Smart and Robotic Homes: SmartBathroom: Developing an Environment to Study/Facilitate Bathroom Transfers

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Rehabilitation Engineering Research Center on Technologies to Support Successful Aging with Disability

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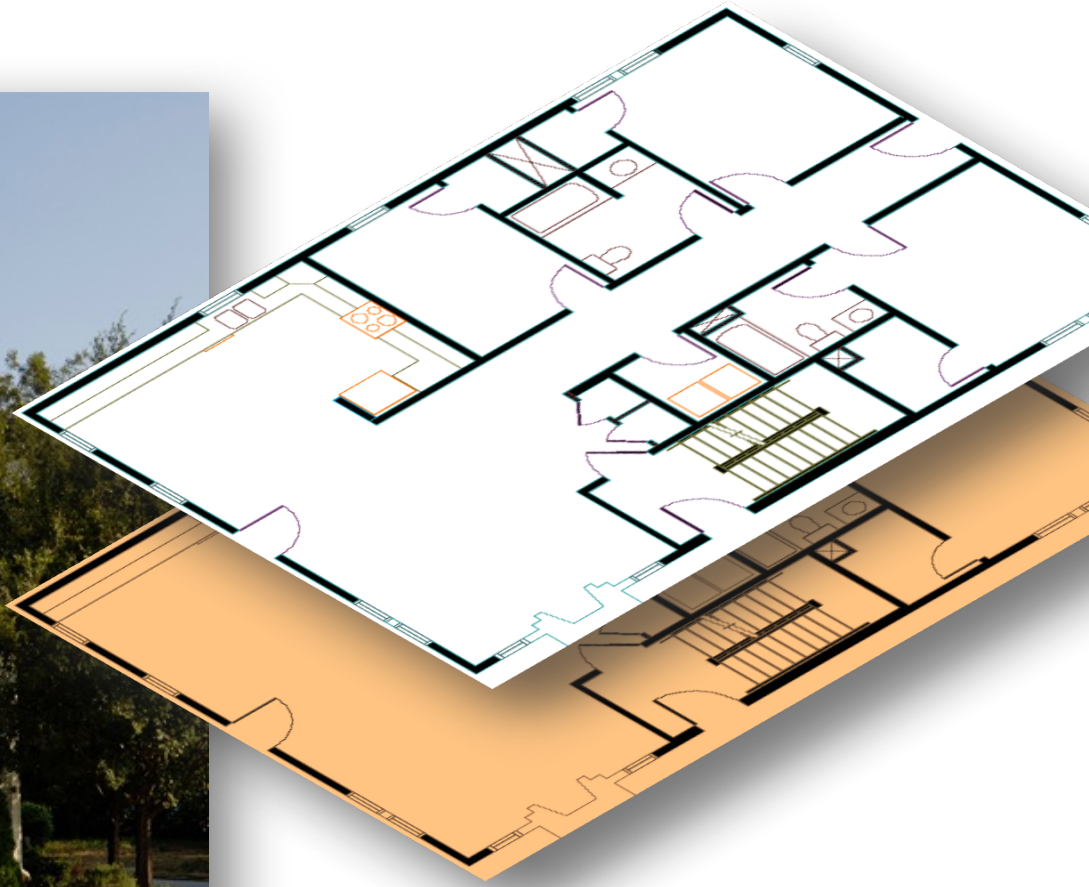
The Aware Home



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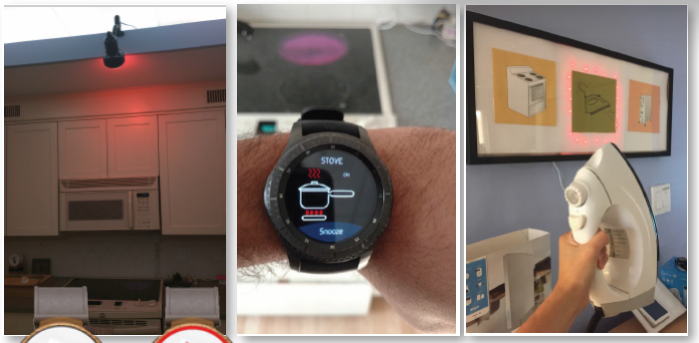
Research Areas

