



The Development of Intelligent Systems to Support Older Adults and Aging-in-Place

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Intelligent Assistive Technology and Systems Lab

The Need

- With the growing number of older adults, there is an increased need for new treatment options and solutions
- These solutions need to help support aging-in-place
- Solutions need to be robust and easily scalable to meet the needs of all users

Long-term Vision

Our goal is to develop an intelligent home that can enable aging-in-place, without extra burden to the users





Zero-Effort Technologies

- Technology should operate **without any effort from the user or caregiver**
- This means the systems must:
 - Automatically learn about the user and environment
 - Continuously collect and redistribute data
 - Use contextual information to autonomously operate and make decisions
 - Dynamically adapt to changing user needs

Our Design Philosophy

- **Develop for real-world contexts**, using real-life problems and motivations
- **Involve the user** from the start to the finish of the design process
- **Test new technologies** as often as possible throughout the design process
- **Universal Design** principles to accommodate all potential users



The Difficulty with Trials...

- We believe AI technology has the potential to support ADL completion
- However, the classic method of iterative design is difficult with this population
 - Frail population
 - Disruptive
 - Time consuming
 - Costly
 - Limited explicit feedback
 - Ethical considerations

This results in a slow and cost-prohibitive development process!



Design Approach Revisited



**How can we improve
the design process
without compromising
the end product...?**

Actors in Design

- Let's try using actors to optimise prototypes!
- Actors might be able to simulate different behaviours to troubleshoot problem areas
- Once device is optimised, test with real older adults with dementia to ensure efficacy

Actor simulations - Objectives

- Pilot research investigated the following questions:
 - Can actors believably simulate older adults with dementia?
 - Can actors simulating older adults with dementia be used to optimize technologies before they go to clinical trials?

The COACH



An intelligent cognitive device that tracks a user through an ADL, providing cues when necessary

