WASHINGTON STATE UNIVERSITY

World Class. Face to Face.

think beyond

INNOVATORS

inspiring + exploring + transforming

the future of aging in place

Merging psychology and technology to help us live independently longer

WEDNESDAY, DECEMBER 8

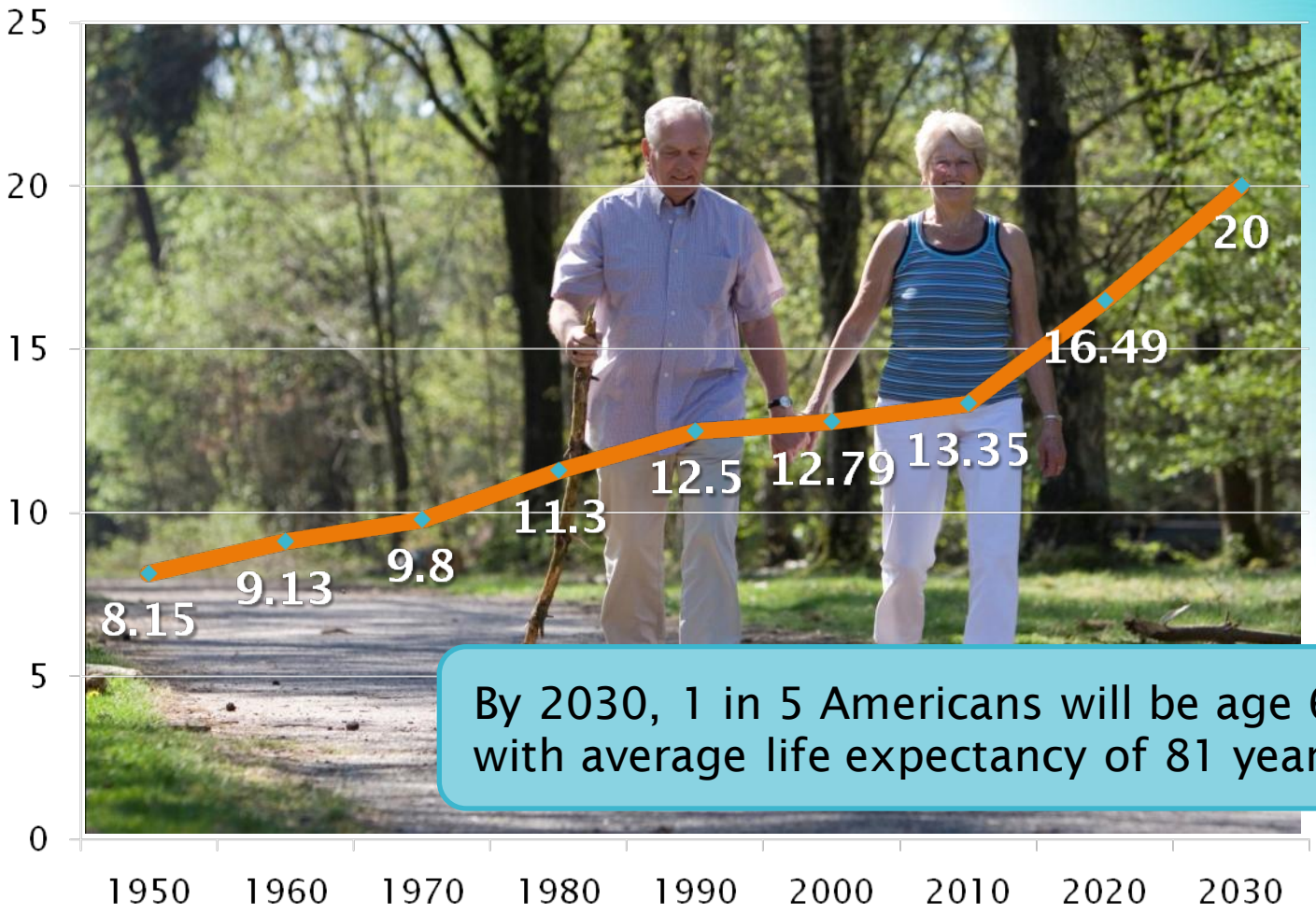
FEATURING

Maureen Schmitter-Edgecombe, Ph.D.
Professor, Department of Psychology,
College of Liberal Arts

Americans want to age in place

Aging of America

Trend in percent of individuals 65+



By 2030, 1 in 5 Americans will be age 65 or older; with average life expectancy of 81 years

With the aging of the population we are going to see:

- An increase in age-related disease
- Rising costs to health care
- Shortage of professionals
- Rise in individuals unable to live independently

Need innovative health care

How are we going to pay for and deliver quality health care to our aging population?

Facilities cannot handle coming "age wave"

One solution: shift more care to the home

Caregivers experience higher levels of emotional distress and physical health problems than non-caregivers

Need innovative health care

Innovative health care will need to consider the sick, the frail, the healthy, and the informal caregivers

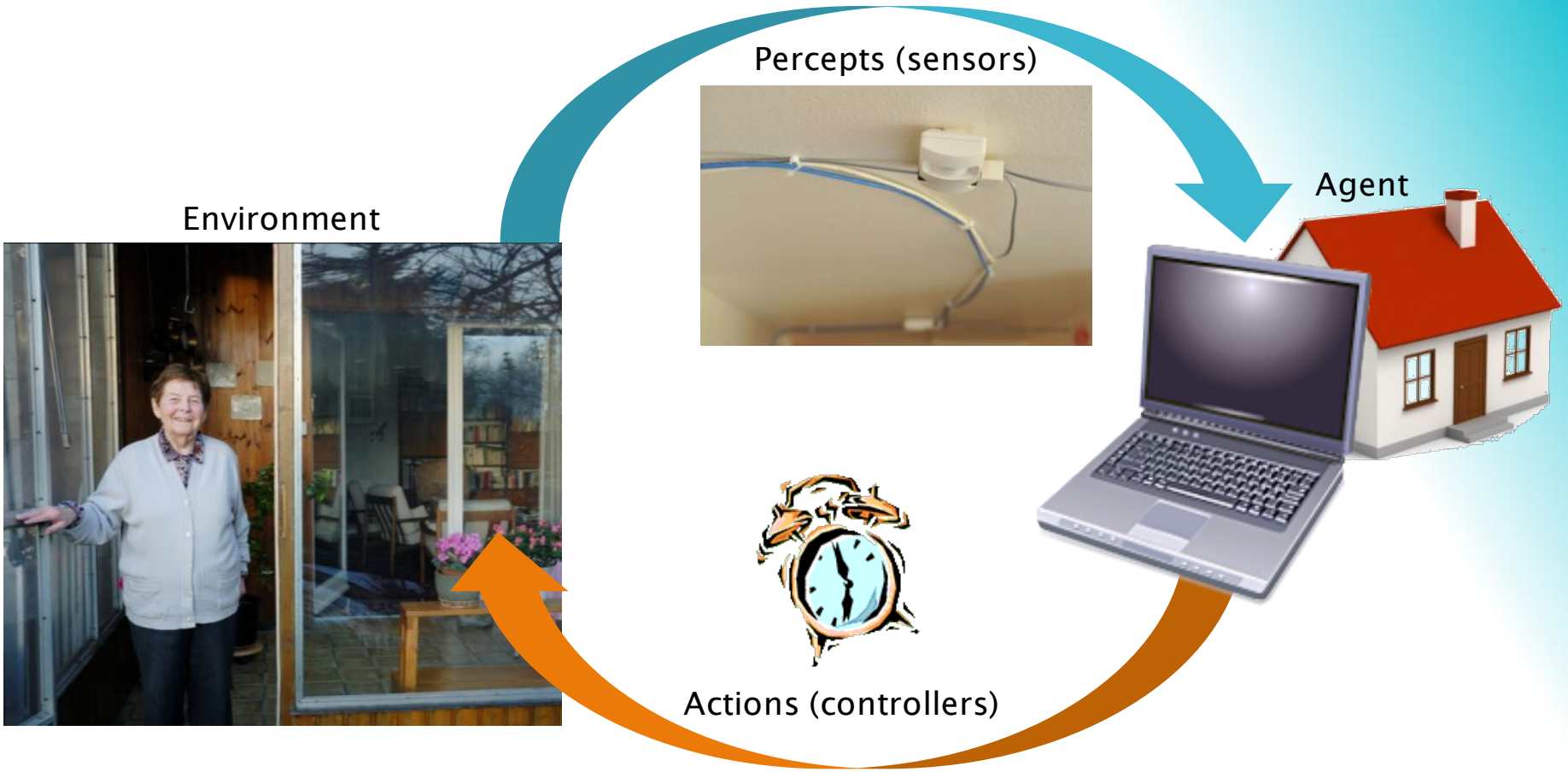
“Smart” environment technologies

- Have the potential to help Americans age in place by providing health monitoring and assistance (preventative and proactive) while also
  - Increasing quality of life
  - Decreasing caregiver burden
  - Decreasing cost of care to society