Health and Well-being

Empowering: Independence; Health self-management; In-home rehab; Wellness; Social connectedness

Connected Home Experience

Simplifying smarthome setup & management; Data/behavior-driven home control; Whole home gaming; Sustainability (resource management)



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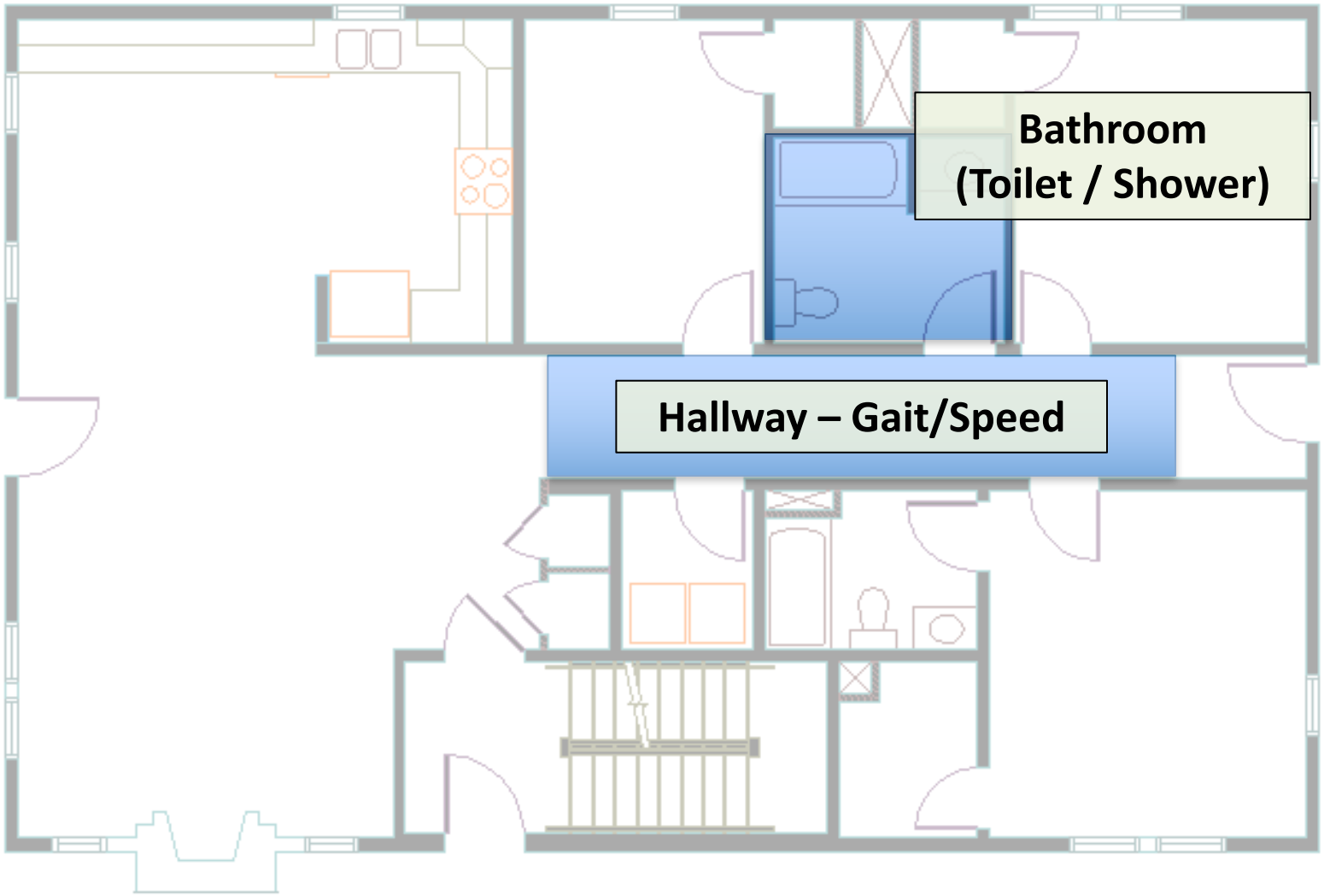
Assessing Function to Inform Adaptive Supports in the Home

Hypothesis:

In-situ assessment of individual function can contribute to identification of daily and longitudinal trends that will allow automated adaptation of the environment to support greater independence of the individual.

