

# ORAL PAPER PRESENTATION 1: HOUSING AND DAILY LIVING

## GUARDIAN: An assisted living social robotics eco-system

H. H. Nap, D. R. M. Lukkien, M. Stal ter, R. Bevilacqua, G. Amabili, N. Morresi, G. M. Revel, S. Casaccia, J. Alberts, J. de Koning, A. De Masi, A. V. Naveira, K. Wac, B. M. Hofstede

**Purpose** GUARDIAN is a new technology-enabled ecosystem to support older adults and their carers in an indoor living environment. The GUARDIAN ecosystem is designed to address the different needs in different countries, creating an ecosystem accepted by the end user through a socially assistive robot (SAR) and two web applications (one for caregivers and one for frail older adults) that appropriately consider cultural differences. The project aim is to support older adults, formal carers and informal carers so that older adults can live safely at home for longer with enough comfort. Amongst others, the GUARDIAN Socially Assistive Robot (SAR) will be able to provide older adults with input and stimulation for activities (see also, Nap et al., 2018). This paper describes the iterative co-design and evaluation of GUARDIAN in three countries (Italy, Switzerland & The Netherlands) up to a first alpha working prototype of the SAR connected to the web interfaces that can be operated via a tablet. **Method** To gain insight into the perceptions, accessibility, acceptability and satisfaction with GUARDIAN, usability evaluations were performed using the IBM usability questionnaire (Lewis, 1995) and interviews were performed in the three different countries involving a total of 13 older adults, 14 informal carers and 15 formal carers. User requirements were translated into additional technical requirements for the further development of the SAR and supporting eco-system. Through a mixed-methods approach involving both project partners and end-users, it was explored how societal needs and concerns about the social and ethical impact (Lukkien et al., 2021) of using the SAR can be addressed in the design and use of GUARDIAN. **Results and Discussion** Based on the user-centered, value-sensitive and responsible innovation co-design results, three core functionalities have been identified for GUARDIAN: 1) monitoring the behavior, emotions, health and well-being of the older adult; 2) day structure support for e.g., medication and appointments; 3) social companionship. The results from the usability evaluations show that the proposed ecosystem is of high usability for both older adults and their carers, with positive mean scores above the scale mid-point of the usability questionnaire items. Only error handling and error messages scored slightly lower than the scale mid-point for the carers. From the interviews it appeared that GUARDIAN satisfies the user requirements, highlighting the feasibility of the application of the ecosystem as a supportive technology for monitoring, day structure and social companionship for older adults. Based on the interview results with the informal carers, it was found that they feel reassured through GUARDIAN about the well-being of the older adult. They reported positive attitude to the ability to monitor the relative at a distance; without being too intrusive to the older adult's privacy. Formal carers reported that GUARDIAN supports them to (re)activate their clients from a distance and GUARDIAN provides additional insights into the behavior and well-being of the client. From a responsible innovation perspective, some high-level opportunities were identified for shaping a more meaningful and ethically acceptable SAR, for instance in relation to personalization, safeguarding older adults' autonomy and promoting human connectedness in care practices supported by SARs. GUARDIAN has large potential to support independent living for older adults and (in)formal care at a distance.

## References

- Lukkien, D.R.M., Nap, H.H., Buimer, H.P., Peine, A., Boon, P.C., Ket, J.C.F., Minkman, M.M.N., & Moors, H.M. (2021). Towards Responsible Artificial Intelligence in Long-term Care: A Scoping Review on Practical Approaches. *The Gerontologist*; gnab180. DOI: 10.1093/geront/gnab180.
- Lewis, J.R. (1995). IBM computer usability satisfaction questionnaires: Psychometric evaluation and instructions for use. *International Journal of Human-Computer Interaction*, 7(1), pp 57-78. DOI: <https://doi.org/10.1080/10447319509526110>
- Nap, H.H., Suijkerbuijk, S., Lukkien, D., Casaccia, S., Bevilacqua, R., Revel, G.M., Rossi, L., & Scalise, L. (2018). A social robot to support integrated person centered care. *International Journal of Integrated Care*, 18(s2):120. DOI: <http://doi.org/10.5334/ijic.s2120>



Figure 1. GUARDIAN Socially Assistive Robot (SAR)

**Keywords:** assistive technology, eco-system, social robotics, SAR, older people, informal carers

**Address:** Vilans, Postbus 8228, 3503 RE, Utrecht, The Netherlands

**Email:** [h.nap@vilans.nl](mailto:h.nap@vilans.nl)

**Acknowledgement:** We gratefully acknowledge support from the Active Assisted Living (AAL) Programme, co-financed by the European Commission through the H2020 Societal Challenge: Health, demographic change, wellbeing. In particular, the work reported here has been supported by the AAL GUARDIAN project (AAL-2019-6-120-CP).