
Poster

Prototype Development of a Responsive Emotive Sensing System (DRESS): System Operations Testing Outcomes

Diane Mahoney^{1*}, ARNP, PhD; Winslow Burleson^{2*}, PhD; Jeremy Rowe², EdD; Edward Mahoney³, MS

¹School of Nursing, MGH Institute of Health Professions, Charlestown, MA, United States

²School of Nursing, New York University, New York, NY, United States

³Gerontechnology R & D, EDDEE Consulting, Charlestown, MA, United States

*these authors contributed equally

Corresponding Author:

Diane Mahoney, ARNP, PhD

School of Nursing

MGH Institute of Health Professions

36 First Avenue

Charlestown, MA, 02129-4557

United States

Phone: 1 617 643 2745

Fax: 1 617 643 6350

Email: dmahoney@mghihp.edu

Abstract

Background: Smart-home consumer technologies have been criticized for failing to disclose their operational performance characteristics to the marketplace. As one result, some users of wearable fitness technologies have reported being frustrated by invalid motivational responses based on fluctuations in accurate performance measurement by certain brands. Gerontechnology researchers have similarly documented the critical importance of valid operations and technical stability as major influences on whether older adults and their caregivers adopt and use new cognitive assistive technologies. We have been iteratively developing the DRESS (Development of a Responsive Emotive Sensing System) system, integrating context aware computing with effective sensor and interactive technologies, to customize coaching persons with dementia to dress independently. Our prior testing focused on components and clothing identification, not the overall system performance. Consequently, we initiated system testing, as part of our alpha version development phase, to assess key metrics and disclose the performance outcomes.

Objective: To assess the operational accuracy (validity) and stability (reliability) of the DRESS system alpha prototype model.

Methods: We conducted a 110 day device trial run-in study. The system operated 24/7 in a studio-sized testing unit using the local WiFi network. A 69-year-old tester documented any usability issues during this period. Automatic log reports were generated daily by the system and validated and annotated by the project manager. A content analysis of the user and log reports was conducted, and descriptive statistics were used to describe the operational findings.

Results: The system functioned error free for the majority of the trial (75% of days) with stable performance for 95.5% of days. Thirty-seven correctable error events occurred during 28 of the 110 days and resulted in 4 categories of errors: Hardware (0.9%), from a defective iPad charger; Network (3.6%), from host network disconnects/power outage; Usability (4.5%), from the visual displays/buttons on the caregivers' device being too small in size; and Re-initialization (24.5%), from the operating system/Indigo software updates.

Conclusions: Overall, the system performed very favorably for an alpha prototype. As expected, the initial deployment required an immediate debugging period primarily rectified by software recoding. Notably no fatal or irresolvable errors occurred. The system remained stable except for a disconnect due to a weather-related regional power outage. Lessons learned, such as integrating a remote automatic reboot capability, will be used to further optimize system performance before advancing to an in-home study with persons experiencing dementia.

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KEYWORDS

cognitive assistive technologies; context-aware computing; dementia caregiving

This poster was presented at the Connected Health Symposium 2016, October 20-21, Boston, MA, United States. The poster is displayed as an image in [Figure 1](#) and as a PDF in [Multimedia Appendix 1](#).

Figure 1. Poster.



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OPERATIONAL ACCURACY AND STABILITY TESTING OF A "SMART" DRESSER FOR PERSONS WITH DEMENTIA

Diane F Mahoney PhD RN FAAN (1); Winslow Burlison PhD (2);
Jeremy Rowe Edd (2); Edward L Mahoney MS (3)

1) MGH Institute of Health Professions, Boston, MA 2) New York University, New York, NY 3) Eddee Consulting, Boston, MA, USA

PURPOSE

To assess the operational accuracy and stability of a prototype cognitive assistive coaching technology (DRESS system, alpha version 2), being developed for persons with dementia (PWD), to enable them to dress with more privacy and less dependency on caregivers

RESULTS

- This alpha version ran error free for the majority of the trial (75% of days) and operationally stable for 95.5% of days (Fig 2)
- 37 error events occurred on 28 days out of the 110 day period (25% rate); 16 in (mo1), 14 in (mo2), and 7 in (mo3+) respectively; all correctable. Four categories of errors emerged (Fig 3):
 - Hardware** (n1) 0.9% of days, a defective iPad charger (replaced)
 - Network** (n4) 3.6%, host network disconnects/power outage (required rebooting)
 - Usability** (n5) 4.5%, Caregiver device screen button too small (enlarged), wrinkled fiducial inaccurate (smoothed out); drawer left open and PWD "stuck" states were recognized and alerts generated but not visible on the caregivers' device (re-coded)
 - Re-initialization** (n27) 24.5% predominantly automated operating system/Indigo software updates (rebooted/blocked)

IMPLICATIONS

- Hardware and usability errors occurred within the first two weeks and informs the time period needed for the pre-installation "run-in" and in-home tech support
- Network and re-initialization errors were intermittent and identified the need for ongoing blocking of automatic updates, as well as the capacity to remotely re-boot the system after storm related power losses
- Responsiveness to errors, through remote and in-home tech support, will be necessary during deployment to resolve any "glitches" that could upset users and negatively affect device adoption and usage

SIGNIFICANCE

- Developers of smart technologies and wellness devices have been criticized for not disclosing technical performance outcomes and problems
- Transparency in operational findings is critical to informing consumers, providers, researchers policy makers and institutional review boards about the state-of-the-art to establish realistic expectations and ensure user safety

CONCLUSIONS

- The dresser system ran robustly for an alpha stage device and was reliably stable over 3+ months. No fatal (un-resolvable) errors occurred
- Lessons learned from this promising trial will be used to make quality improvements in the next version, to further reduce the type and rate of errors prior to dyadic (PWD/caregiver) intervention evaluation

METHODS

- A technical operations 110 day run-in pilot test
- The same 69 yr old person tested the system weekdays am and/or pm in a studio unit where the system's hub was plugged in and DRESS operated 24/7 using the local Wi-Fi network. He alternated the role of the helper, using the caregivers' device, or the PWD by putting on fiducial imbedded clothing, getting "stuck," distracted, perseverating, and completing the task. He recorded usability issues in a diary
- In-person and remote system diagnostic checks were conducted to identify issues, validate the reliability of operations, confirm and annotate the system generated error log reports
- A content analysis was conducted on the event diary recordings and the annotated log reports. Quantitative analyses employed descriptive statistics to report the % of days with errors and types



Fig 2. System Accuracy and Stability
(as a % of 110 day trial)



Fig 3. Type and Rate of Errors
(% of 110 days)



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Multimedia Appendix 1

Poster.

[\[PDF File \(Adobe PDF File\), 412KB-Multimedia Appendix 1\]](#)

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