Robot-human cohabitation: A framework for people living with frailty

Evangelia Chrysikou[1], Jane Biddulph[2] , Fernando Loizides[3], Nathan Jones[3] ,Helen Hobbs[4],
Eleftheria Savvopoulou[5], Taha Hatcha[6], Jonas Rehn-Groenendijk[7]

[1] The Bartlett School of Sustainable Constructon UCL, United Kingdom
[2] Research Department of Epidemiology and Public Health, UCL, United Kingdom
[3] School of Computer Science and Informatics, Data Science Academy, Cardiff University, United Kingdom
[4] Hobbs Rehabilitation Intensive Neurotherapy Centre, United Kingdom
[5] SynThesis Architects, Greece
[6] Albertinen Krankenhaus, Germany
[7] HOCHSCHULE DARMSTADT, University of Applied Sciences, Germany

Background

Europe and the UK are promoting innovation for people living with frailty (PLWF) with robots at the forefront. Yet, the adoption of robots in care environments is limited to devices such as voice assistants, even though the robotic industry races to break the commercialisation barrier.

Robotics aiming to support people with frailty are usually tested in labs without real built environment (BE) considerations. For example, in Image 1 are the robots currently tested in the Robot House – University of Hertfordshire. To our understanding, most are not suitable for home use and have very little to offer to people with frailty. They might even create additional practical problems and even expose people to hazards, such as tripping (Image 1).

