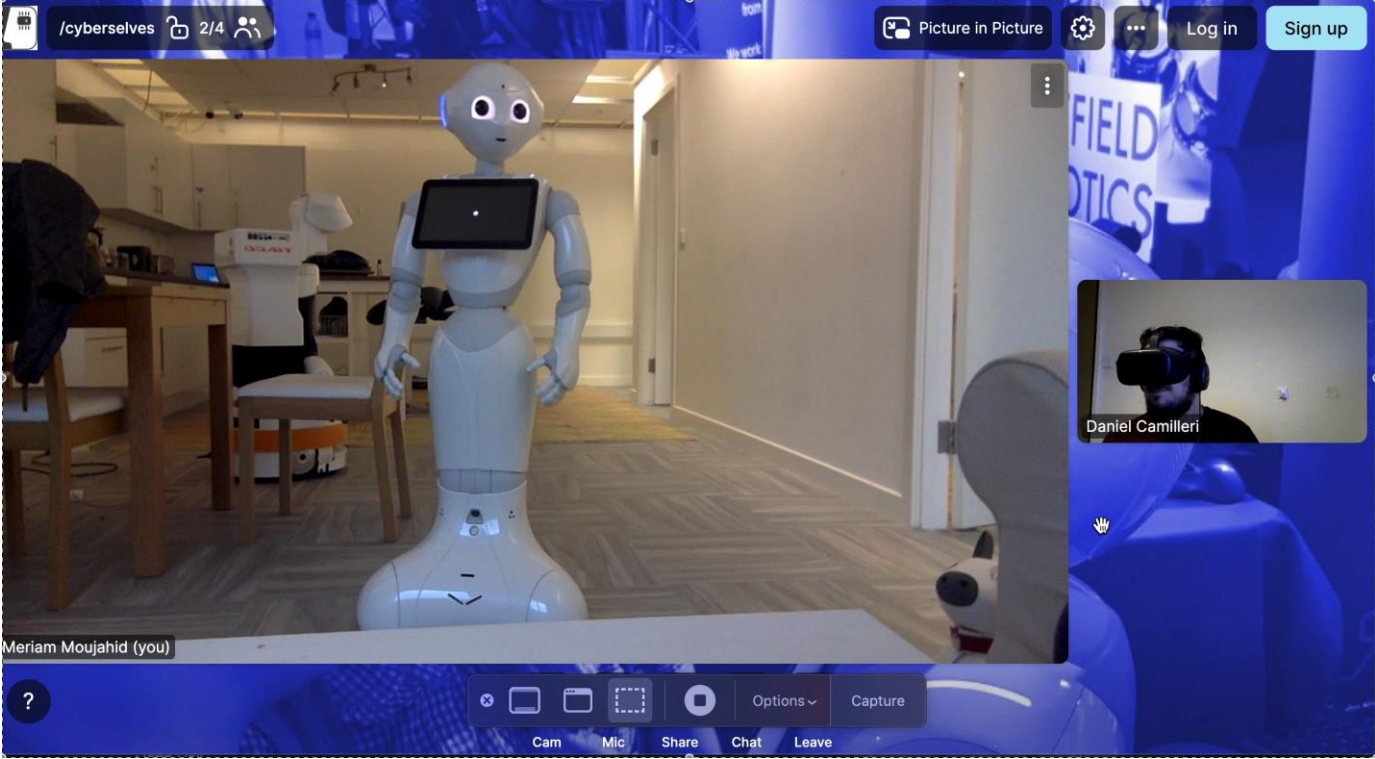


Higher motor readiness in H-R prior to action execution.

1. (Possibly) Higher cognitive demand
2. Evidence of human adapting to the robot

Sara Cooper, Stuart Gow, Samuel F.P. Fensome, Mauro Dragone and Dimitrios Kourtis
 An EEG investigation on planning human-robot handover tasks, *2020 IEEE International Conference on Human-Machine Systems (ICHMS)*. IEEE, 2020.

Telepresence Robotics



Cyberselves
Human ways of talking to machines

Custom made, modular robotics?