The
COACH
Cognitive Orthosis for Assisting Activities in the Home

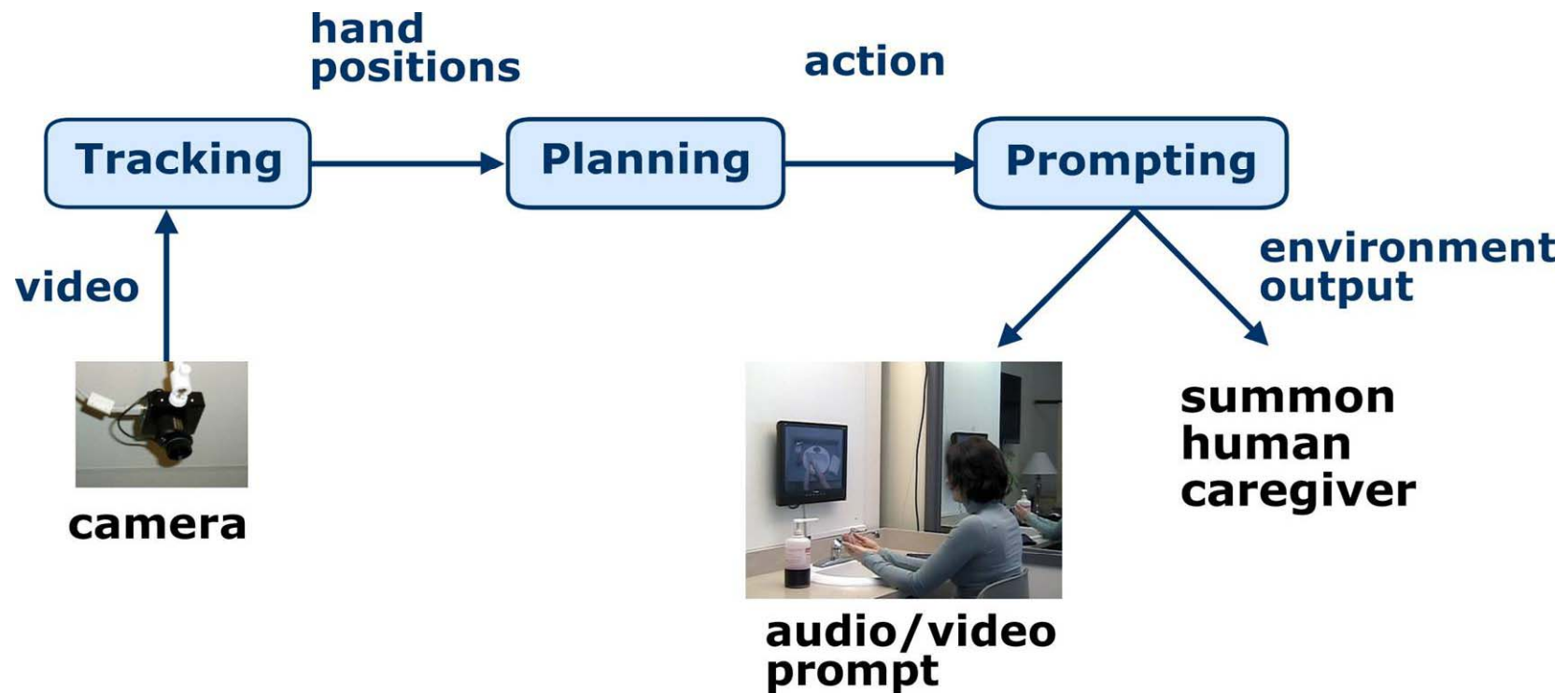
The COACH

Digital
Video
