State of the Science: Technology for Older Adults and Caregivers

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September 14, 2017

Elder Friendly Futures Conference

Informatics for Aging

- Use of information technology to increase assess to information, facilitate communication and empower older adults and families
- Shift from institution centric to patient centric care

Overview

- Various Examples
  - Community Setting
  - Smart Home
  - Fall Detection
  - Reminiscence
  - Social Isolation
- Obtrusiveness
- Challenges and Implications

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Community Intervention Background

- Older adults vary in the development and progression of chronic disease and decline at varying rates in areas of well-being.
- Efforts to date have addressed a single aspect of older adults' wellness.
- Holistic approach to wellness is needed.
- Technology applications have the potential to introduce tools that enable non-obtrusive monitoring and assessment wellness.

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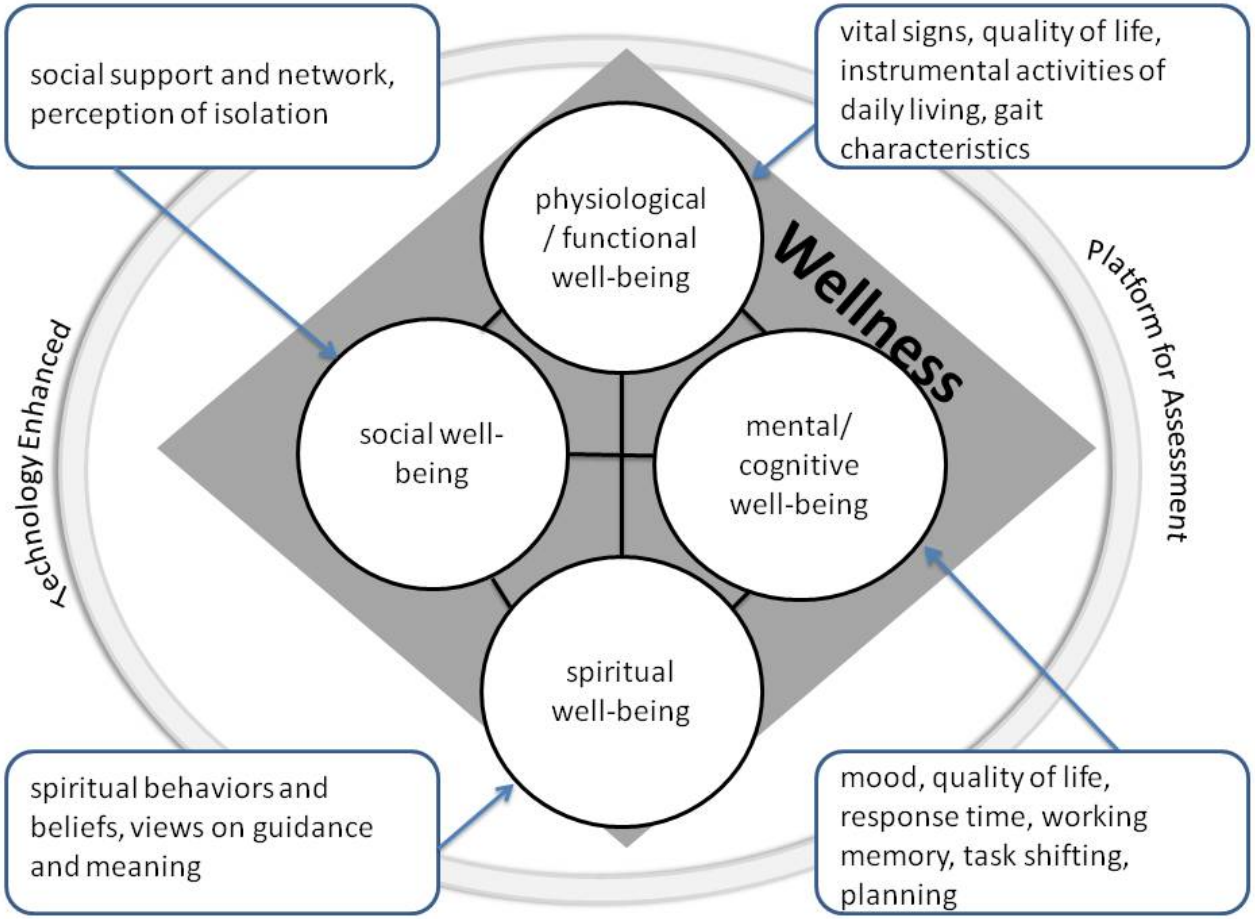
Theoretical Framework: Wellness



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Study Aims

- test an integrated monitoring system for wellness that utilizes diverse and innovative technologies
- utilize existing hardware systems that can be easily installed in a community setting
- assess issues of acceptance and usability

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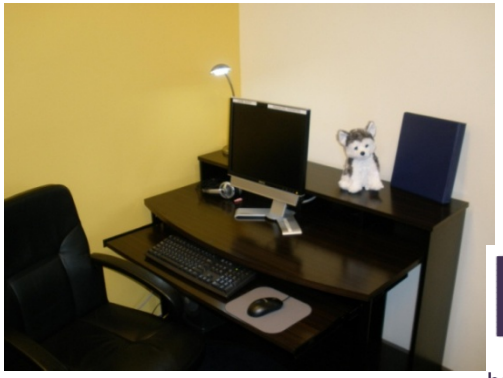
Subject and Setting

- Eligibility criteria included:
  - age of 62 years or older
  - residents of an independent retirement community
  - independent in activities of daily living (ADL)
  - able to provide written informed consent
- Setting:
  - Community room