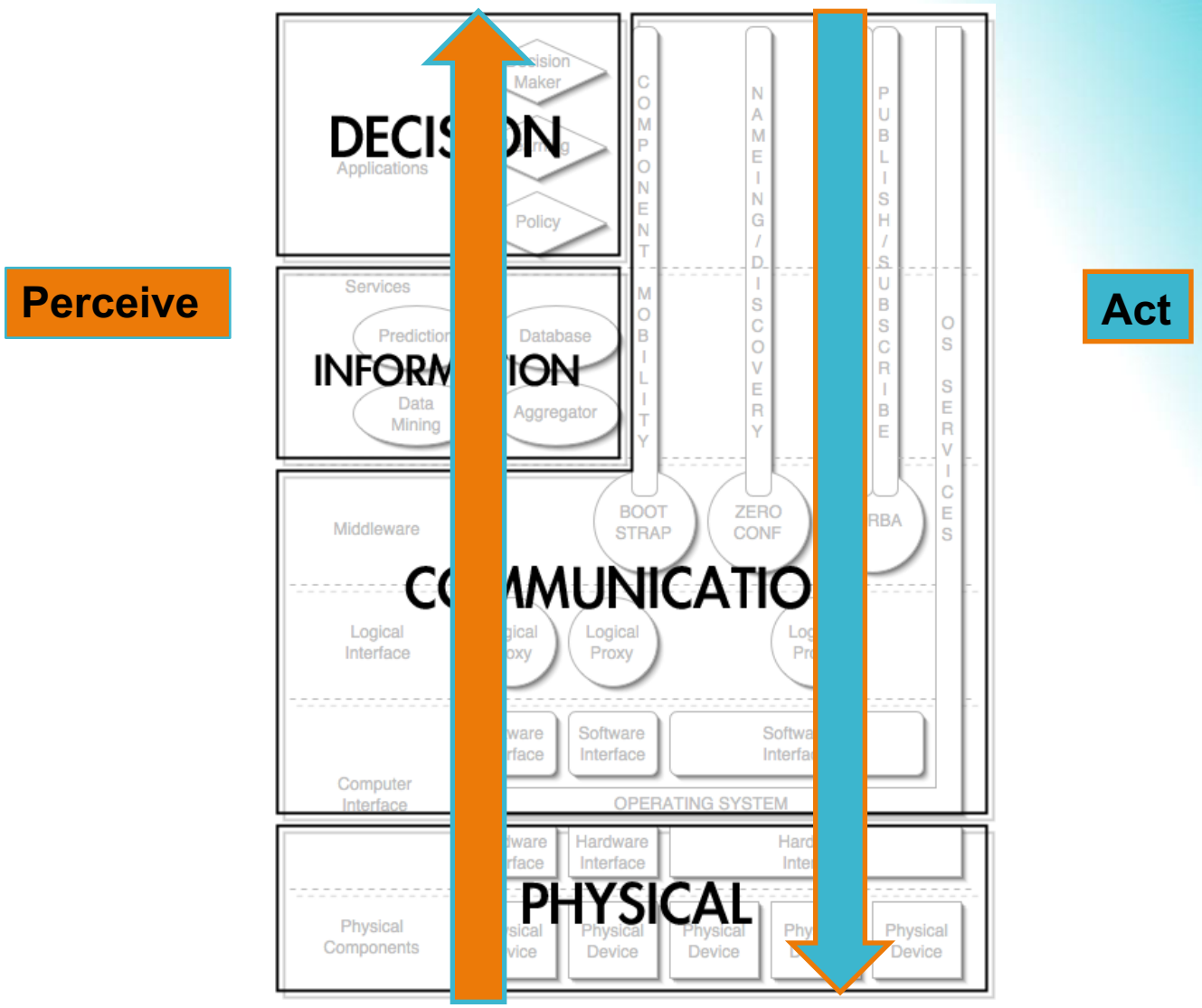
Long term goals and vision

What is a “smart” environment?

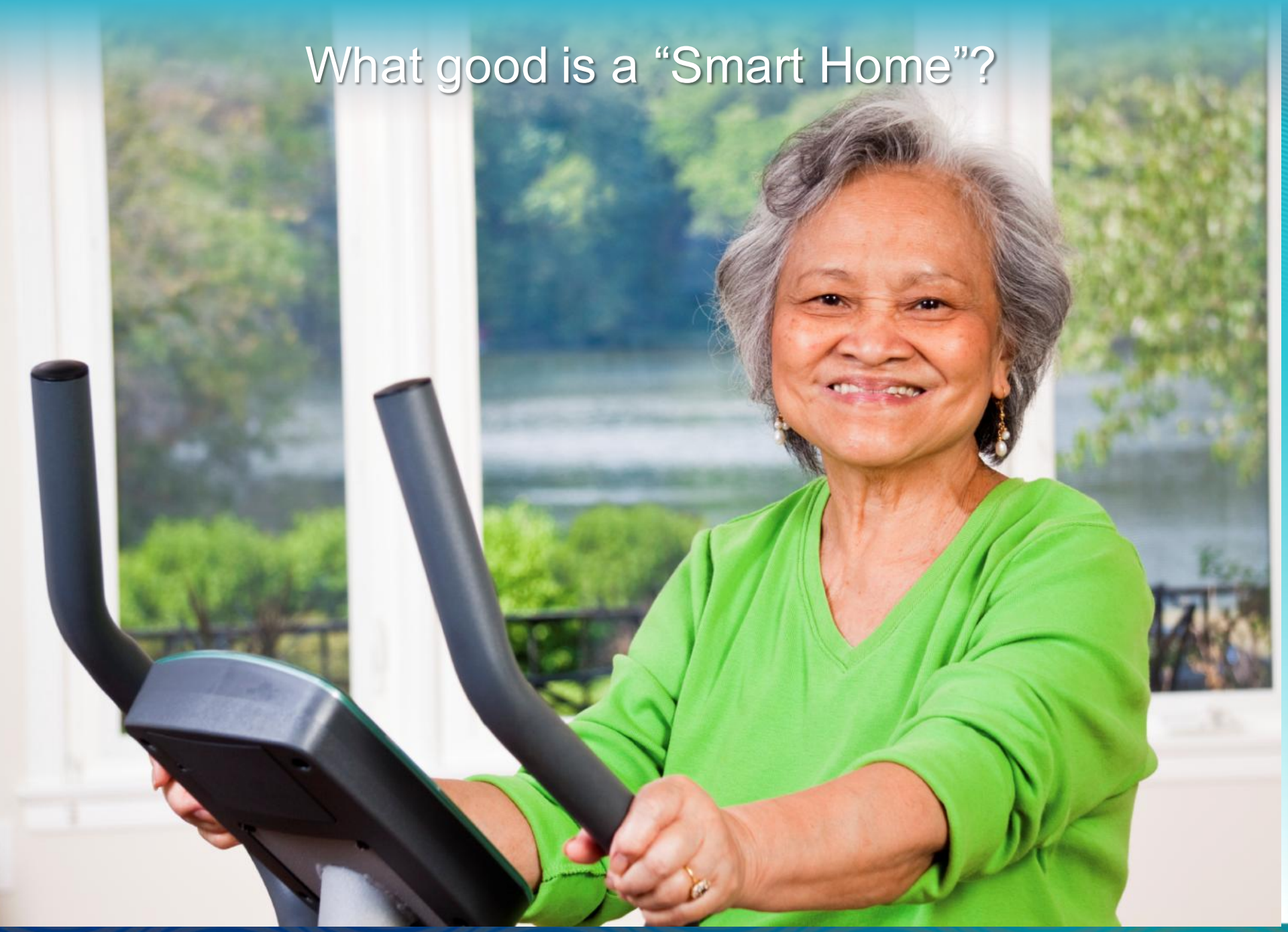
An environment able to ***acquire and apply knowledge*** about the ***resident and the physical surroundings*** to ***improve the resident’s experience.***



Components of a "smart" environment



What good is a “Smart Home”?