In-situ Functional Assessment

Aware Home Floorplan



In-situ Functional Assessment

Kinect for Gait Speed Analysis

Proof of Concept Gait Speed Measurement Device

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SmartBathroom

A lab designed to study transfer performance in a home bathroom environment

Purpose

Integrate Physical and Digital Worlds:

Develop a bathroom environment with embedded sensors capable of assessing an individual's abilities at any point in time and automatically adjusting supportive environmental features to accommodate those abilities.

Goal:

Explore task performance during toilet, shower and bath transfer of older adults (60+), who can ambulate with or without a caregiver, but who have physical upper or lower-body impairment

Prior Research: Demonstration of Transfers

Prior Research: Demonstration of Toilet Transfers

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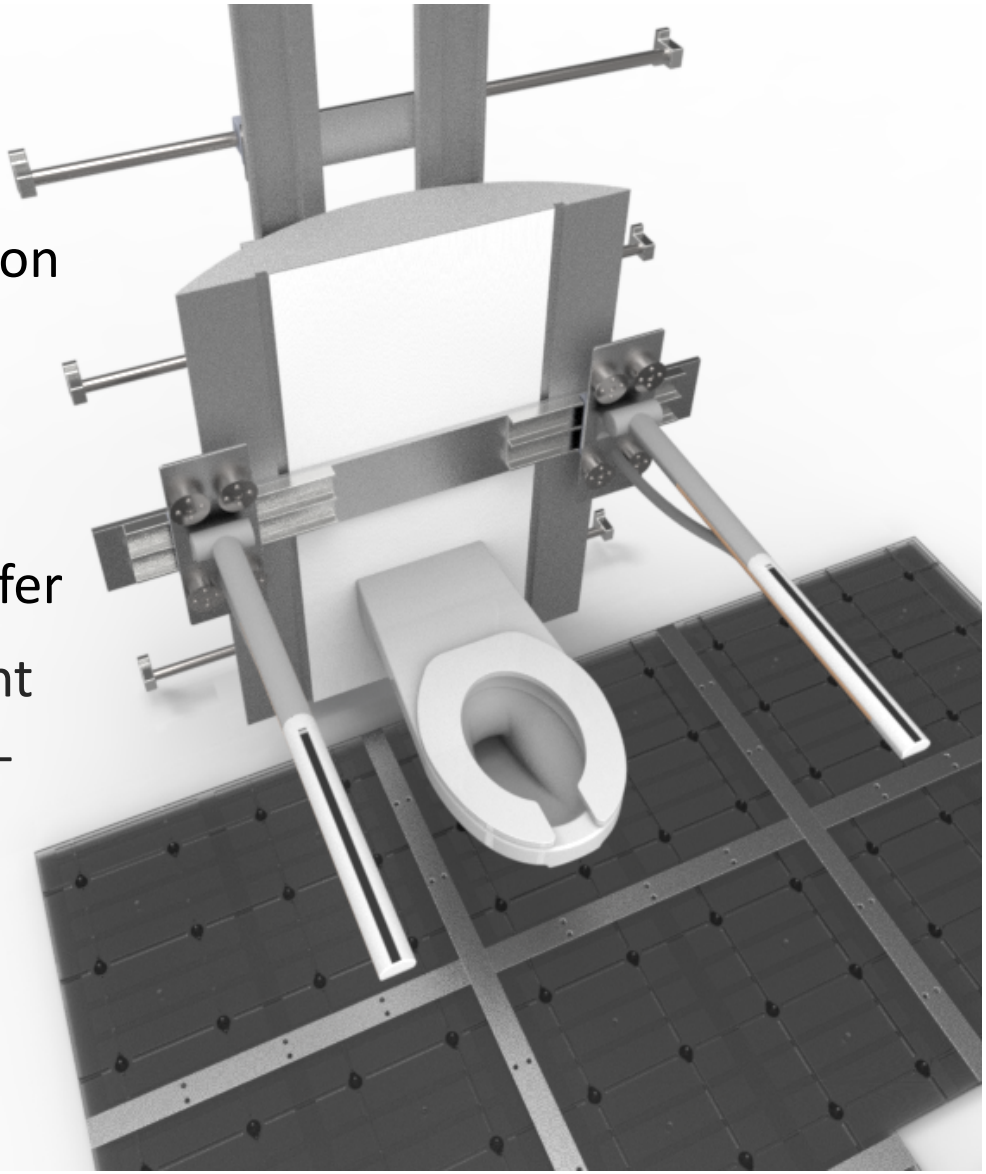
SmartToilet Development