Filter



Porter



Social



UV

Additive Manufacturing (AM) process, using a large bed 3D printer

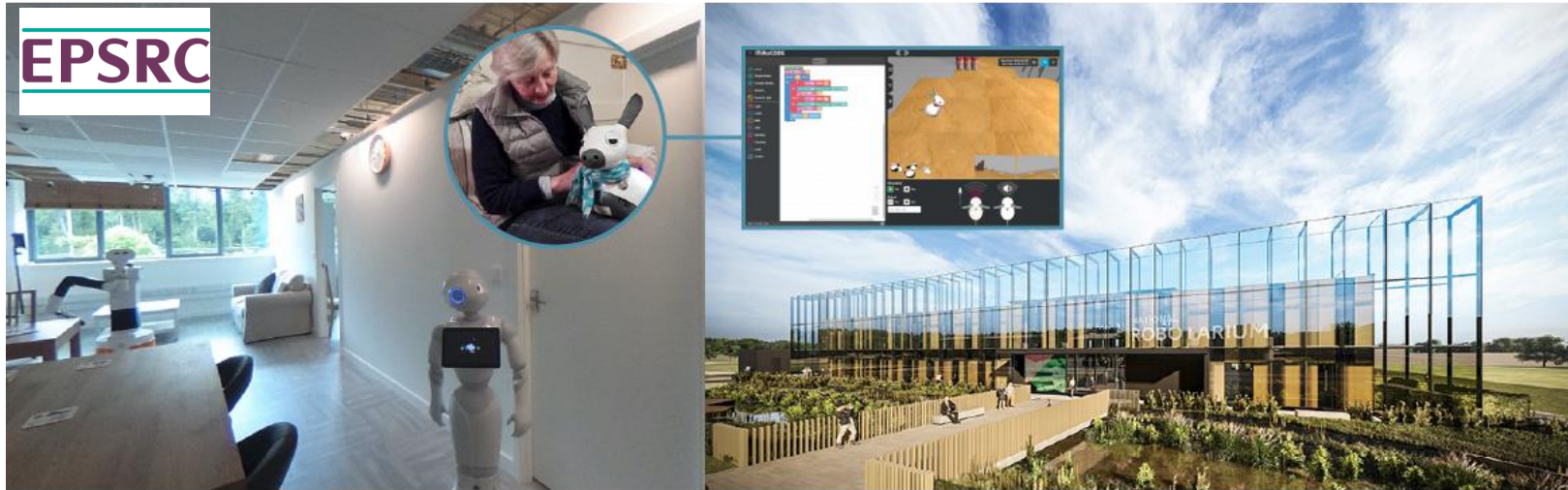
- Encourage local manufacturing
- Enable rapid physical interaction with prototypes
- Promote engagement of local communities



MAAH kompanion.com

A. Colle, R. Smith, S. MacLeod, M. Dragone, Robobrico, a novel modular concept to design a versatile robot with the support of users, shortlisted, ICSR 2021 Robot Design Competition

Open Ambient Assisted Living - OpenAAL



- EPSRC Impact Acceleration Award, <https://ralt.hw.ac.uk/openaal.html>
- Co-Creation of AAL & Health and Social Care robotics

Blackwood
homes | care | support

THE DATALAB
value from data

DIGITAL
HEALTH & CARE
INSTITUTE

Consequential
ROBOTICS

CPS
COALITION OF CARE AND
SUPPORT PROVIDERS
IN SCOTLAND

Sight
Scotland

Cyberselves

ACTION ON
HEARING
LOSS
SCOTLAND
A national charity since 1911

Scottish Care
Voice of the independent care sector

Inclusion
Scotland
Disabled People's Organisation

NHS
Lothian

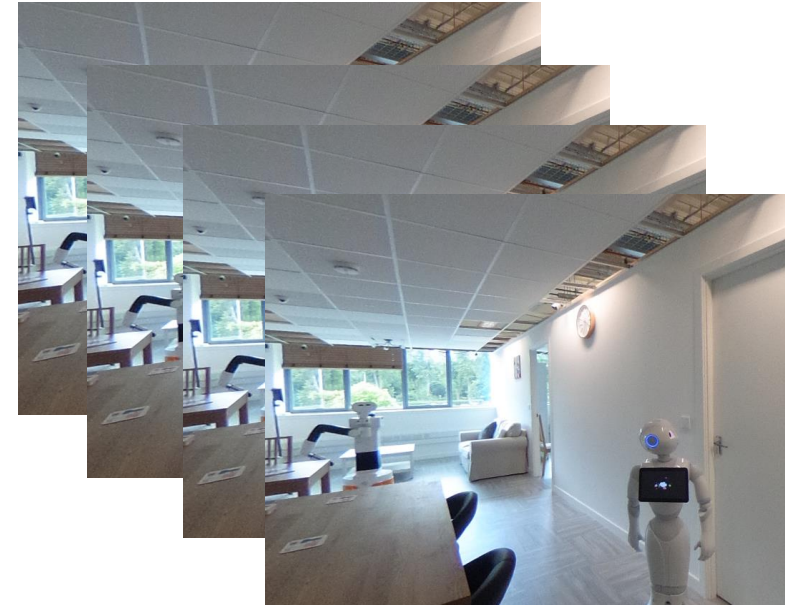
EPSRC Impact Accelerator Award OpenAAL Internet of Lab Things [1]