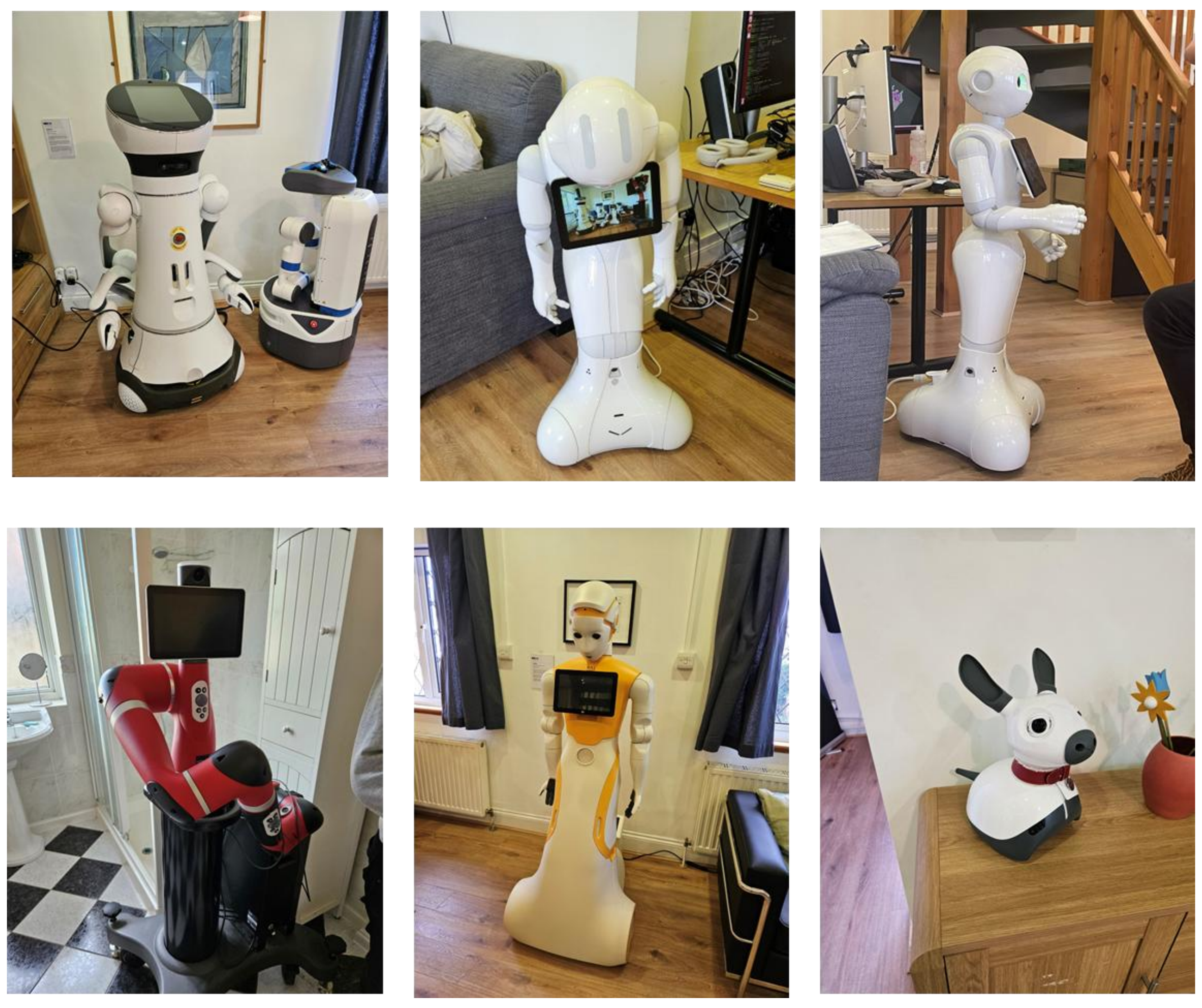

Image 1. Robots at the Robot Lab, University of Hertfordshire. Miro-E (the 'dog' at the right-down image) it's too small and could expose people to hazards such as tripping.

This research, by bringing together expertise from healthcare architecture, population health, human-computer interaction and clinical practice, uncovered a link between robots being tested in labs bearing little resemblance to actual built environments (BE) as a barrier for the adoption of such technologies.

This discontinuity leads to care environments not designed for robots or the needs of PLWF and to not-fit-for-purpose robots for home use, even robots could support PLWF with activities promoting mental and physical agility.

Methods

Methodology included:

- meetings with allied health professionals,
- visiting the Robot House,
- a pilot at an empty flat in Gloucester, England, with personas home visits including auditing eight lived-in residential properties of PLWF in sheltered housing at Gloucester,
- 3D scanning of all properties and design of actual CAD floor plans,
- production of 3D scans images to recreate plans of actual lived-in extra care environments simulating robot's function within the home environment, using personas for different case scenarios.

Findings

Based on data collected, the team produced **a multi-level-framework that takes the user through essential steps to consider for optimising the potential for the cohabitation of humans with robotic assistance and associated smart technology, within their home.**

It incorporates three levels that triangulates the resident's needs, BE and robots/technology. Level 1 refers to "Identifying user needs, preferences and social cohesiveness", Level 2 to "The Architectural Structure & Built Environment Features", e.g. how does the BE need to be designed or adjusted to fit the requirements of the robots to be implemented and Level 3 "Technology considerations for the robotic system" refers to the various types and functionalities of the robots.