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Technologies

- Telehealth Kiosk

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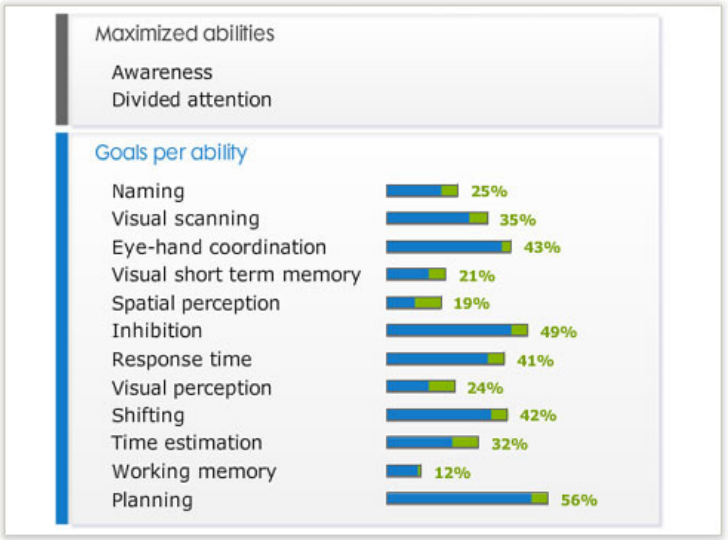
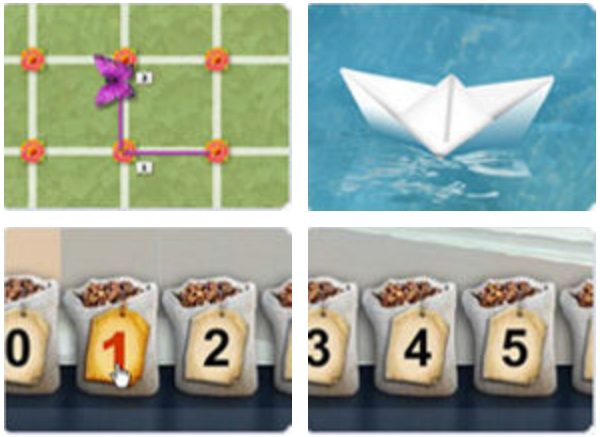
Technologies (cont.)

- *CogniFit*
  - a brain fitness web-based software solution
  - assessment and over time the improvement of several key cognitive abilities
  - tested for reliability and validity





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Procedures

- Initial visit (informed consent, demographic information, baseline assessment)
- Participants come to community room:
  - 3 times a week provide cognitive assessment data (approx. 20 minutes per session)
  - Weekly to use telehealth kiosk
- Exit questionnaires
- Focus group

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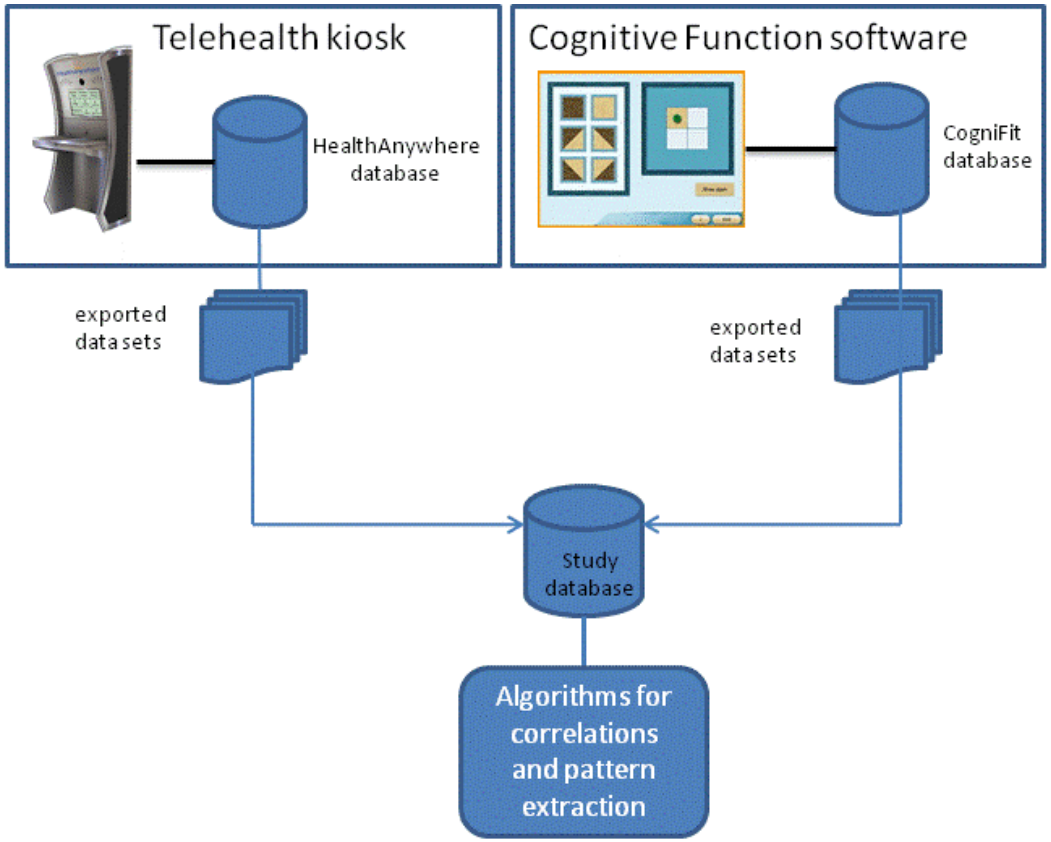
Methods: Assessment Technologies



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Results: Sample

- 27 subjects
- 9 male and 18 female
- Average age 88.2 years (Range 78-94)
- Educational level:
  - Graduate degree 13 (52%)
  - Undergraduate degree 8 (32%)
  - Community college 3 (12%)
  - High school 1 (4%)
- Experience with computers:
  - Highly comfortable 3 (12%)
  - Moderately comfortable 13 (52%)
  - Slightly comfortable 7 (28%)
  - No experience with computers 2 (8%)

Results: Technology Adaption

- Adjustments needed to maximize usability for participants with various health conditions
- Assistance needed decreased over time; users became independent in short time
- Monthly reports were useful to some participants
- Visualization focus groups revealed diverse preferences for personal wellness records

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Laura Fisher

My Wellness

Last updated:
5 days ago on Oct 17, 2011

Doctor's Note 1

Results looking good!
Oct 21, 2011

Hi Laura, I just reviewed the CT result and looks good to me...