SmartToilet Features

Sensing Capabilities

- **SmartFloor** – detect foot location and weight shift
- **SmartGrabbar** – measure grip location, strength, weight and direction of forces during transfer
- **SmartToiletSeat** – detect weight and during transfer and weight-shift while seated.



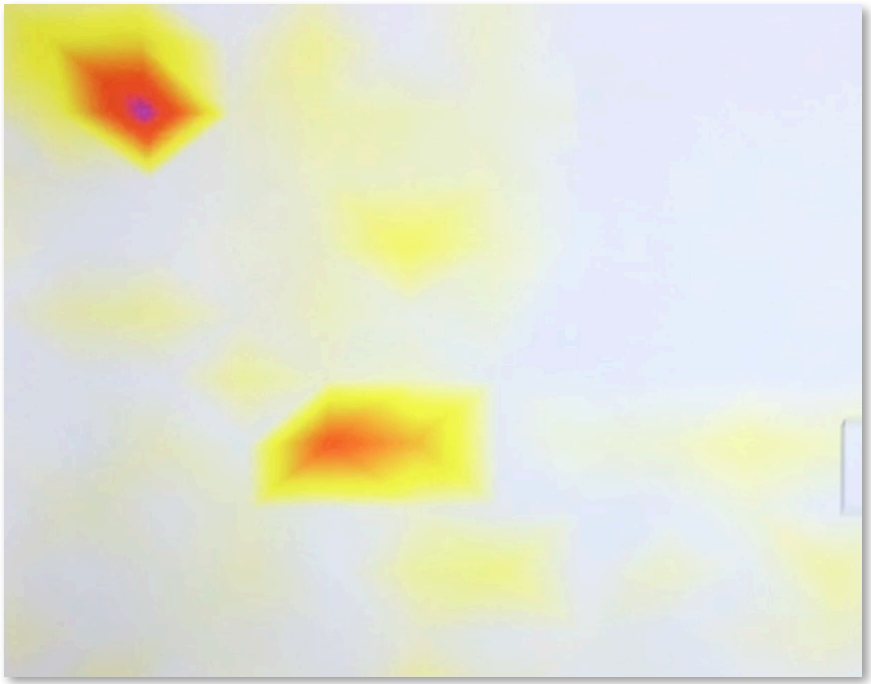
SmartToilet Features

Adjustable Features

- **Toilet**
  - Height (motorized)
  - Horizontal position
- **Bi-lateral toilet grabbars**
  - Height relative to toilet seat
  - Horizontal distance relative to toilet center line