Camera

Flat Screen
Monitor &
Speakers



System Overview

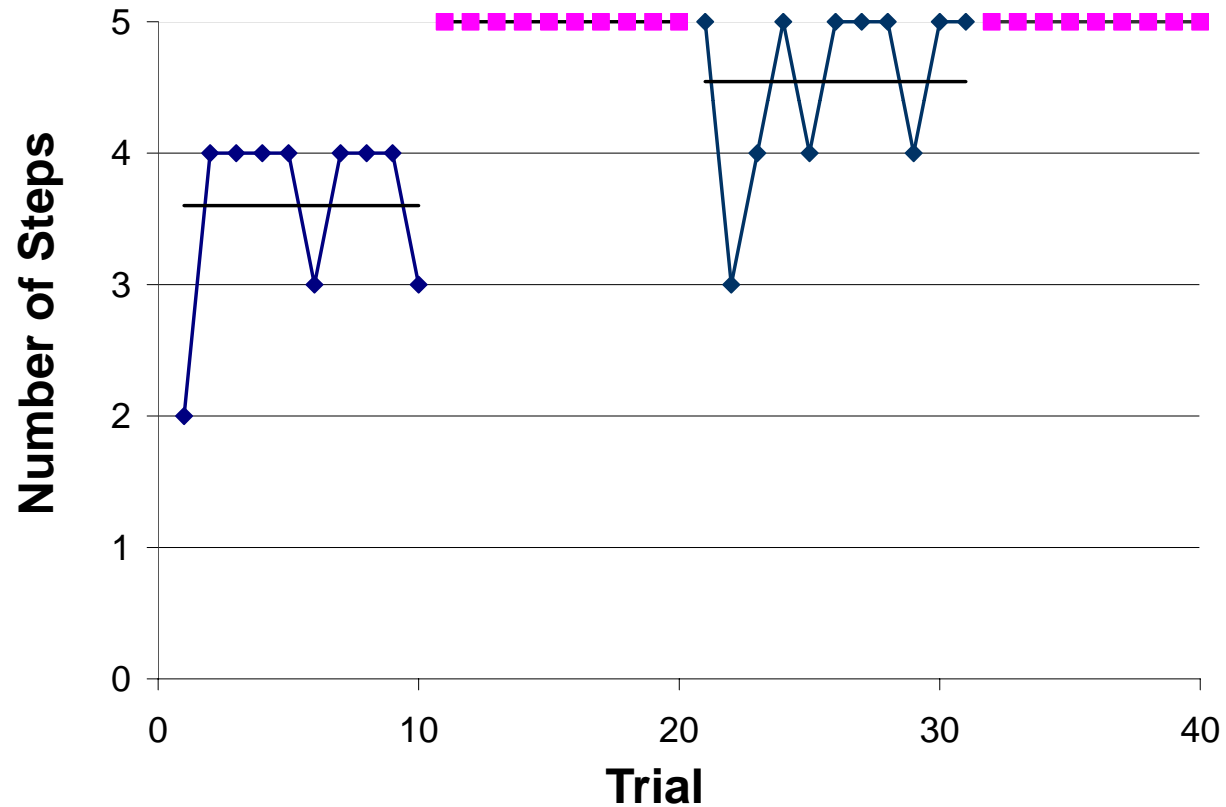


Example of Use



Does it work?