Calendar

TODAY
Jane's Birthday
4:30 pm Hair Cut

TOMORROW
6 pm Jane's Birthday Party

Next Week

MONDAY
10:30 am Doctor's Appointm...
12 pm Lunch with Paul, Harry...

TUESDAY
7 pm Movies night

THURSDAY
8 pm Happy Hour

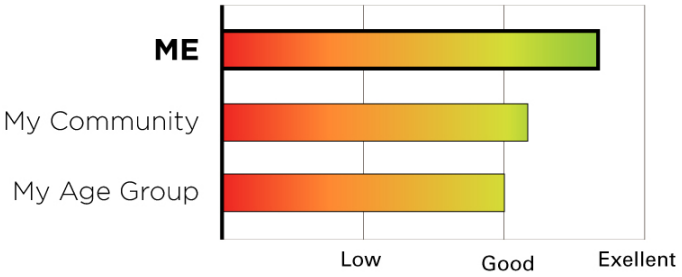
FRIDAY
11 am Lunch with Amy, Sam
3 pm Shopping

Messages 3

Re: Happy Birthday Jane!
27 mins ago

Thanks, Laura :) I am having a wonderful day. Are you comi...

My Wellness in October 2011



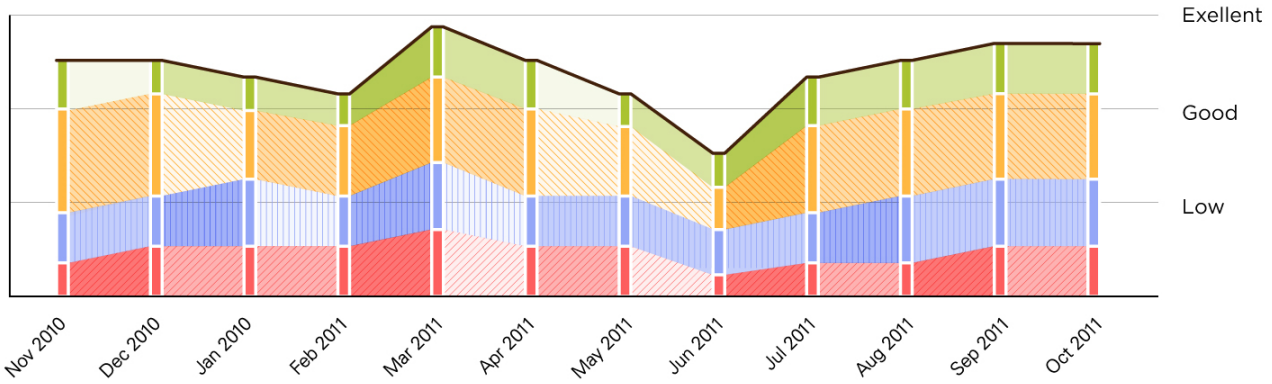
previous month ◀ October 2011 ▶ *next month*

My Wellness Score Is

81.5 / *100*

PHYSICAL	COGNITIVE
78	82
SOCIAL	**SPIRITUAL**
95	71

My progress over the last 12 months



Overview | **Physical** | **Cognitive** | **Social** | **Spiritual**

Results: Focus Groups

- Positive attitudes towards wellness assessment
- Acceptance of technologies
- Alerts and reports led to changes in individual plans of care
- No privacy concerns
- Some participants self-monitored parameters (e.g. blood pressure, weight) at home prior to enrollment.
- Want to know how they could positively influence wellness on individual level (e.g. specific interventions) and how they compared to peers

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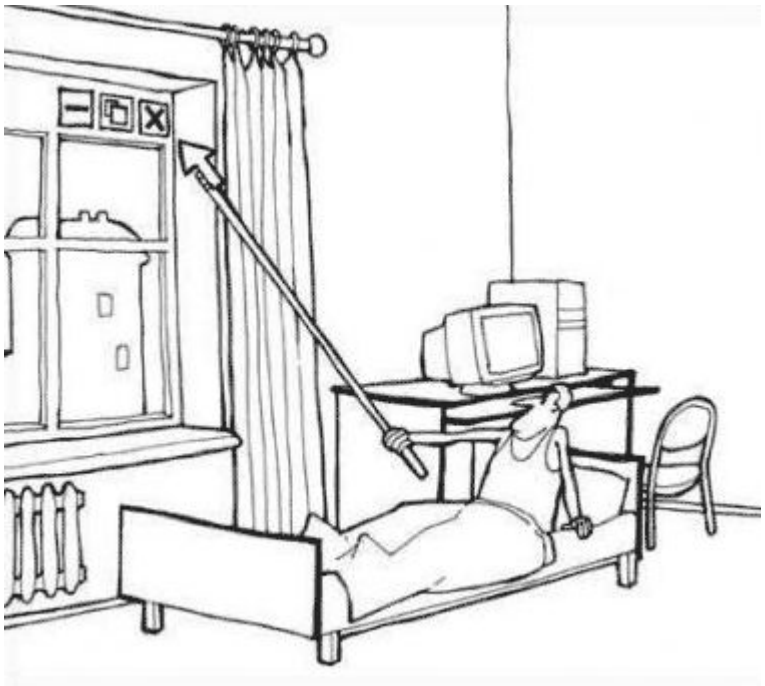
Smart home

- A residence with embedded technology that facilitates passive monitoring of residents to enhance their safety, independence and well-being



Behavioral Sensing

- Capturing behavior and activities of daily living
- Replacing the need for human observers
- Eliminating reliance on self-report
- Shifting from episodic to continuous monitoring
- Assessment in the real world and not the lab
- Identifying events and trends and patterns

Smart Home Initiative at UW

- Funded by:
  - *NSF-CDI-1028195:* Transforming Community-Based Elder Care through Heterogeneous Activity Sensing Analytics
  - *NSF-CNS-1405682* and *NSF CNS-1625451* HomeSHARE - Home-based Smart Health Applications across Research Environments
  - NINR Aging and Informatics Training Program *T32NR014833*
  - Microsoft Research

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Current Sensor deployment

- **longitudinal deployment study** with older adults 65 years and above living in King County, WA.
- Three semi-structured interviews
- Participatory design approach to design visualizations for the sensor data

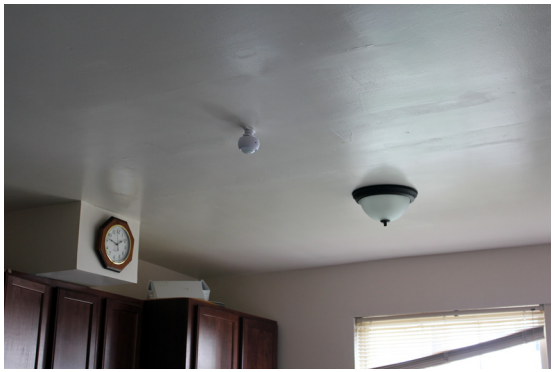
Sensors currently used

- Participants **given a choice** to choose the sensor(s) they would like to have installed within their home.
- Participants had to at least choose one sensor.