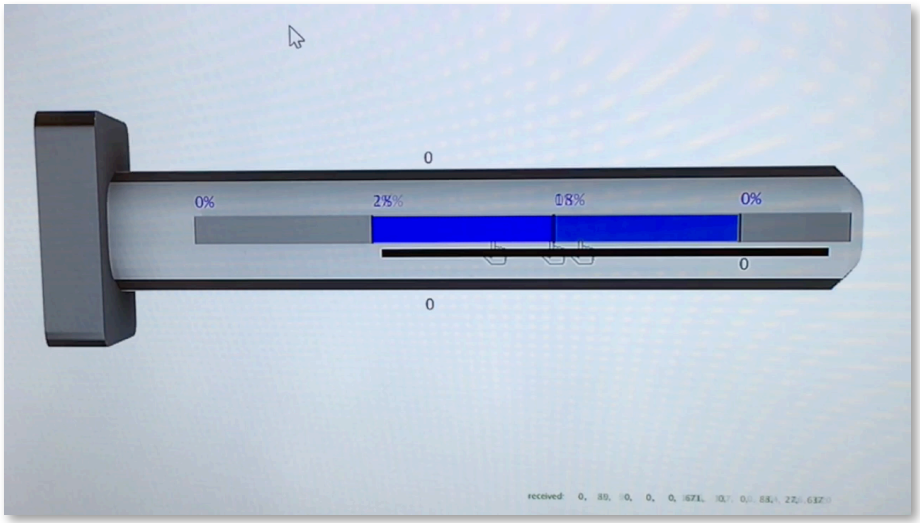
SmartFloor

- Floor sits on top of load cells
  - Detect location and vertical forces



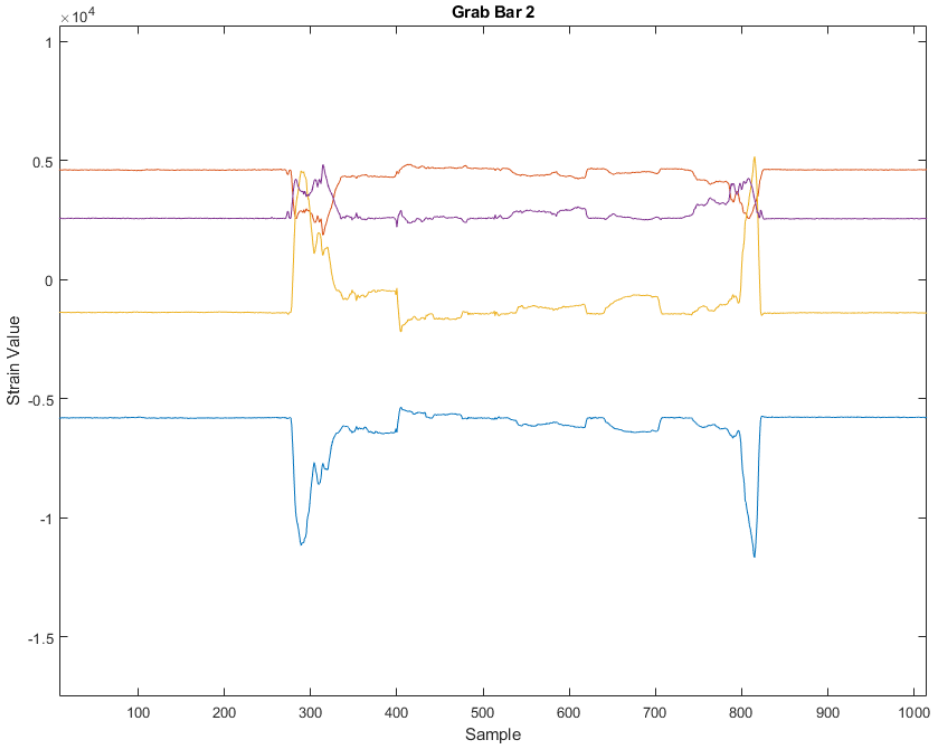
SmartGrabbar: Grip

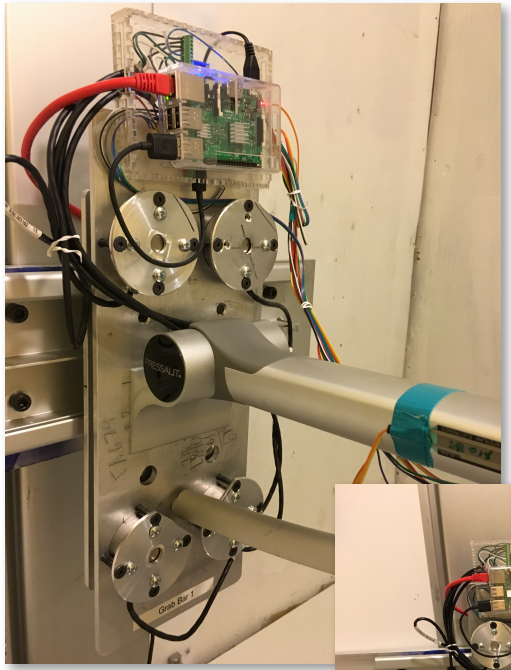
- Force/location sensors on top of bars
  - number of hands
  - position of hands
  - relative grip strength
- Force sensors on sides and bottom
  - type of grip
  - relative grip strength