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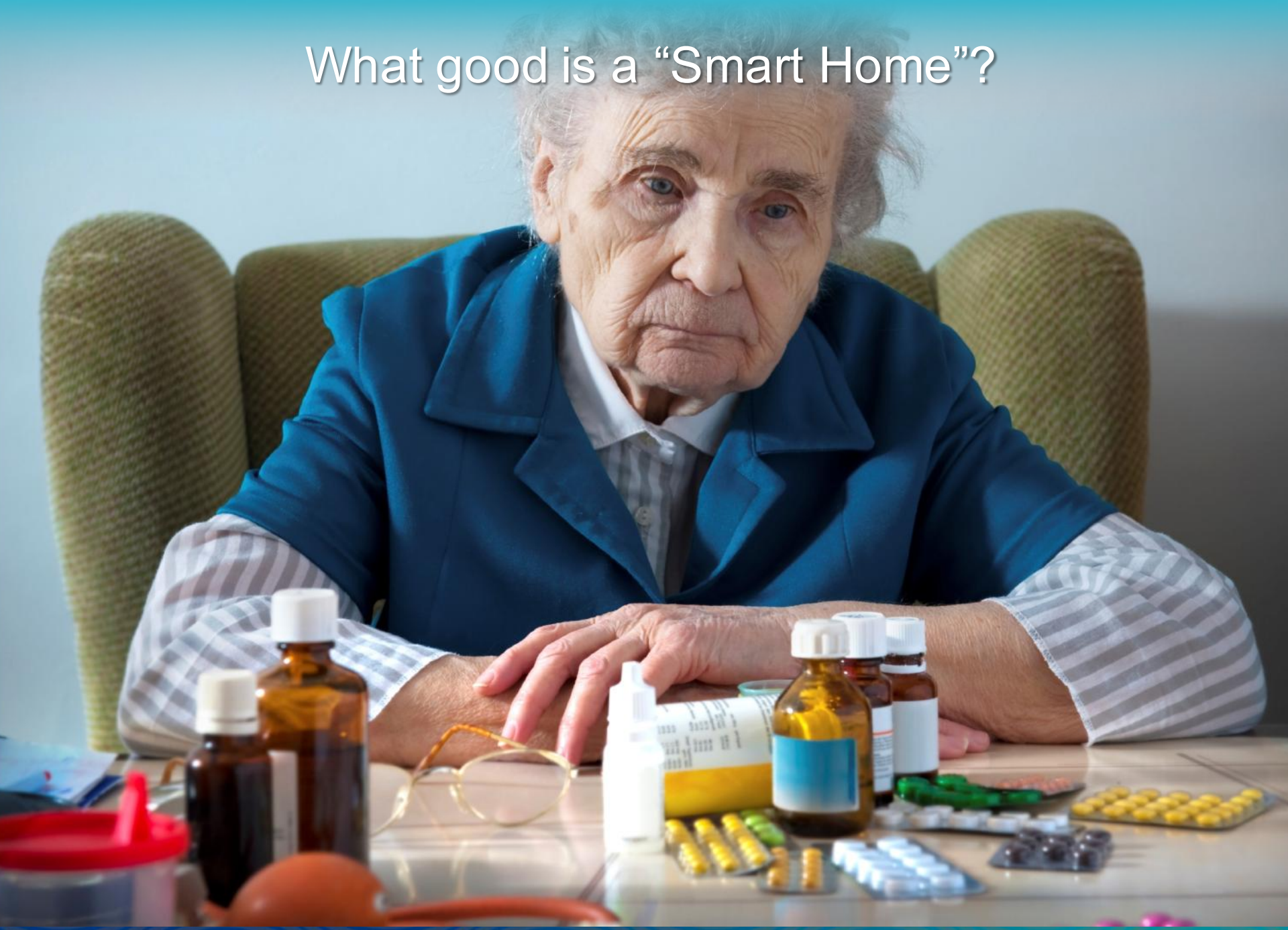

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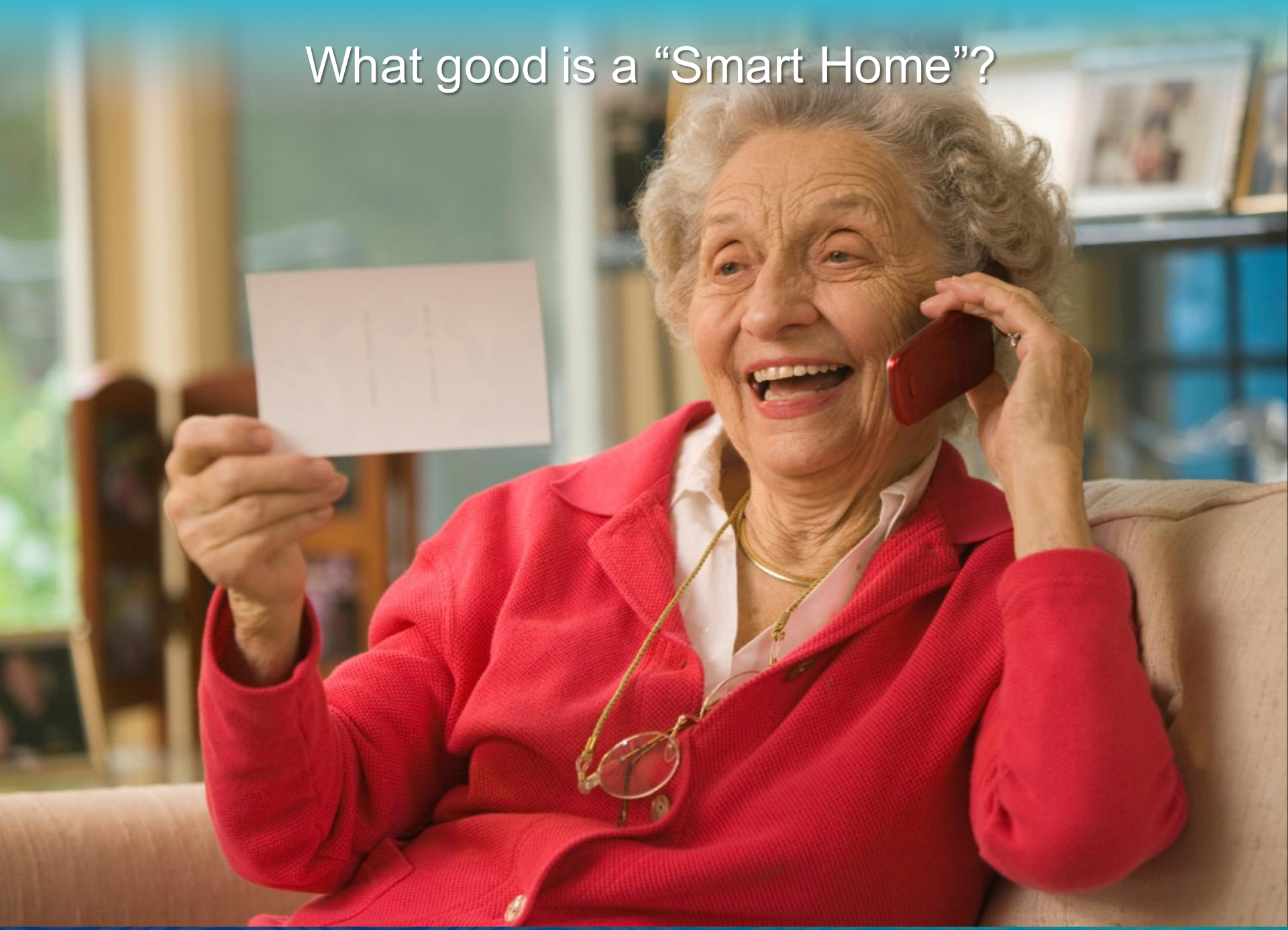


How is our cross disciplinary work at WSU moving us closer to these goals?

What assistance is needed?