Number of steps completed without human assistance for S4



Actor simulations – Method

- Actors were trained using video footage from previous handwashing trials
- Videos were recorded of older adults washing their hands:
 - Six were actors portraying dementia (“simulated”)
 - Six were people with dementia (“real”)
- 20 videos per person, for a total of 240 videos

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Actor simulations – Rating Task

Caregiver Rating Task 1

Professional caregivers were randomly shown 20 segments (10 simulated and 10 real) and asked to rate on a scale from 1 (not at all) to 10 (very much):

“Was the client behaving in a way a person with dementia would?”

Actor simulations – Rating Task

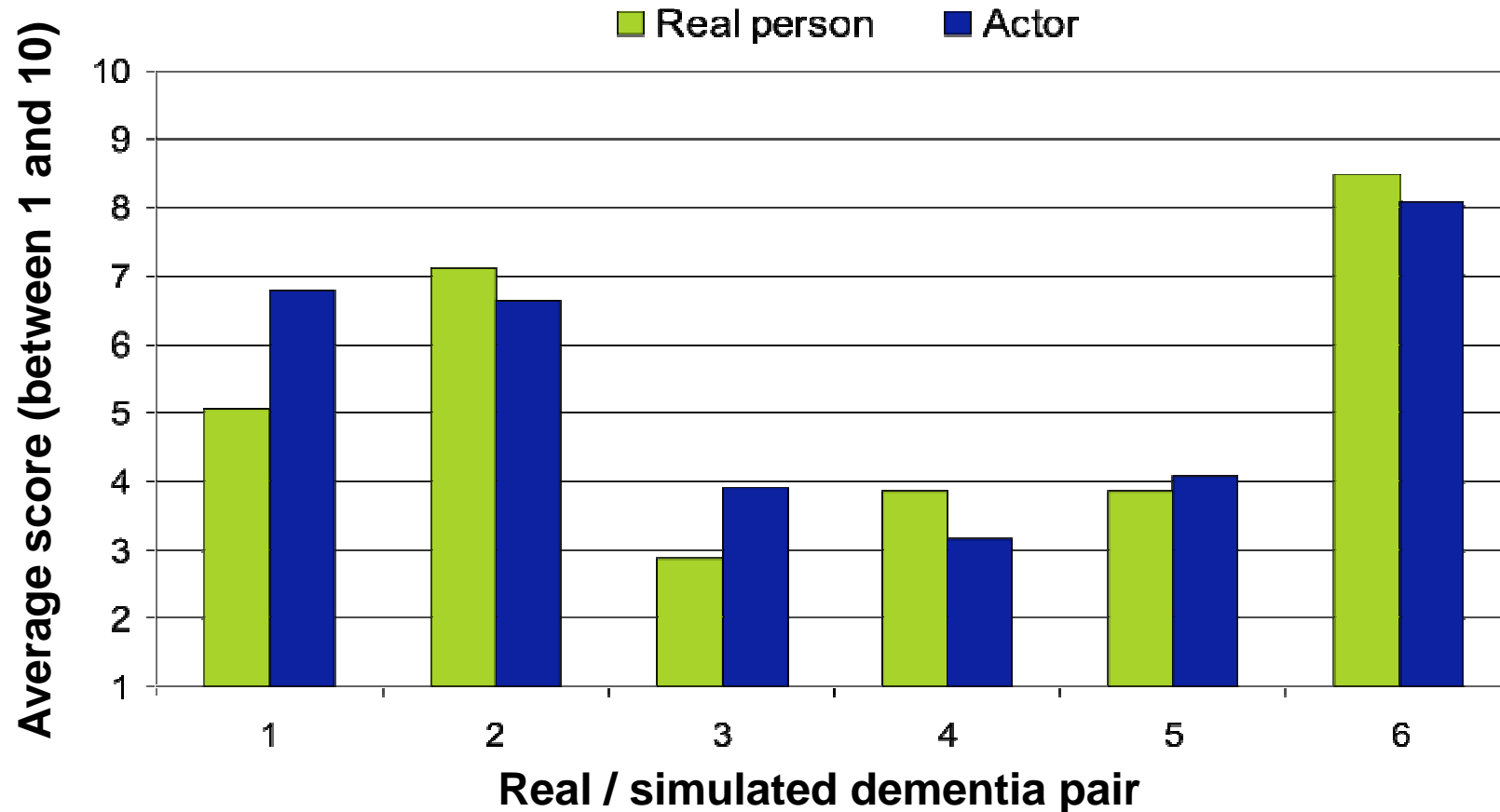
Caregiver Rating Task 2

Professional caregivers shown 10 video pairs containing a simulated and a real trial and asked to choose which video was the actor

Actor simulations – Participants

- 11 participants, all female, with an average:
 - 39.3 years of age
 - 8.2 years as a professional caregiver
 - 7.4 years as a caregiver for older adults with dementia

Actor simulations – Task 1



Higher score = Client behaving more like a person with dementia

Can you tell the difference?



Can you tell the difference?



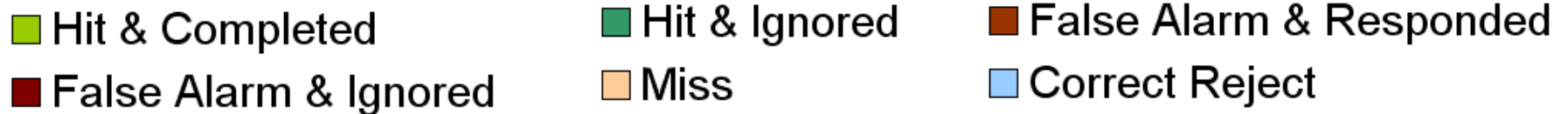
Actor simulations – Task 2

- 65% of the time the actor was correctly identified
- “When making my choices, I felt...”
 - Very sure (0)
 - Somewhat sure (3)
 - Somewhat unsure (7)
 - Very unsure (1)