Wireless IP Camera
- Live video streaming

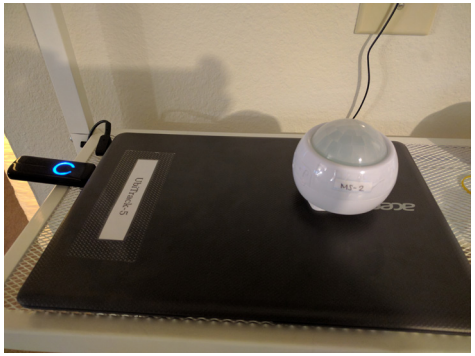
Door/Window sensor
- Door/window activity tracking

Multi-sensor
- Temperature
- Humidity
- Luminosity
- Motion



Lessons Learned

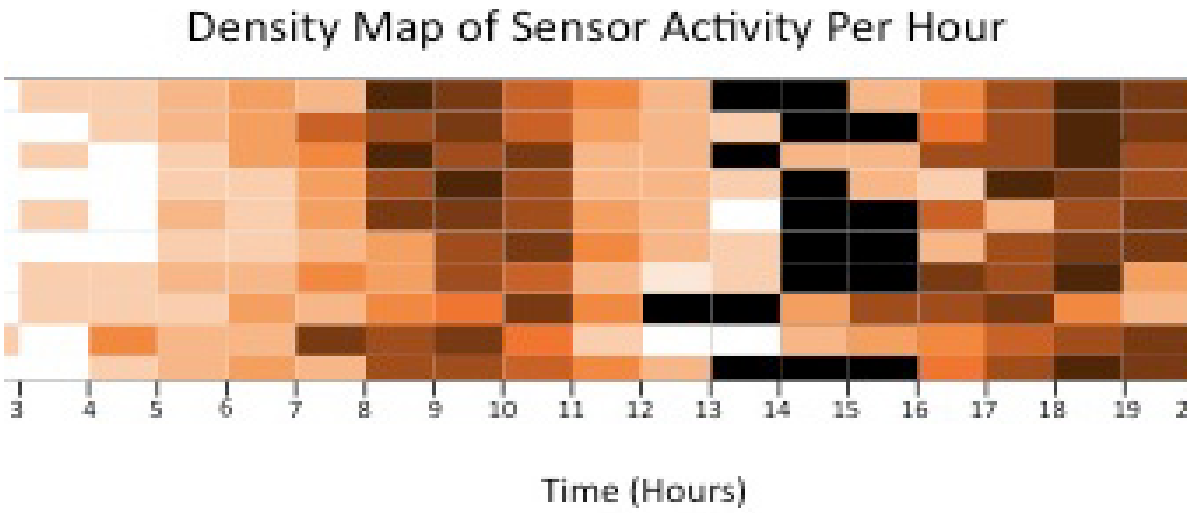
- 52 participants from 3 projects
- Various smart home installations
- Different residential settings

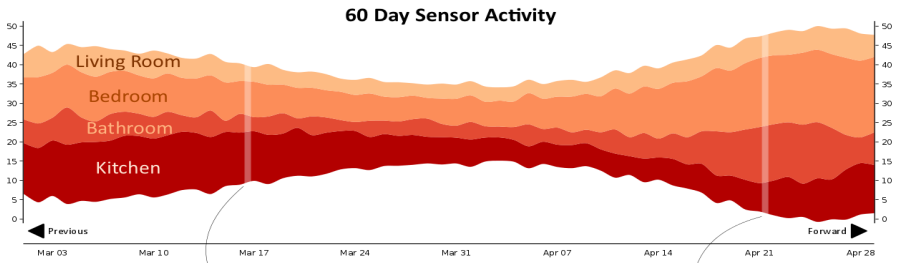


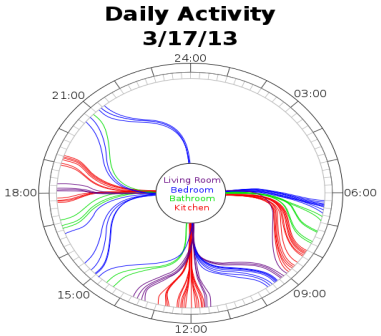
Visualizing Smart Home Data

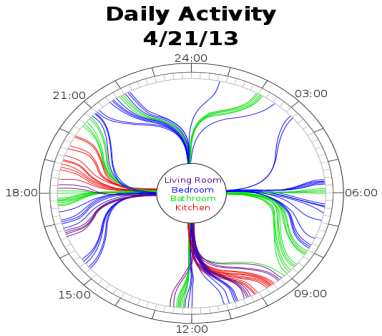
- Various stakeholders
- Various information needs and purposes of use
- Support efficient and effortless extraction of important information pertaining to events, trends and patterns