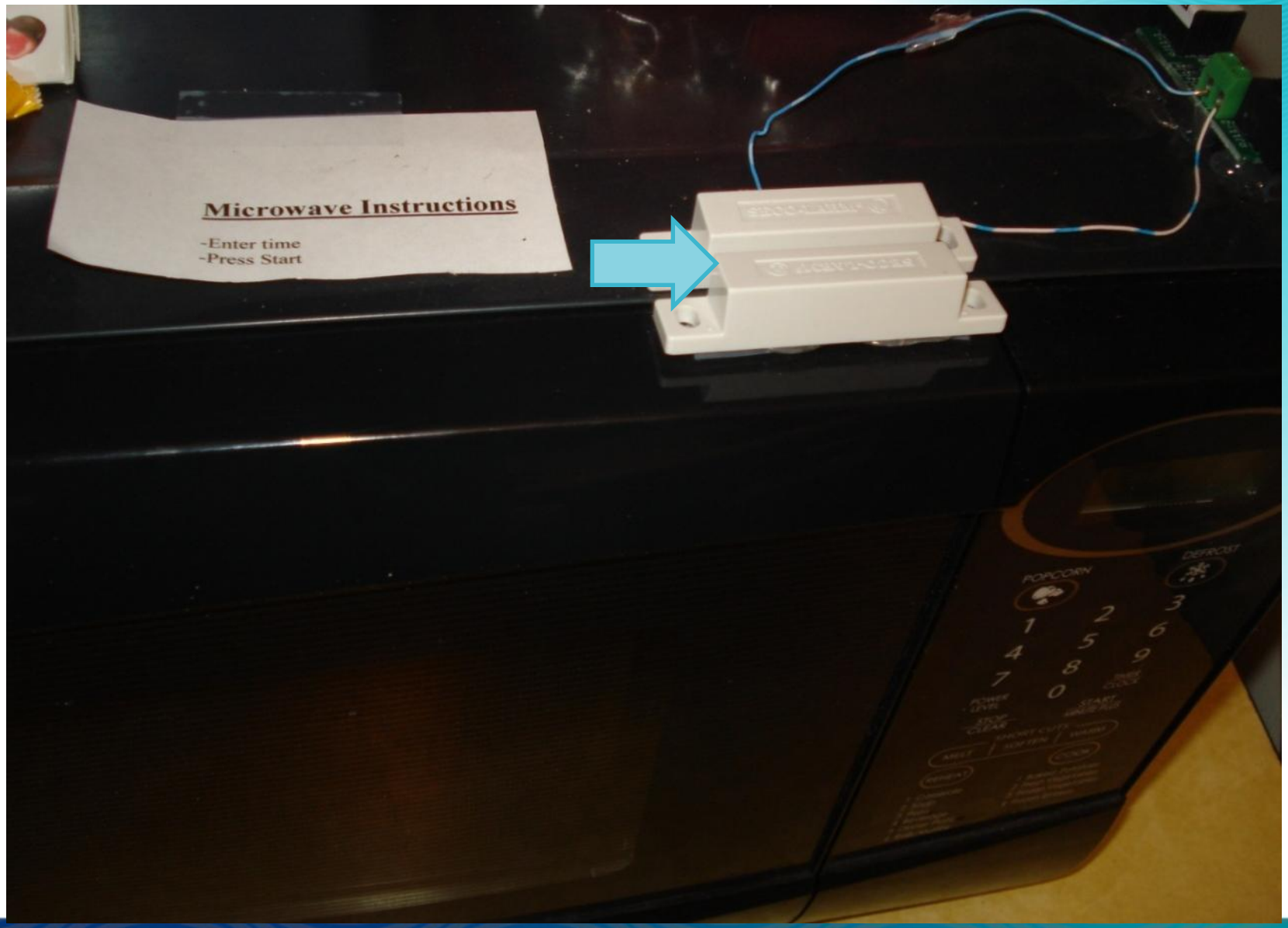
- Activity identification
- Functional assessment
- Medical monitoring
- Medication management
- Tracking of activities
- Caregiver burnout
- Social networking

Motion sensor

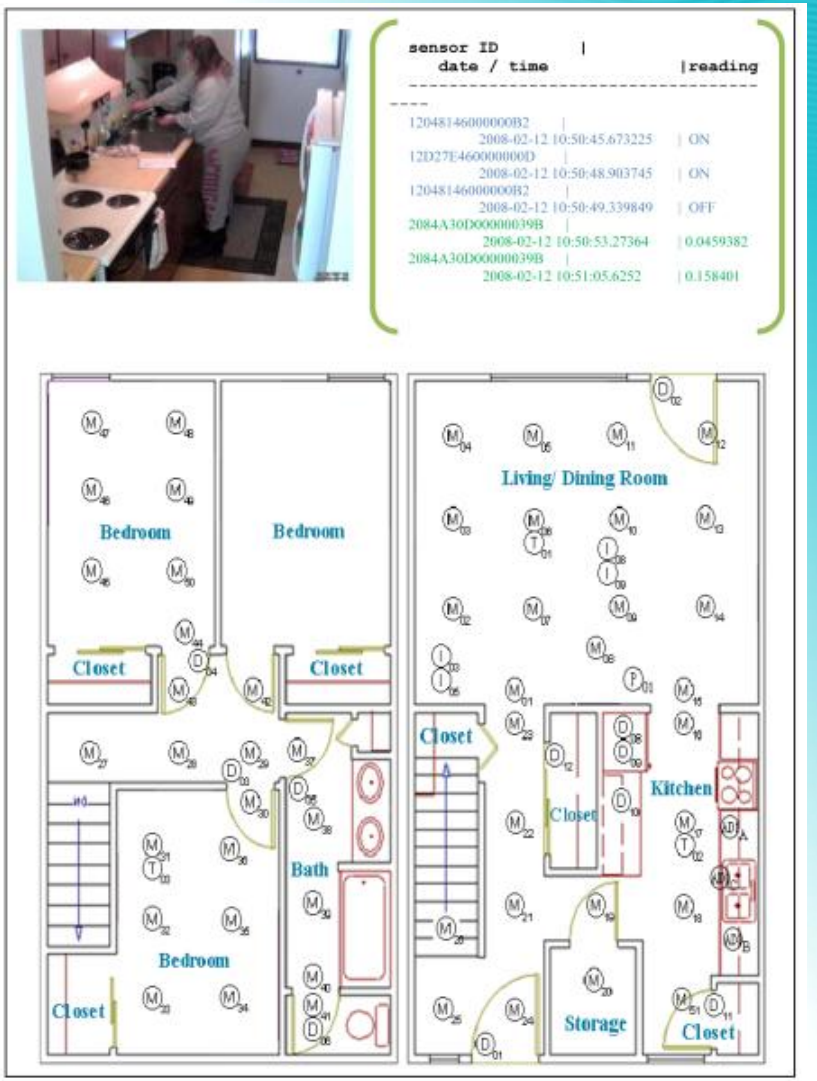
Item sensor


Bisquick
Nutrition Facts
IGA
100% Natural
Nutrition Facts
CRYSTAL LIGHT
SOFT DRINK MIX
JUST EAT IT!
USA
Cranberry Mix
Dill Relish
IGA
CHUNK LIGHT TUNA

Cabinet/door sensor

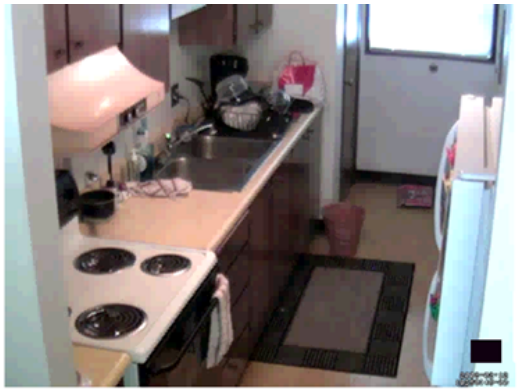


WSU “Smart Apartment”