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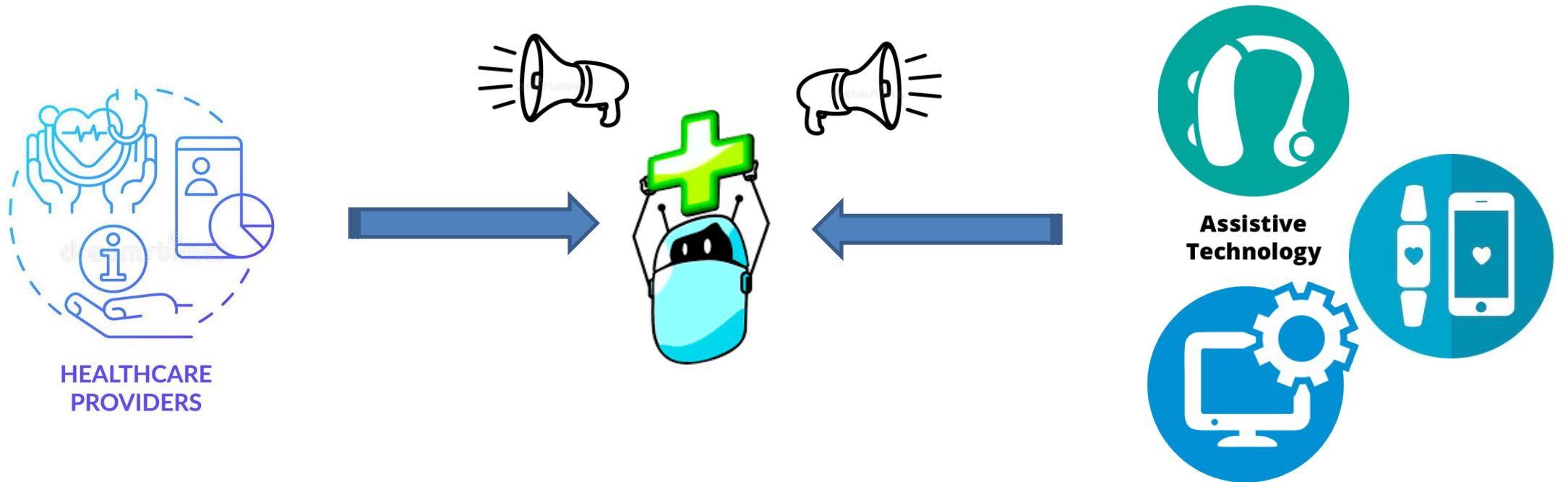
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Amplify R&D&I and learning and teaching capacity with:

- Shared access to lab resources (robots, smart home & IoT devices)
- Cloud, to connect (mash) software solutions and data

OpenAAL



OpenAAL: Co-Design

4 Focus Groups (Sight Scotland, Scottish Care, Capability Scotland, Blackwood)
~8 participants each, Experience of Covid-19 and Technology