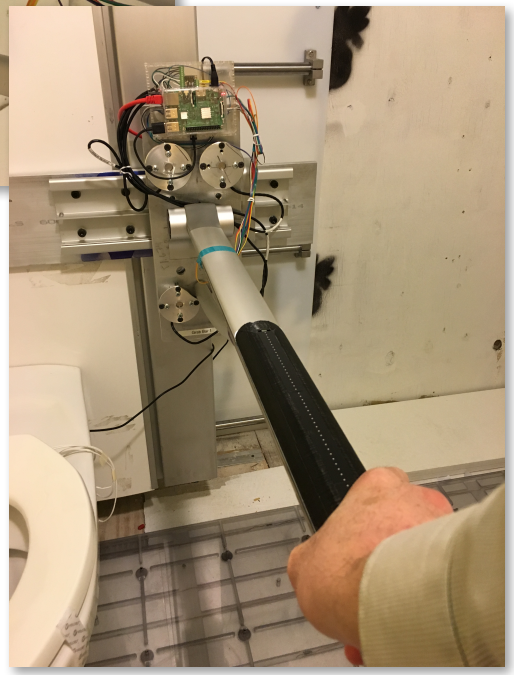


SmartGrabbar: Support Forces

- Load cells support grab bars
  - Provide precise force / direction



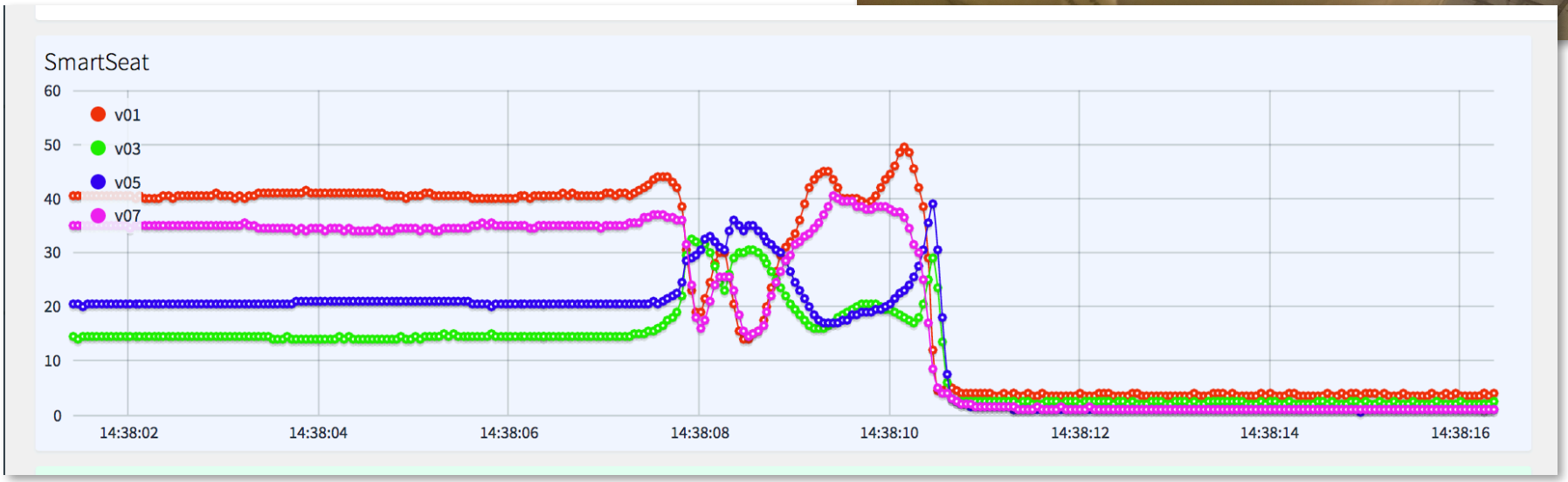