In-home monitoring site

Handwashing activity – sensor readings



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sensor ID          |
   date / time                    | reading
-----------------------------------------
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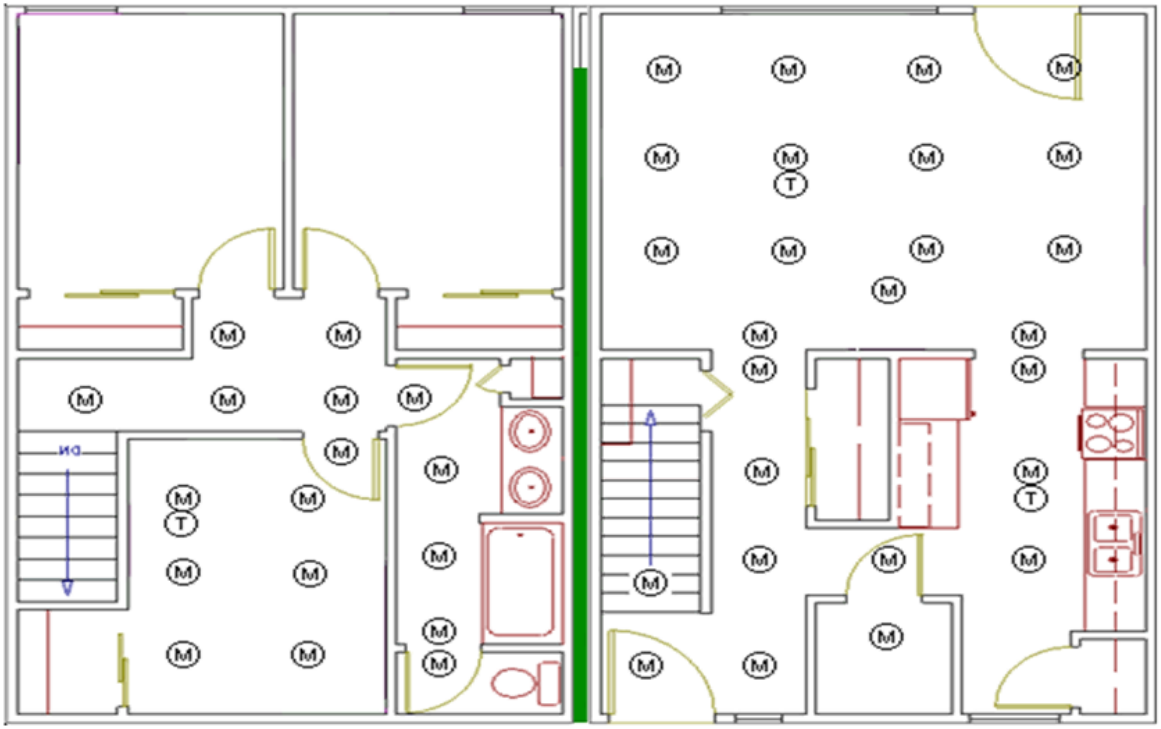
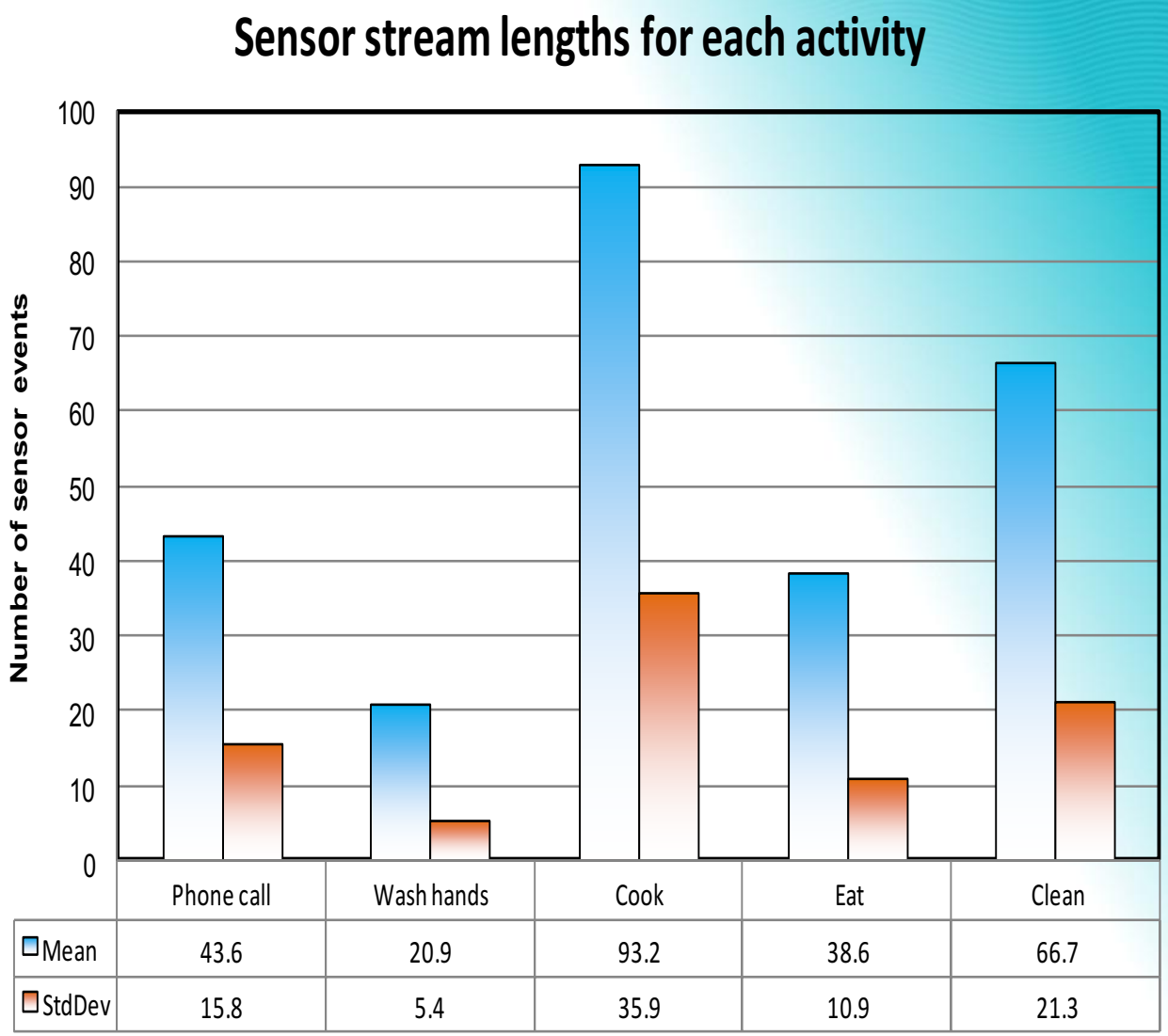


Can we recognize activities?

- 5 activities
- Model showed 98% accuracy discriminating between activities



Activity recognition

What if an individual is multi-tasking?

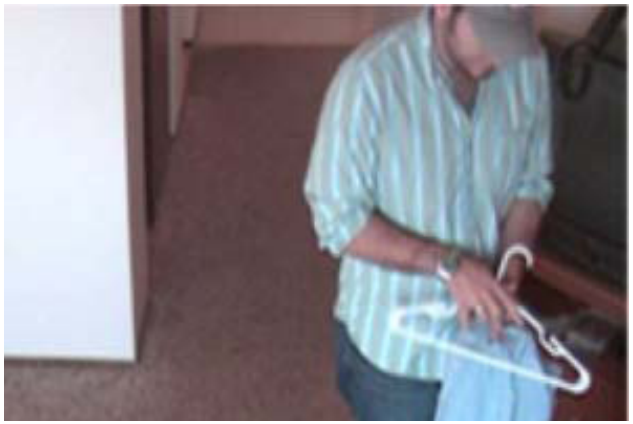
8 everyday tasks:
interweave and complete quickly and efficiently

- Fill medicine dispenser
- Watch a DVD
- Water plants
- Converse on the phone
- Write birthday card
- Prepare a meal
- Sweep and dust
- Select an outfit

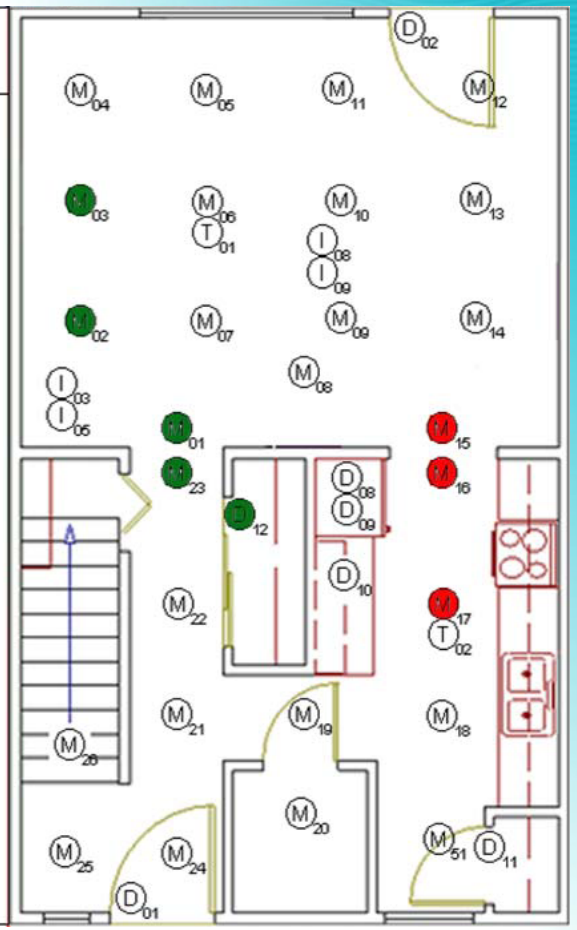
Singla, G., Cook, D. J., & Schmitter-Edgecombe, M. (2009). Tracking activities in complex settings using smart environment technologies. *International Journal of BioSciences, Psychiatry and Technology, 1*, 25-35.