Persona



3 Co-Design workshops (~15 participants each)



- Hackaton
- Match-making
- Talks
- Livestream

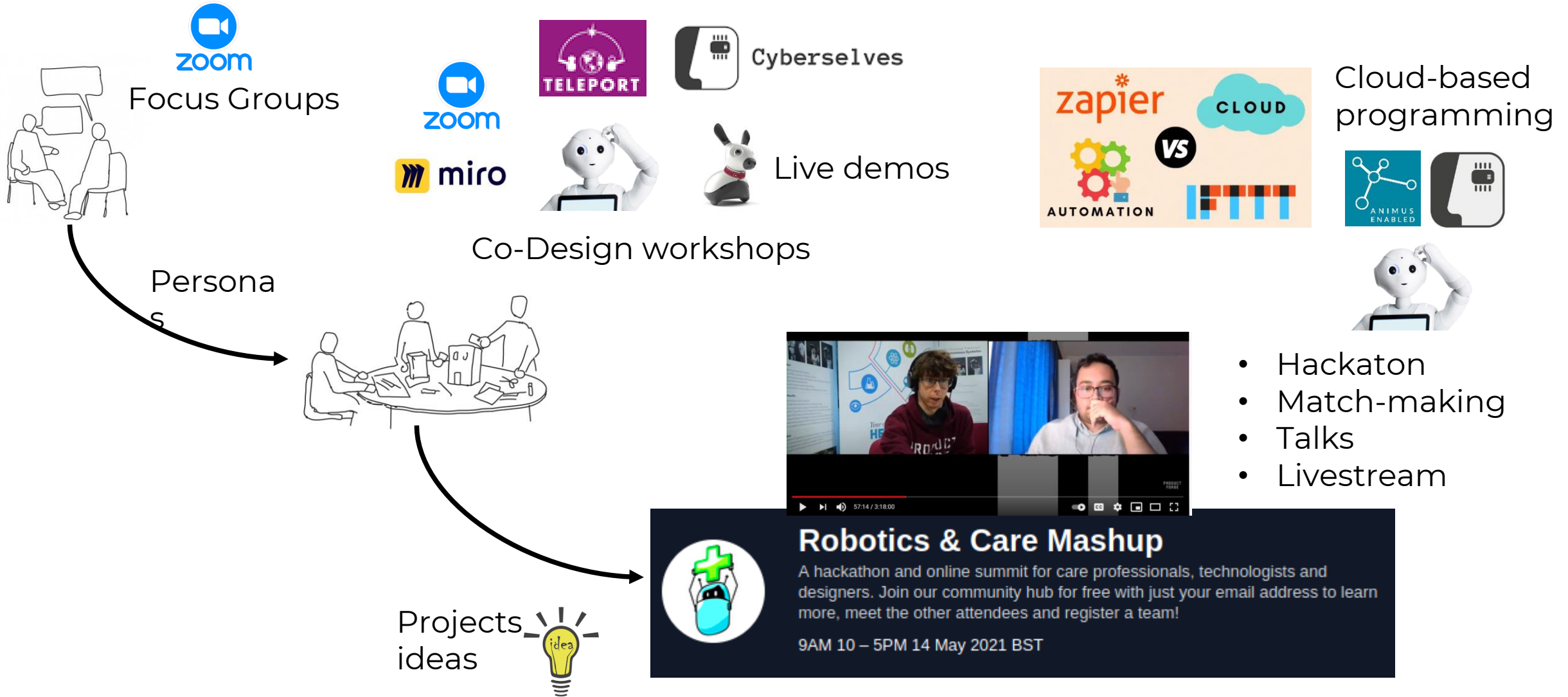
Projects ideas



Robotics & Care Mashup
A hackathon and online summit for care professionals, technologists and designers. Join our community hub for free with just your email address to learn more, meet the other attendees and register a team!
9AM 10 – 5PM 14 May 2021 BST



OpenAAL: Tools



OpenAAL - Focus Groups

Experience of Covid-19 and Technology

4 X 90 minutes online sessions (Zoom) with different groups (6-8 participants per sessions, including service users and support carers, facilitated with the help of care organisations, including Scottish Care, Blackwood Homes and Care, Capability Scotland, Sight Scotland)

- **Part 1 – Experience:** Changes experienced during daily life, impact of Covid-19 on wellbeing
- **Part 2 – Technology:** Daily usage, impact of Covid-19, comments on existing and emerging examples of technology, i.e.
 - smart home
 - ambient and wearable sensors
 - voice assistants
 - telemedicine & health app
 - telepresence and socially assistive robots



Project proposals

Discussion



Persona:

Anna is a retired teacher with mild dementia. She is 82 and lives alone in the country. She loves reading and hill walking. She finds increasingly difficult to look after her high blood pressure and she is also recovering from a recent fall. She has been hooked on to the stream of media update on the pandemic, but finds all the information extremely confusing, bleak and stressful. She is not short of friends but she is not confident with tele-conference tools.

Likes:

Reading, hill walking, currently trying to keep up with covid-19 situation keeping in touch with friends

Other

Rural setting (poor broadband)

Circadian rhythm lighting (dementia)

In terms of care, it breaks some behaviour cycles
Combine mobility with care

Mashup – HUB (vi.to platform)

Hub Set-up guide Admin Public page

Robotics & Care Mashup All posts

Event Livestream
Videos
All posts
People
Sponsors
Presenters
Helpdesk & FAQs
Networking Area
Drop-in and Co-Design Sessions
Home and Contact Details
Event Themes
Ethics
Co-Design
Accessibility
Technology and Providers
Resources at RALT
Robotics and Internet of Things
Earswitch
Cyberselves
Tecla-e
Mydex
Mashup Ideas

PARTICIPATING TEAMS

Your Team / Team Formation
Earswitch-Tecla Model Team
Curi-O
Hive Robo-Care
BLEC
Fall Detectives
Communicare - Hermes

View code of conduct

Share your thoughts
0/350 Post

All Following My Faves

Allan Lloyds @allan Product Forge 8 days ago
thanks to everyone who joined us for the mashup - we'd really value your feedback, if you have a few minutes to complete our after event survey: <https://forms.gle/CE3MrmQXhrHP5qTv7>
in Event Livestream