SmartGrabbar: Support Forces

Load cells support toilet seat

- Forces during transfer
- Weight shift while seated



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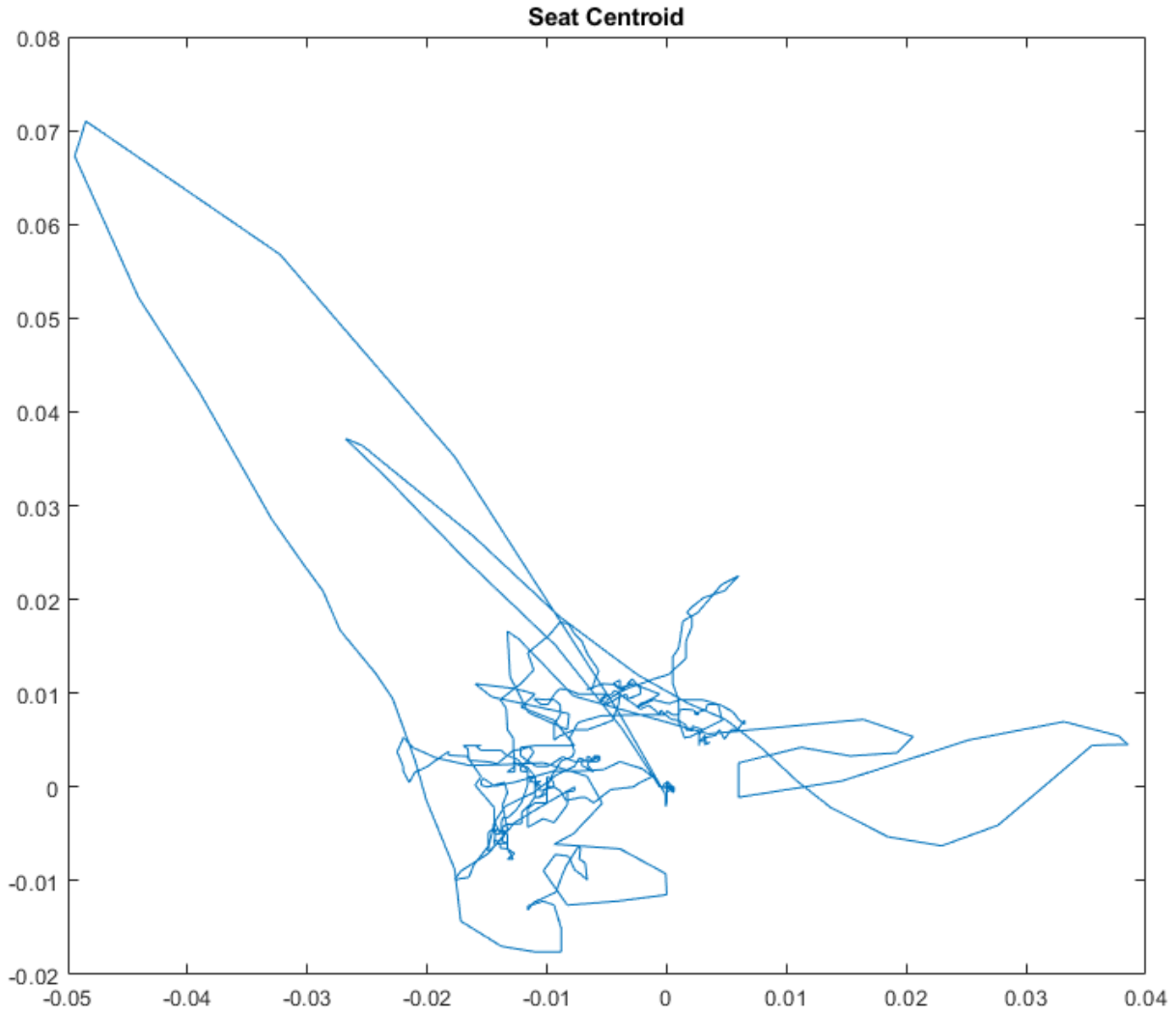