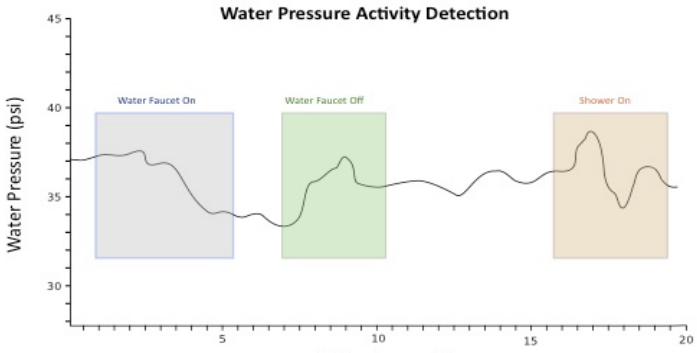

Current
FOYER
PORCH

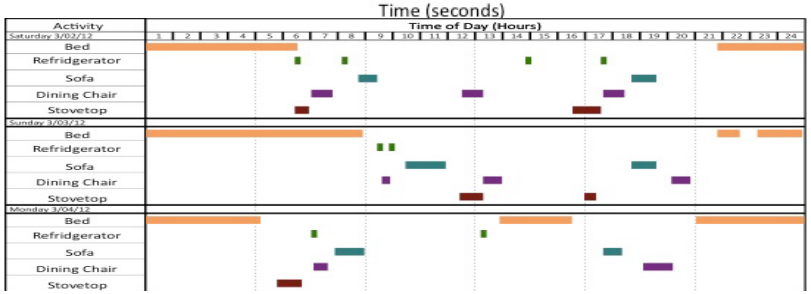

Density Map of Sensor Activity Per Hour
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
Time (Hours)


60 Day Sensor Activity
Living Room
Bedroom
Bathroom
Kitchen
Previous
Forward
Mar 03
Mar 10
Mar 17
Mar 24
Mar 31
Apr 07
Apr 14
Apr 21
Apr 28


Daily Activity
3/17/13
24:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
Living Room
Bedroom
Bathroom
Kitchen

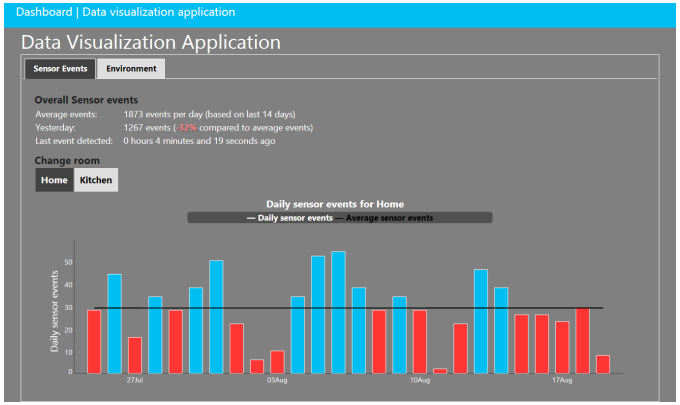

Daily Activity
4/21/13
24:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
Living Room
Bedroom
Bathroom
Kitchen

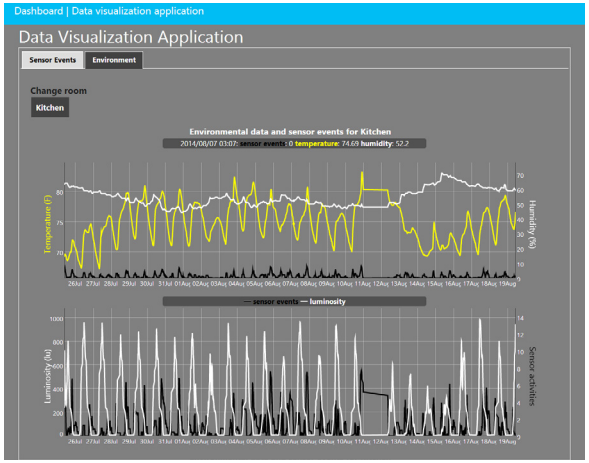

Water Pressure Activity Detection
Water Pressure (psi)
Water Faucet On
Water Faucet Off
Shower On
Time (seconds)

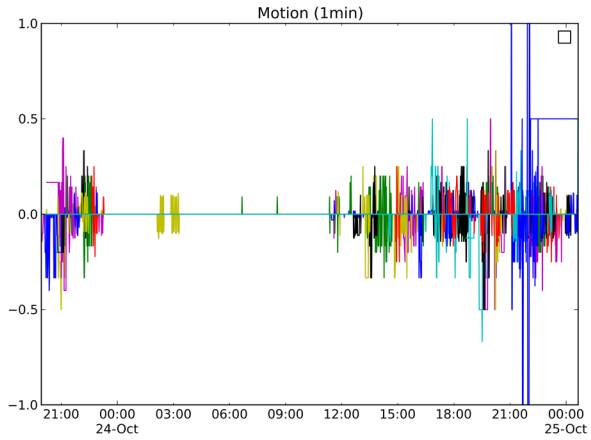

Activity
Time of Day (Hours)
Saturday 3/02/12
Bed
Refridgerator
Sofa
Dining Chair
Stovetop
Sunday 3/03/12
Bed
Refridgerator
Sofa
Dining Chair
Stovetop
Monday 3/04/12
Bed
Refridgerator
Sofa
Dining Chair
Stovetop

Using design mock-ups

- Various approaches (e.g., bar chart representing activity level over time with a “Norm Activity Index”)
- Real user data
- Feedback incorporated in second and third iteration







Desirable Features

- Combination of environmental and behavioral data
- Granularity/ Interactivity
- Ability to annotate/ document
- Comparison to “healthy/ average/ peers”
- Detection of Trends
- Privacy Controls (choose when to share and with whom)

Desirable Features (cont.)