Activity recognition

What if more than one individual is in the environment?



Sensor ID/ Date/ Time		Sensor Reading	
2008-11-10	14:29:33.1159	M17	ON
2008-11-10	14:29:34.108609	M16	ON
2008-11-10	14:29:35.33645	M17	OFF
2008-11-10	14:29:37.744859	M15	ON
2008-11-10	14:29:40.285569	M03	ON
2008-11-10	14:29:42.10099	M02	ON
2008-11-10	14:29:42.73407	M01	ON
2008-11-10	14:29:43.515799	M23	ON
2008-11-10	14:29:43.77201	M02	OFF
2008-11-10	14:29:43.976389	M15	OFF
2008-11-10	14:29:44.66421	D12	OPEN
2008-11-10	14:29:46.040679	M01	OFF
2008-11-10	14:29:46.72827	M23	OFF
2008-11-10	14:30:27.88842	M17	ON
2008-11-10	14:31:05.212919	M17	OFF
2008-11-10	14:31:07.15455	M17	ON
2008-11-10	14:31:27.565	M16	ON
2008-11-10	14:31:27.90807	D12	CLOSE

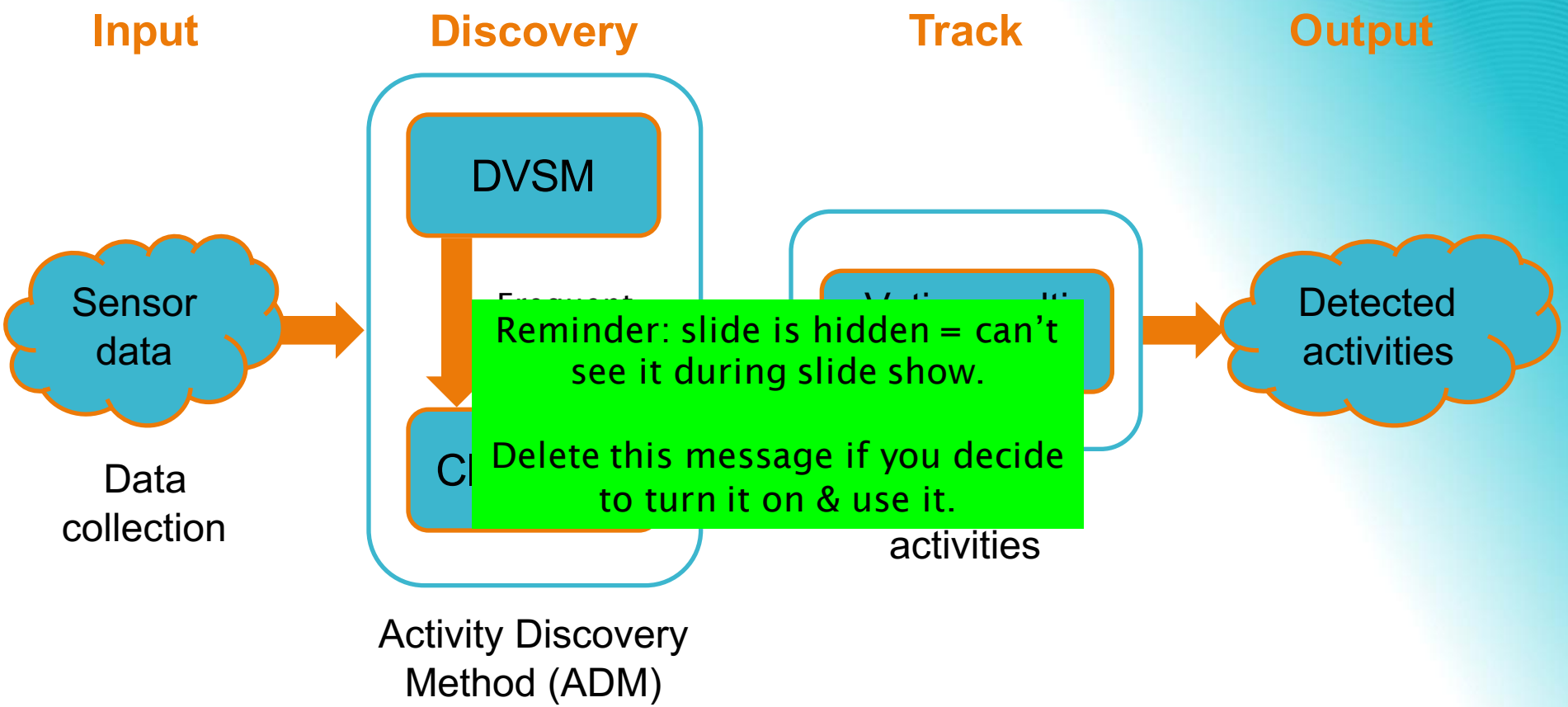


Singla, G., Cook, D. J., & Schmitter-Edgecombe, M. (2010). Recognizing independent and joint activities among multiple residents in smart environments. *Journal of Ambient Intelligence and Humanized Computing*,1, 57-63.

Activity recognition

Study	# Participants	# Activities	Recognition accuracy
Scripted activities	20	5	98%
Interwoven activities	20	8	85%
Multiple residents	40	12	77%
In-home monitoring	11 homes (1 or 2 residents and pets)	12	81%

Can we discover activity patterns?



Reminder: slide is hidden = can't see it during slide show.

Delete this message if you decide to turn it on & use it.

Rashidi, P., Cook, D. J., Holder, L. B., & Schmitter-Edgecombe, M. (in press). Discovering activities to recognize and track in a smart environment. *IEEE Transactions on Knowledge and Data Engineering.*

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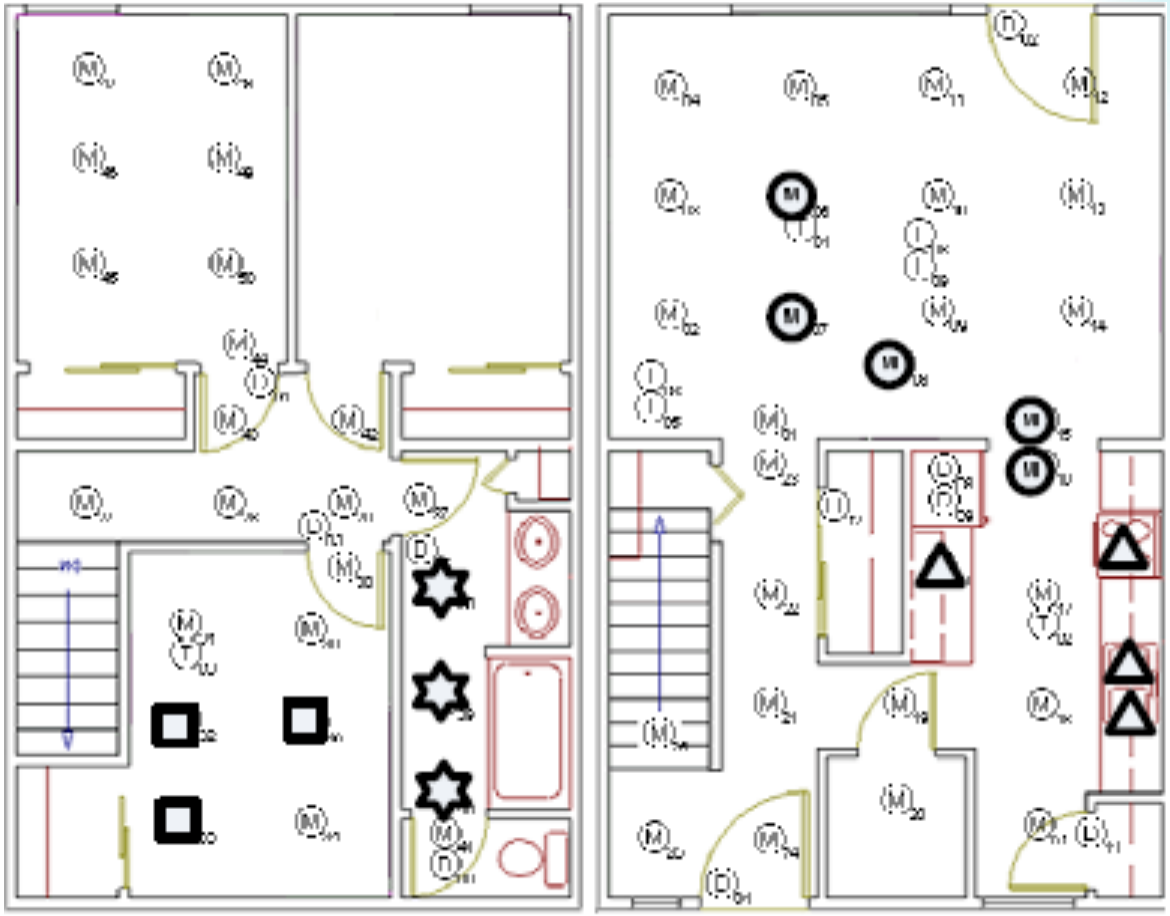
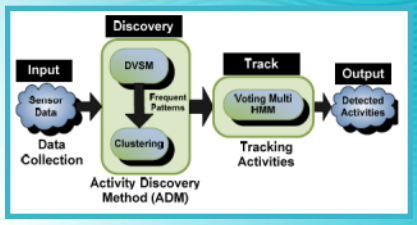