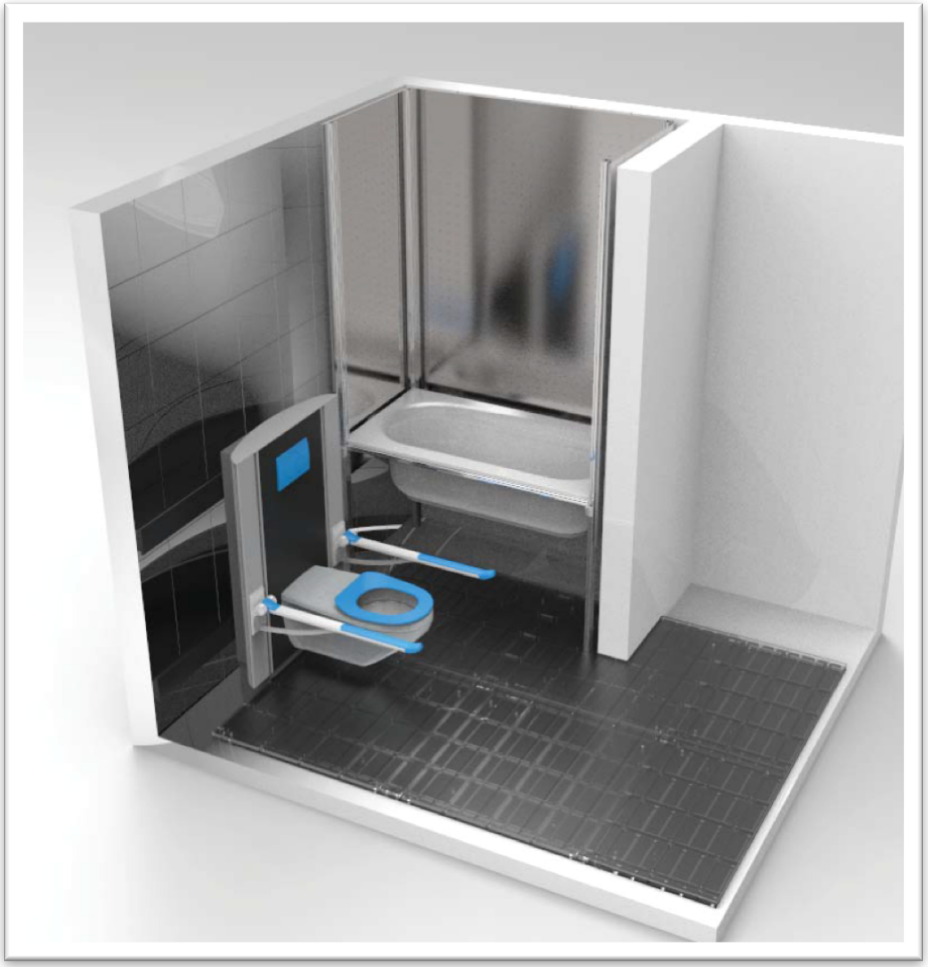
Future Plans

Study Plans

- Monthly Visits / trials with target participants to build a dataset of function over time.
- Identify data (devices) most useful for identifying changes in function and where supports might improve performance
- Explore patterns in dataset of individuals and across individuals as related to

Expansion

- Develop SmartBathing Testbed
- Long-term: Automate aspects of the bathroom to facilitate personalized transfer



Thank you

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