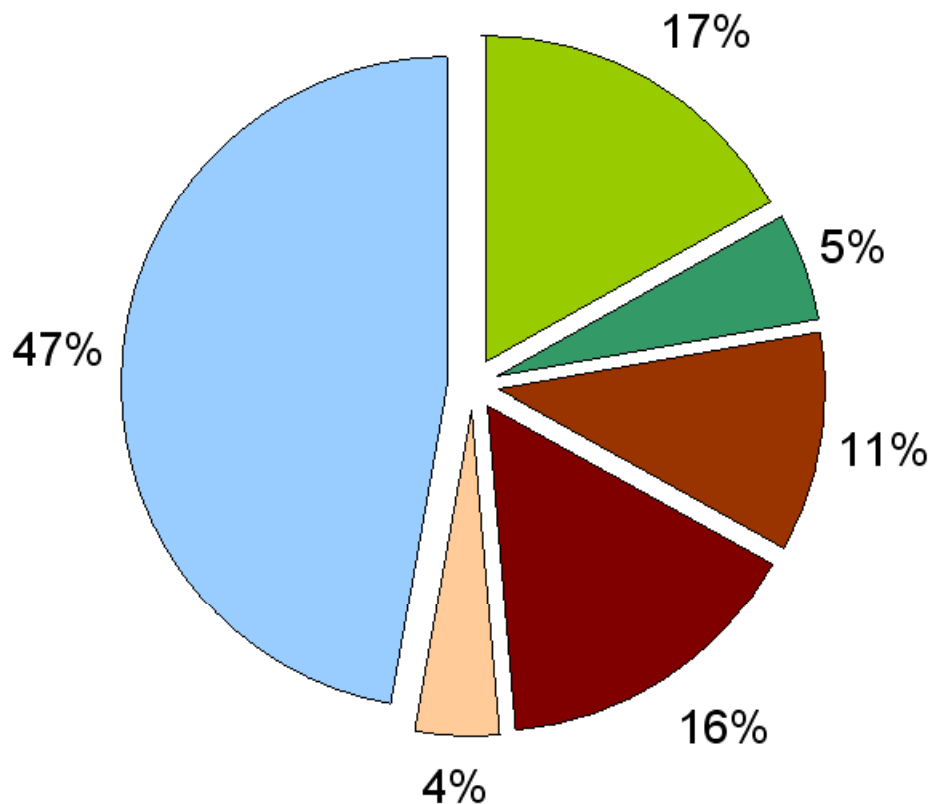
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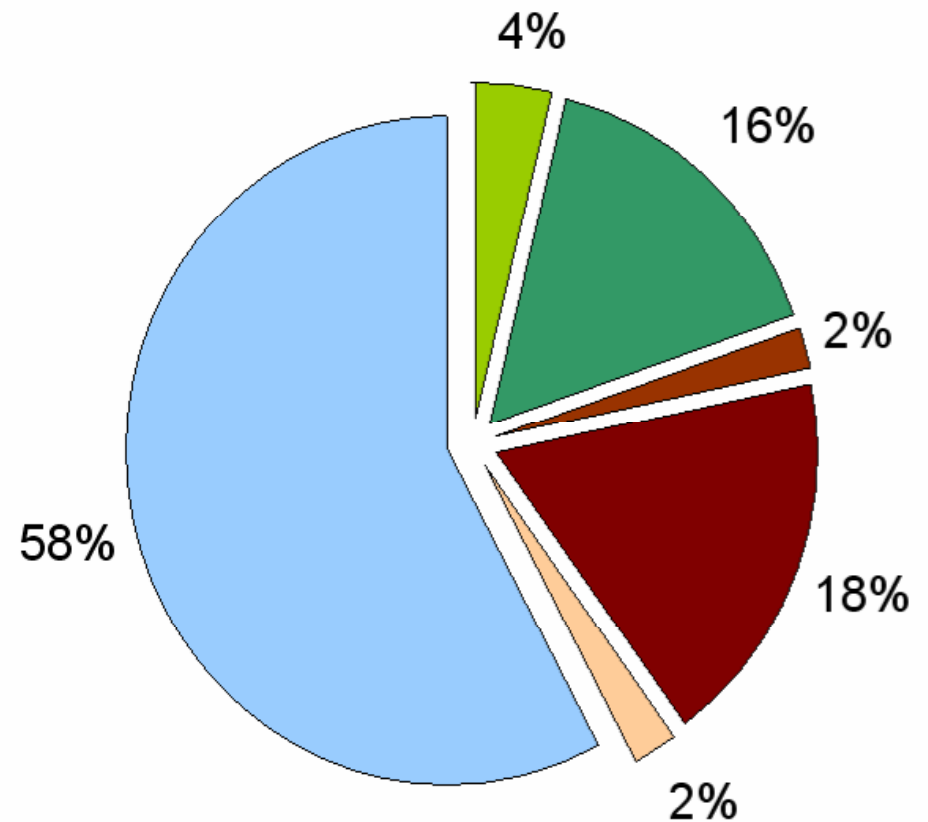
Actor simulations – Device



Actors Simulating Dementia



Real OA w/ Dementia



Conclusions

- Non-traditional tools and techniques, such as AI, have the potential to make environments more usable and safe
- Intended user must be kept in mind and involved often for successful outcomes
- The potential exists to use actors to improve design process
- In addition to technological challenges, development must focus on the social and ethical implications

Future Work

- Actor simulations
 - Larger study
 - Multiple ADL
- COACH@Home System
 - Multiple tasks
 - Easy installation
 - Aesthetics

Team Members / Contributors

- Alex Mihailidis, Axel von Bertoldi, Vicky Young, Dave Giesbrecht, Melinda McLean, Tony Tam (IATSL)
- Craig Boutilier (University of Toronto)
- Jesse Hoey (University of Dundee)
- Pascal Poupart (University of Waterloo)

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