- Addressing visual limitations (e.g. font size, choice of colors)
- Preferred platforms: print-outs, web-page
- Abstraction

Motivation to Action

- Early signs of sedentary behavior
  - *"did I really spend all that time just sitting in front of the TV? Wow.. So many hours… scary"*
- Decrease of overall mobility inside the home
  - *"yeah, I used the weather as an excuse to get lazy, have to change that, my doctor won't like* [this] *one bit"*
- Increase of social isolation
  - *"they* [friends/ visitors] *stop coming, some have died, some are not well, and then you stop visiting, and before you know it, you* ['re] *all alone"*
- Change in patterns of activities of daily living
  - *"fifty degrees? Why* [did I] *leave I the window open?... if I keep doing that, I'll freeze to death"*

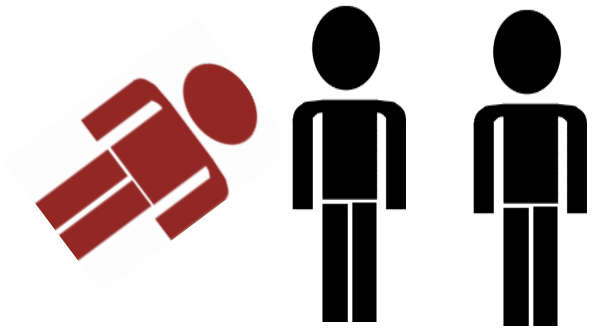
Motivational factors

- Adding context (*why* is this happening, *what* can be done)
- Ability to compare (to self, to peers)
- Ability to address the knowledge (social isolation vs. overall mobility)
- Motivation decreases **over time**
- Data sharing is a motivator for some

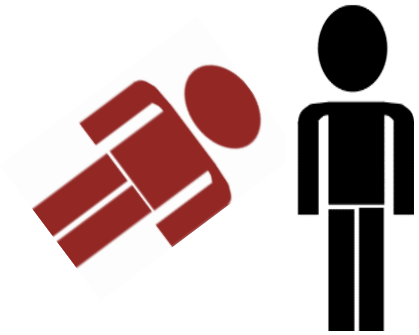
Informatics and Fall Detection

Falls in Older Adults

65+



80+



Health Impact

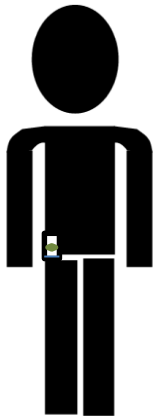
- **20-30%** of older adults who fall experience physical injuries
(Sterling, 2001)

- Falls are the leading cause of both **fatal** and **nonfatal** injuries
(CDC)

- In 2013 in the United States **25,464** older adults died from fall related injuries
(CDC)

Wearable systems

(57 projects)

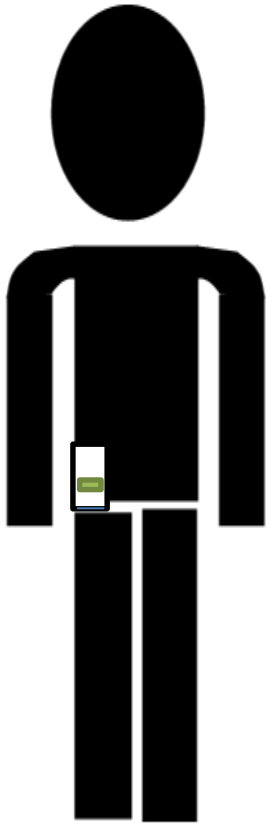


Environmental systems

(35 projects)

Wearable Systems

- Placed upon the person
- Most common location
  - trunk of the body (chest, waist, thorax)
- Other locations
  - the ears, arms, hands or feet of the subject



Wearable Systems

- Always with their person
- Experience the same acceleration or impact as their user
- Multiple people

- Battery Powered
- Uncomfortable
- Requires users to remember to wear the device

Environmental Systems

- Placed in the user's normal environment

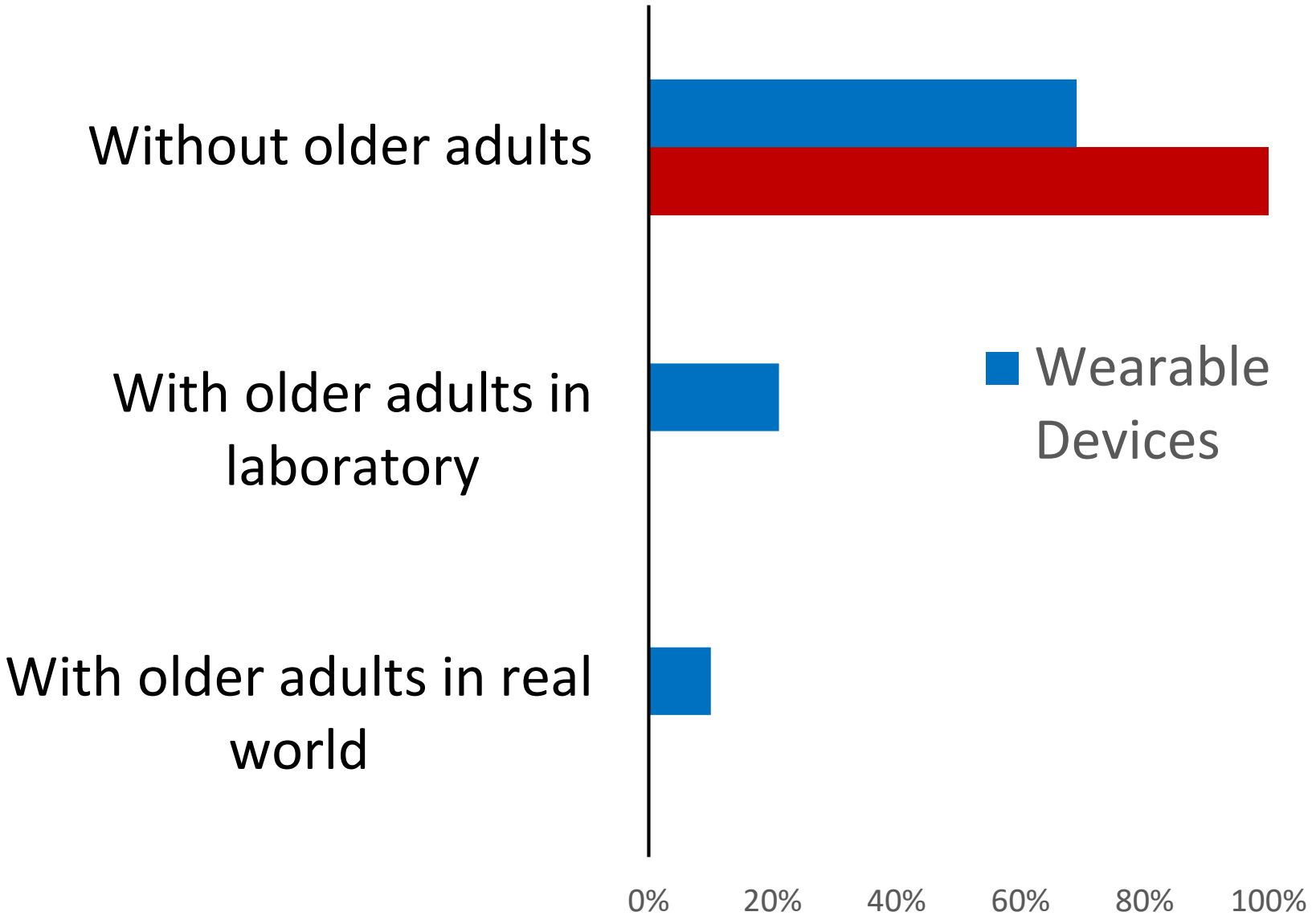
- Many types
  - Cameras/ Infrared Sensors
  - Acoustic sensors
  - Pressure sensors