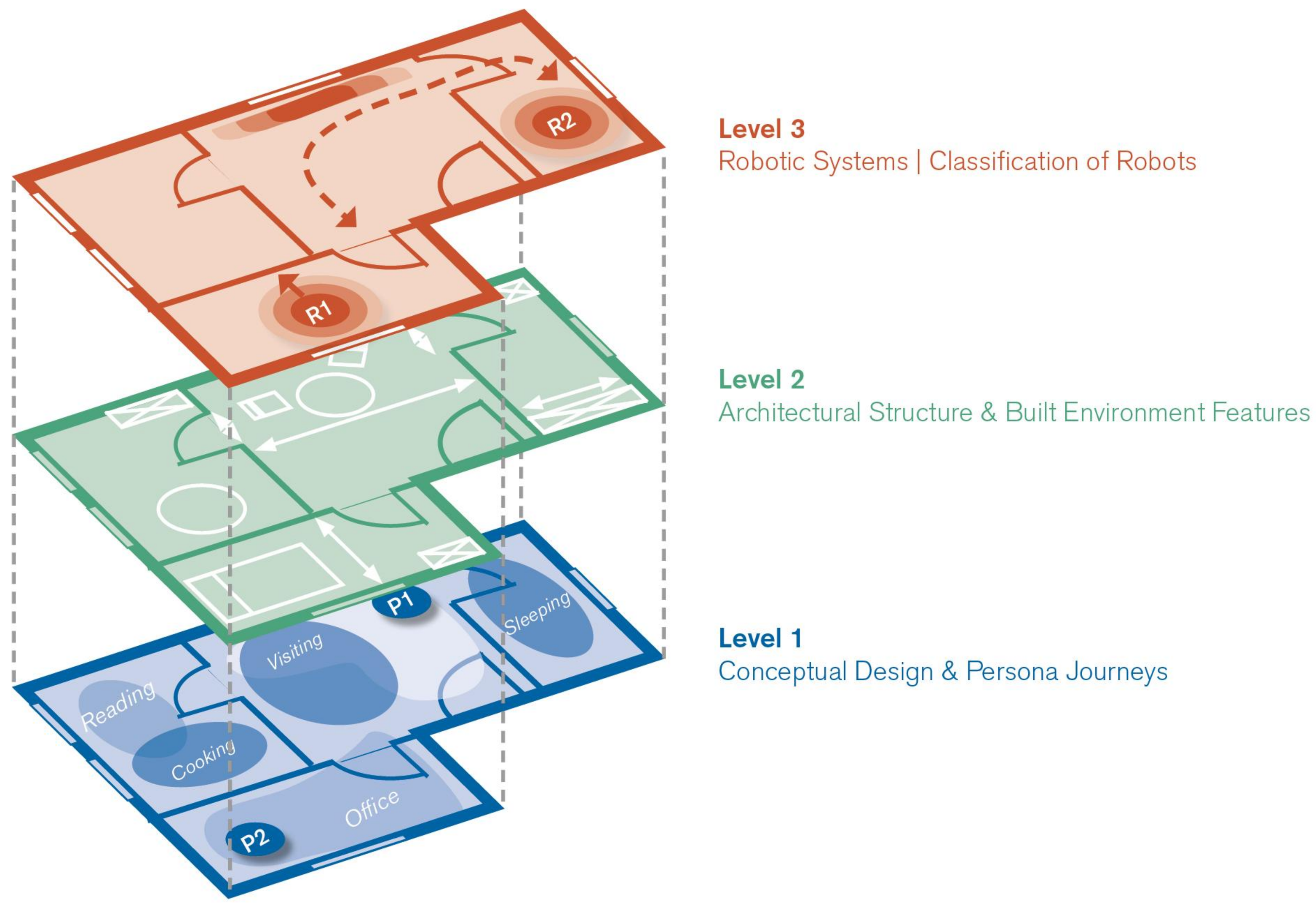

Image 2. Multi-level framework for human - robot cohabitation in real residential BE.

Conclusion

Putting people with frailty and robots inside real BE can create difficulties that have been, so far, unexplored, preventing technologies from reaching their full potential. Currently, most available robots would not adequately fit in an independent living accommodation.

This framework encompasses a vision where inclusive residential design supports aging through facilitation of the use of technological advances and can be used to aid the planning of homes for living with/and technological support for an aging population with diverse and changing needs, with the intention to minimise relocation due to those needs. By unifying these three essential aspects it enables a range of stakeholders, such as planners, architects, housing providers etc. to consider aspects of those factors that may have hitherto been overlooked.

Publication

Chrysikou, E., Biddulph, J., Loizides, L., Savvopoulou, E., Rehn-Groenendijk, J., Lloyd Jones, N., Dennis-Jones, A., Nandi, A., Tziraki, C. 2024. Creating Resilient Smart Homes with a Heart: Sustainable technologically advanced housing across the lifespan and frailty through inclusive design for people and their robots. Sustainability 16(14): 5837. https://doi.org/10.3390/su16145837

Acknowledgments

This research was funded by UKRI EPSRC 'EMERGENCE: Tackling Frailty-Facilitating the Emergence of Healthcare Robots from Labs into Service' (RIS 19737222, EPSRC Funding EP/W000741/1).

Attending the European Healthcare Design Conference 2025 is supported by BSSC Conference Fund.

Join: Evangelia Chrysikou PhD
Like: Evangelia Chrysikou
Follow: Evangelia Chrysikou
Talk: synthesislia

E: e.chrysikou@ucl.ac.uk
M: +44 7827 571927