Tony Ellis @Toymaker Robotist, inventor and Tech Director 13 days ago
Well done everyone and to my team - it has been an interesting week!
in Event Livestream

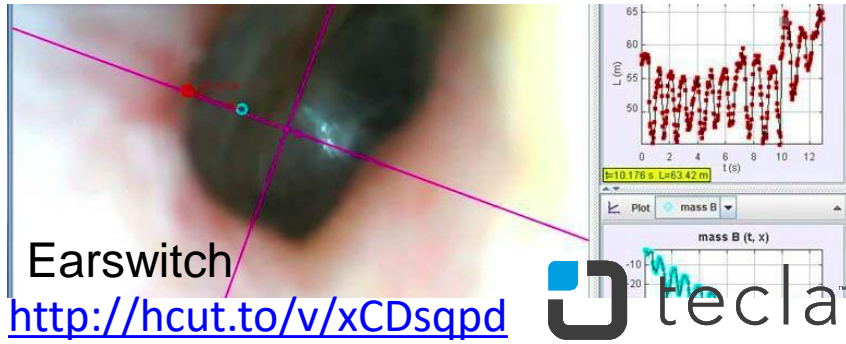
Robert Rea_SHIL @Robert_Rea Head of Innovation 13 days ago
thanks everyone- brilliant week- looking forward to hearing more about each team in the future and seeing their products actually get out there and benefit the world
in Event Livestream

Hannah @Hanamal They/Them Mechanical Engineering 13 days ago
Thank you everyone involved. This event has been the highlight of my week :)
Thank you @allan for organising everthing :)
in Event Livestream

Allan Lloyds @allan Product Forge 13 days ago
Thank you to all our amazing participants, sneakers, mentors and sponsors!

- 140 profiles , over 1 month
 - 20 (17%) from SMEs & technology companies
 - 72 (61%) from academy
 - 21 (22%) from healthcare organisations
- ~400 posts (networking & mashup ideas),
 - from ~50 different participants
- Inputs from healthcare and support organisations and end users
 - Ethics
 - Accessibility Guidelines
 - Research findings and record of issues faced by people at high risks during Covid-19
- 14 Talks from international scientists (cybersecurity, healthcare robotics, ethics ...)
 - ~average 30-40 viewers

Robotics + Care Mashup – Hackaton



- Model Team (Earswitch) + 6 Teams entries
- Mentored throughout the week
 - DAY 1 – Product Discovery
 - Scottish Health Innovation Ltd (SHIL)
 - Scottish Social Services Council (SSSC)
 - DAY 2 – Design Thinking
 - University of Edinburgh, Design Informatics
 - Digital Health & Care Innovation Centre
 - DAY 3 - Prototyping
 - Scotland Innovation Centre for sensing, imaging and IoT technologies (CENSIS)
 - Product Forge
 - DAY 4 – Presentation
 - Product Forge



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2021-2023
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Lessons Learnt (so far)

- People and care and support organisations generally keen to explore robotic innovation
- Support and links with care organisations and innovation hubs is key
- Mixed results in involving potential users of the technology (they were on the platform, but did not participate to the actual hackaton)
- Team formation and other tasks are very challenging with the online platform
- In future instances we plan to:
 - Run challenge, co-design and initial match-making events well ahead of the hackaton, and in-person !
 - Hackatons, aimed at innovators, technology developers
 - Needs specific tutorials to facilitate cloud-based access to the laboratory resources, and also tutorials about contributed hardware, software and APIs

Current projects/studies looking for participants

- EPSRC Healthcare Network Plus **EMERGENCE** (healthcare robotics in support of people with frailty and age-related sensory, physical and cognitive impairments)
Co-production with clinician/healthcare experts, care provider and end-users, Mauro Dragone, m.dragone@hw.ac.uk, Edinburgh, 4th and 15th July
- **User study** – (How) can telepresence robots be used to help people with mild-cognitive impairment / early Alzheimer, e.g. to assist with (I)ADLs? Recruiting people with caring experience, for tests and interviews, Scott MacLeod (sam19@hw.ac.uk)
- **User study** – Evaluation of automated ADL-based cognitive assessment, Scott MacLeod (sam19@hw.ac.uk)
- **Co-design** with MAAH and RoboBrico, Alexandre Colle, ac385@hw.ac.uk
- **Tests of telepresence robots** are being facilitated by the **OpenTAS** project, offering virtual visits to the UK RAS laboratories involved, mauro.dragone@hw.ac.uk

Thank you !