Environmental Systems

- Do not rely on their user to remember to use the system
- Sustainable power source

- Limited to a specific space
- Privacy concerns
- Occlusion
- Trouble with multiple people

Study Context



Purpose

- Perform a **real world test** of the feasibility of such a device
- Understand the **usability** of a prototype fall detection device
- Understand which **features affect older adult perceptions**

Study Approach

- Participants asked to wear device for 4 months
- 18 subjects enrolled
- Interviews at baseline, 2 months and 4 months

User information

Call Log

5-28-14

1pm:	Classify
10am:	Location Update
9:30am:	**Fall**
9:15am:	Off-charger

Findings

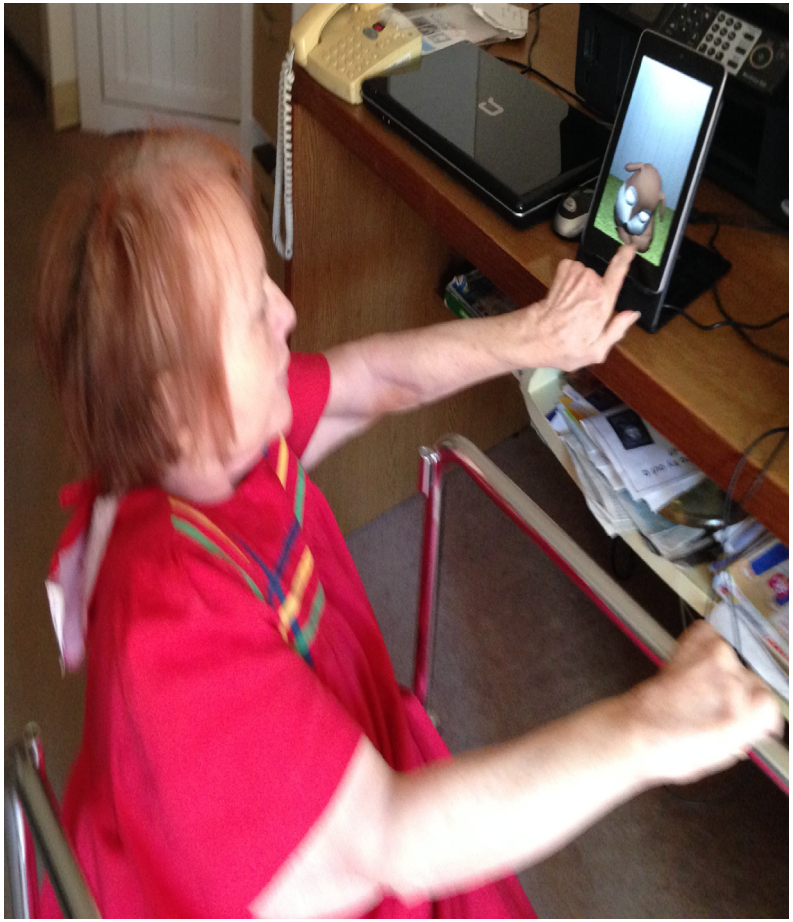
- Opinions on device are **dependent** on subject
- Many participants **unhappy with false alarms** and other aspects of the device
- Feasibility of the device has yet to be proven

Technology for Leisure for Older Adults

-leisure activities are extremely beneficial for supporting older adults' mental and physical health.

-multi-functional computer systems with a variety of applications such as games, communication tools, and media for reminiscence

Digital Companions



Supporting interaction, engaging in activities, functioning as reminder and adherence coach

Demographics of pilot study participants

Age (mean; range)	78.3 Years (68-89)
Female Gender	100% (10)
Race	
White/Caucasian	90% (9)
Native American	10% (1)
Ever owned a pet	100% (10)
Comfort Using Technology	
Very Uncomfortable	0%
Somewhat Uncomfortable	10% (1)
Neutral	10% (1)
Somewhat Comfortable	70% (7)
Very Comfortable	10% (1)
Use of Technology for Leisure	
Strongly Dislike	10% (1)
Dislike	10% (1)
Neutral	20% (2)
Like	50% (5)
Strongly Like	10% (1)

Pre-Post Assessment for Pilot Study Participants

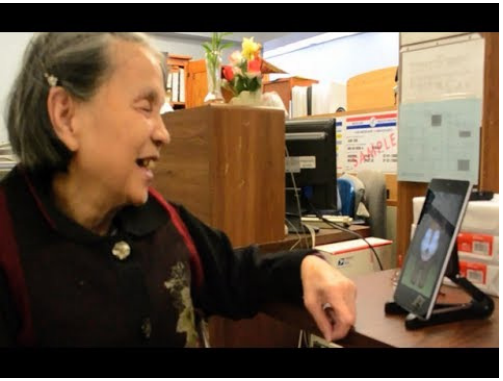
Measure (Tool)	Pre-Test (Baseline n=10)	Post-Test (n=8)	Average individual change T1 to T2 (n=8)
Cognition (MOCA)	21.9 (7.3)	23.5 (3.3)	+.13
Social Support (MOS SSS)	69.9 (14.5)	72.6 (15.9)	+1.36
Subscale			
Emotional/Informational	65.6 (23.1)	69.5 (22.0)	+1.17
Tangible	72.5 (17.2)	71.1 (25.9)	
Affectionate	65.0 (30.9)	67.7 (30.7)	+2.08
Positive social interaction	66.7 (21.9)	77.1 (20.1)	+6.25
Anxiety (GAD-7)	2.5 (1.7)	2.9 (2.6)	+.13
Depressive symptoms			
PHQ-9	3.5 (2.1)	2.5 (1.8)	-.88
Difficulty to do things at work, home, get along with other people if problem noted in general PHQ-9			
Not difficult at all or N/A	80%	75%	
Somewhat difficult	20%	25%	