Visualization of discovered patterns

Using the bathroom

Resting-Working with PC

Preparing Meal

Watching TV, Getting Snack

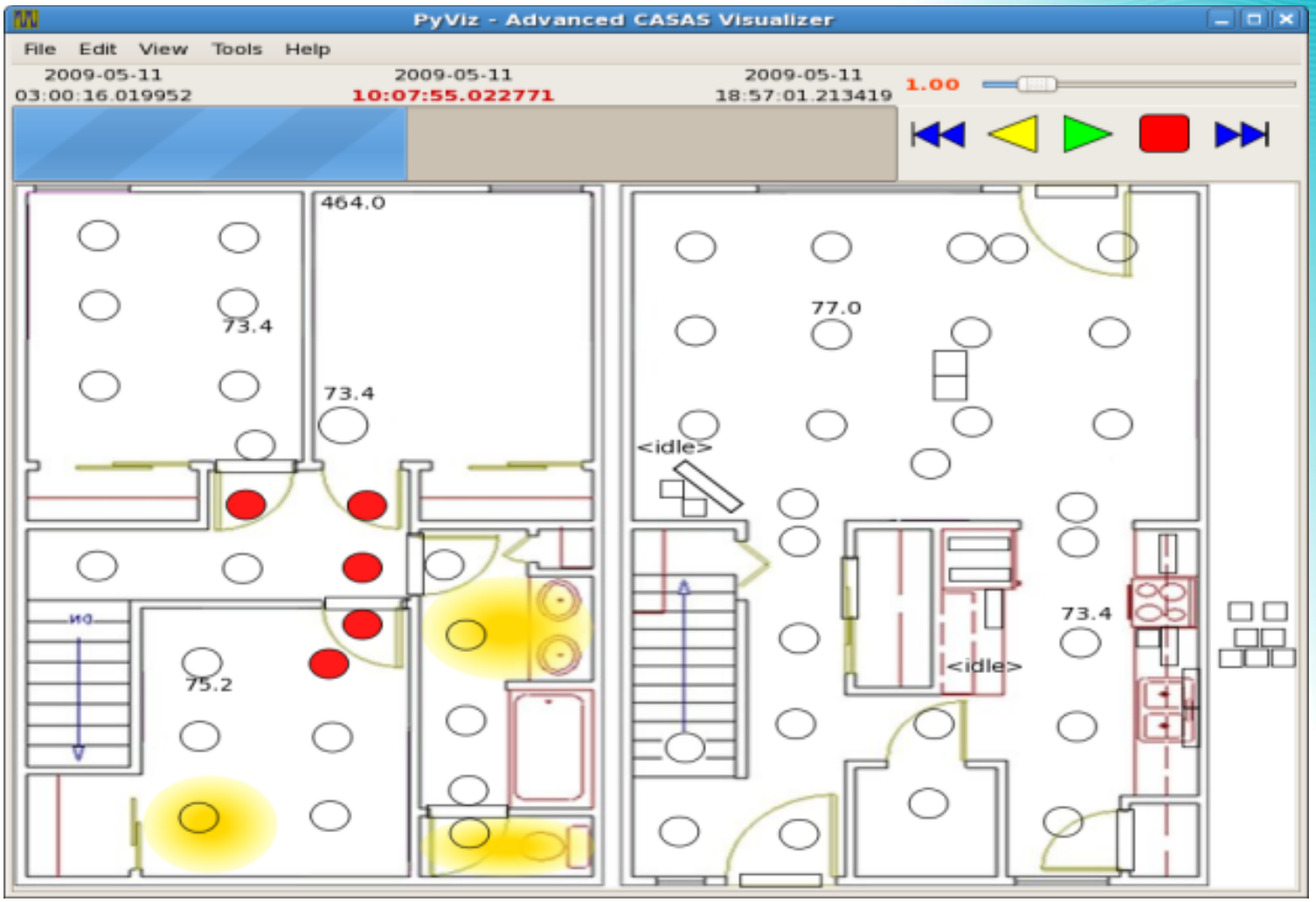
Rashidi, P., Cook, D. J., Holder, L. B., & Schmitter-Edgecombe, M. (in press). Discovering activities to recognize and track in a smart environment. *IEEE Transactions on Knowledge and Data Engineering*.

Can we generalize to new settings?

11 in-home monitoring sites

- Learned abstract models for 11 common activities: personal hygiene, sleep, bed-to-toilet, cook, eat, work, leave home, enter home, relax, take medicine, bathe
- Activity models trained on 10 of the datasets, then tested on the "left-out" dataset

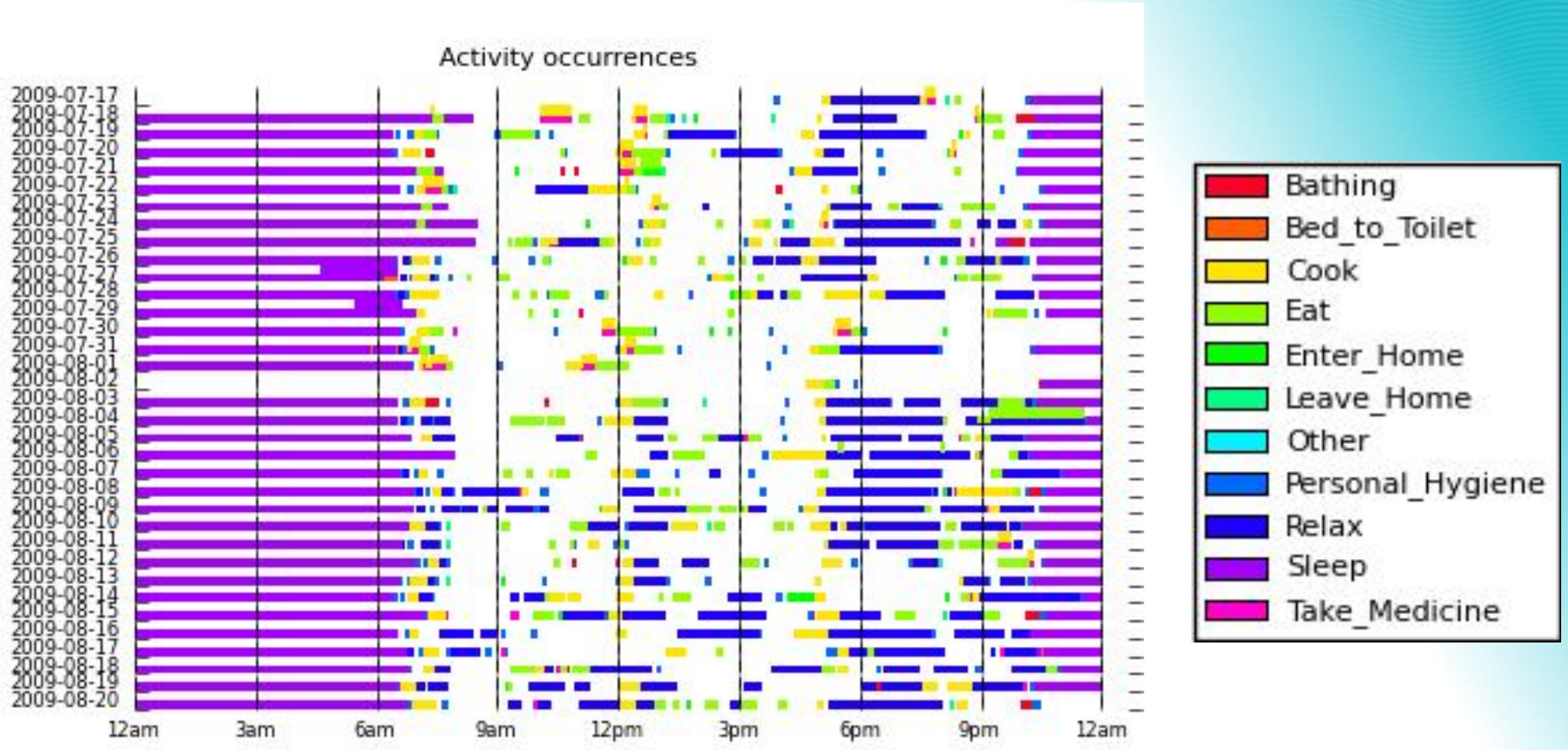
Can we present the data in a usable format?



