

# On Integrating Voice-Activated Digital Assistants with Smart Home Technologies to Support People with Long-Term Mobility Disabilities: Needs Assessment, Product-Selection and Implementation

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## Abstract

Individuals with long-term mobility disabilities and age-related limitations can face many challenges in home environmental control, home healthcare tasks (e.g., reminders to take medications), maintaining a requisite amount of physical activity, and social interaction. In a previous pilot-study, the authors have shown that *Voice Activated Digital Assistants* can help address the challenges faced by the above-mentioned demographic<sup>1</sup>.

In this paper we present a three-step methodology for the integration of *Amazon Alexa* devices with a variety of smart home technologies that will help the aforementioned demographic to live independently at home. The first step is a needs assessment exercise involving a small pilot with members of the targeted demographic, namely older adults with long-term mobility disabilities. We developed an instrument that gauges the technology-solutions they require. Additionally, we assessed ability to cope with newer technologies, which is subsequently used to develop the format and content of training materials in the third-step. The second step starts with detailed assay of *common-off-the-shelf* (COTS) components that can be integrated, with minimal developmental effort, to provide technology solutions to the “gaps” identified during the needs assessment. The technology-solutions were ranked for safety, ease-of-use, and the level of expert technological-support needed for continued use. The selected solutions were presented to a test-audience within a simulated home environment. The third step involves the development of appropriate training-material and product testing in real homes of the target group.

We have successfully implemented the first two steps of the aforementioned methodology in the development of a product that integrates smart light bulbs, smart doorbells, and robotic vacuums at a senior living facility near the University of Illinois at Urbana-Champaign. We expect to complete the third-step by March 2020, in time for the final presentation at the conference.

We are implementing the same methodology for a different activity domain, namely healthcare activities. We currently in the early-stages first-step in the development of a product that can provide health reminders

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<sup>1</sup> Koon, L. M., McGlynn, S. A., Blocker, K. A., and Rogers, W. A. (2019). Perceptions of Digital Assistants From Early Adopters Aged 55+. *Ergonomics in Design*, April, 2019, [DOI-1064804619842501](https://doi.org/10.1080/1064804619842501)

(e.g., medication, hydration) to the target group. We expect to present the results of the first two steps of the methodology for this product at the conference, as well.

## **Keywords**

Healthcare Operations and Healthcare Engineering, Automation and Control, Case Studies, IoT, Human Factors and Ergonomics

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## **Biographies**

**Lyndsie M Koon** is an Assistant Research Professor with the Research and Training Center for Independent Living (RTCIL), Applied Behavioral Science at the University of Kansas. She was a post-doctoral research associate at the University of Illinois Urbana-Champaign in the Human Factors and Aging Laboratory. She has a PhD in Sport and Exercise Science from the University of North Colorado; MS in Exercise Science from the University of Memphis; and a BS in Exercise Science from Arkansas State University. Her research interests include exercise and physical activity, cognitive function, motivation, technology, and older adults. Her current research focus examines the challenges and solution strategies adults aging with sensory and mobility impairments experience with everyday activities and specifically, exercise needs.

**Roshanak Khalegi** is a graduate student pursuing her Ph.D. in Industrial Engineering at the Department of Industrial and Enterprise Systems Engineering at the University of Illinois at Urbana-Champaign. She completed her Bachelor of Science and Master of Science degrees in Industrial Engineering from the University of Tehran, Iran in 2010 and 2012, respectively. Her research is in the area of supervisory control of Discrete-Event/Discrete-State (DEDS) systems and Healthcare Systems Engineering.

**Kenneth A Blocker** is a graduate student pursuing his Ph.D. in Educational Psychology at the University of Illinois at Urbana-Champaign. He completed his Master of Science in Psychology with a focus on Cognitive Aging from the Georgia Institute of Technology in 2017, and a Bachelor of Science in Psychology and Sociology from Florida State University in 2013. His research is in the area of Cognitive Science of Teaching and Learning, and his interests include promoting behavior change with ambient and/or environmental technologies, technology design and acceptance for older adults, health self-management, medical human factors, cognitive aging, educational technologies, and health care.

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**Ramavarapu Sreenivas** received the B.Tech. degree in Electrical Engineering from the Indian Institute of Technology, Madras, India in 1985, and the M.S. and Ph.D. degrees in Electrical and Computer Engineering from Carnegie Mellon University, Pittsburgh, PA in 1987 and 1990, respectively. He was a Postdoctoral Fellow in Decision and Control at the Division of Applied Sciences, Harvard University, Cambridge, MA, before he joined the University of Illinois at Urbana-Champaign in 1992, where he an Arthur Davis Faculty Scholar and Professor of Industrial and Enterprise Systems Engineering. His research interests are in modeling, analysis, control and performance-evaluation of Discrete-Event/Discrete-State (DEDS) systems.