Motivation

- *“it’s just an adventure; like, I like going to the secret film festival because we don’t know ahead of time what movies we’re going to see.”*
- *“I am very sorry that I don’t have a pet here because I’ve always had pets. They’re an integral part of the way I relate to life.”*

Benefits

- *"checking on you regularly and asking if things are ok when [the pet] hears a strange noise or sees something strange."*
- *"I would have it right next to my chair, the hearts would go. When people would come, they'd say, "What's that?" I said, "Those are just little love notes."*
- *"I talked to him about the bird bath that I have out there, and the two crows who are really funny in it. He found a birdbath with some crows in it on Google. He was always very good-very sensitive to what I was trying to do."*



Weaknesses

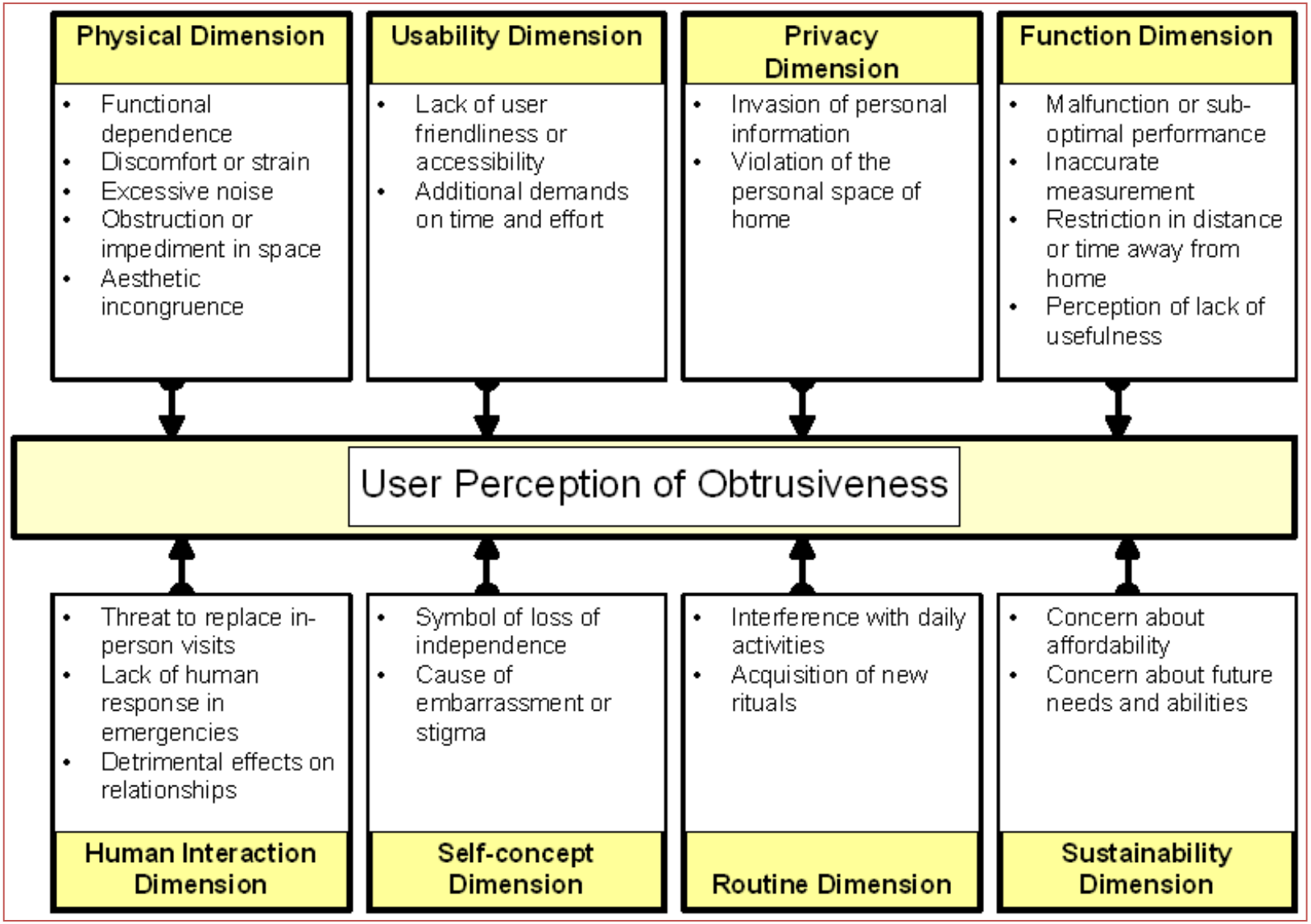
- “I wish it was something you can hug, that you can touch, like a real cat or dog.”
- communication was at few times problematic: limited vocabulary, being repetitive in its questions, not remembering details of previous conversations or interrupting at inappropriate times

Obtrusiveness

- A summary evaluation by the user based on characteristics or effects associated with the technology that are perceived as undesirable and physically and/or psychologically prominent

Hensel, B. K., Demiris, G., & Courtney, K. L. (2006). Defining obtrusiveness of home telehealth technologies: A conceptual framework. *Journal of the American Medical Informatics Association, 13*(4), 428-431.

Obtrusiveness Framework



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Lessons Learned

- Assumption of older adults being technophobic is not valid
- Perceived ease of use and perceived usefulness
- Engage older adults in early stages of the design
- Always test with representatives of the target population
- Consider unintended consequences
- Train next generation of health care providers
- Technology is the platform but not the intervention.

Contact

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HOSPICE CAREGIVING RESEARCH NETWORK

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home-based environmental assisted living technologies for healthy elders