Visualization of areas in the house with greatest activity during past two hours


AT&T
10:42 AM
51 %
Messages
Friday
3
Calendar
Photos
Camera
YouTube
Stocks
280
Maps
73°
Weather
Notes
Contacts
Google Earth
Google
iTunes
TuneWiki
11
App Store
20
Setting
Phone
Safari
3
Mail

Can we present the data in a usable format?



Can we conduct functional assessment?

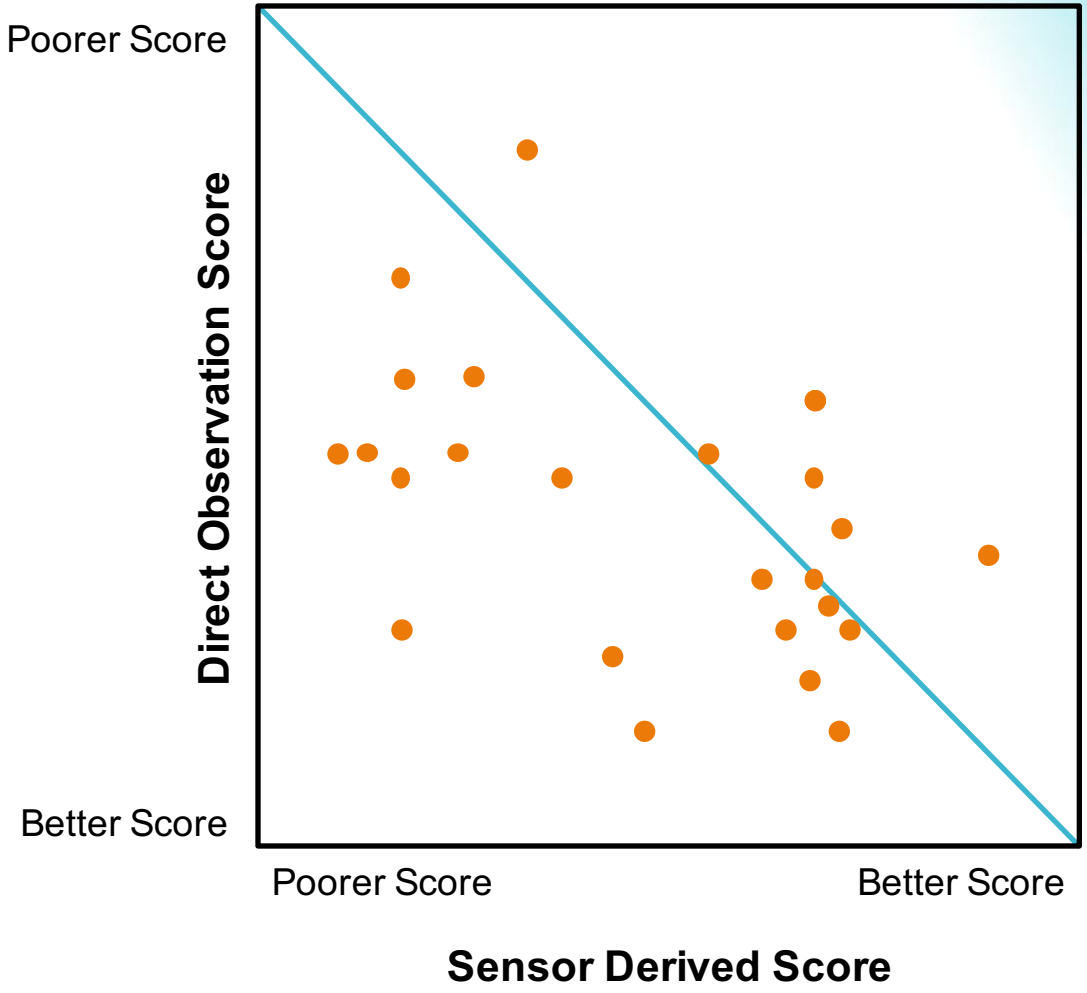
8 scripted tasks

Can we conduct functional assessment?

8 scripted tasks

Can we conduct functional assessment?

Data from 8 scripted tasks



Health Assistance

Can we detect errors in activity completion?

Activity	Error	Specific Error Group; # Cases	Simulation Group; # Cases
Telephone Use	Multiple calls	0	3
Hand Washing	**Left water on**	**20**	2
Hand Washing	Opened cabinet	1	0
Hand Washing	Turned burner on	1	0
Meal Preparation	**Left burner on**	**20**	6
Meal Preparation	Put items back into cabinet	5	0
Meal Preparation	Went back into living room	1	0
Meal Preparation	Did not turn burner on	0	1
Medication Use	**Forgot medicine**	**19**	0
Cleaning	**Did not use water**	**18**	0
Cleaning	Made phone call	0	1
Cleaning	Turned burner on	0	1
Cleaning	Left water on	0	1
Cleaning	Left items out on counter	0	1
All	Wandered around apartment	1	2

Can we develop prompting technologies? What types of prompts work best?

Stove starts Bellevue apartment fire; 30 homeless

Associated Press - October 17, 2010 1:35 PM ET

BELLEVUE, Neb. (AP) - The Bellevue Fire Department says a fire that destroyed or damaged 16 units at an apartment complex started after a person turned on a stove and then fell asleep.

- **Cue types**
- Indirect
- Direct
- Multimodal

Can we develop prompting technologies?

Can we Develop Prompting Technologies?

Time to meditate

Context-based

Prompt only if task not initiated

Prompt can be re-issued

I will do it now

I will do it later

I've done this task

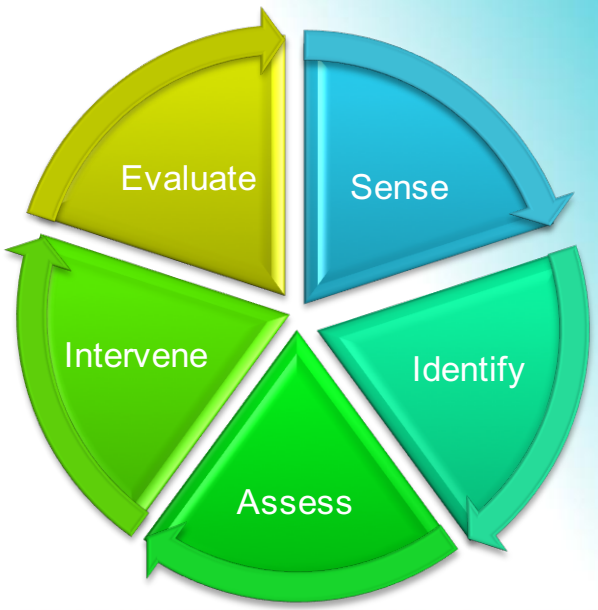
I won't do this task

Aging in place

Our goal is to improve human health and healthcare delivery by developing “smart” environments that aid with health monitoring and assistance

Ongoing/future work

- More reliable sensors with better power sources (sense)
- More robust activity recognition (identify)
- Perform functional health assessment (assess)
- Provide automated prompting (intervene)
- Evaluate resident acceptance, benefit to caregivers (evaluate)



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