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

Facilities cannot handle coming “age wave”

Need innovative health care
One solution: shift more care to the home

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

Perceive

Act
What good is a “Smart Home”?
What good is a “Smart Home”? 
What good is a “Smart Home”? 
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
Cabinet/door sensor
WSU “Smart Apartment”
In-home monitoring site
Handwashing activity – sensor readings
Can we recognize activities?

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

**Sensor stream lengths for each activity**

<table>
<thead>
<tr>
<th>Activity</th>
<th>Mean</th>
<th>StdDev</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phone call</td>
<td>43.6</td>
<td>15.8</td>
</tr>
<tr>
<td>Wash hands</td>
<td>20.9</td>
<td>5.4</td>
</tr>
<tr>
<td>Cook</td>
<td>93.2</td>
<td>35.9</td>
</tr>
<tr>
<td>Eat</td>
<td>38.6</td>
<td>10.9</td>
</tr>
<tr>
<td>Clean</td>
<td>66.7</td>
<td>21.3</td>
</tr>
</tbody>
</table>
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

Activity recognition

What if more than one individual is in the environment?

What if there are multiple residents or pets in the home?
## Activity recognition

<table>
<thead>
<tr>
<th>Study</th>
<th># Participants</th>
<th># Activities</th>
<th>Recognition accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scripted activities</td>
<td>20</td>
<td>5</td>
<td>98%</td>
</tr>
<tr>
<td>Interwoven activities</td>
<td>20</td>
<td>8</td>
<td>85%</td>
</tr>
<tr>
<td>Multiple residents</td>
<td>40</td>
<td>12</td>
<td>77%</td>
</tr>
<tr>
<td>In-home monitoring</td>
<td>11 homes</td>
<td>12</td>
<td>81%</td>
</tr>
</tbody>
</table>
Can we discover activity patterns?

Can we discover activity patterns?

Visualization of discovered patterns

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
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?

<table>
<thead>
<tr>
<th>Activity</th>
<th>Error</th>
<th>Specific Error Group; # Cases</th>
<th>Simulation Group; # Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Telephone Use</td>
<td>Multiple calls</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td><strong>Hand Washing</strong></td>
<td><strong>Left water on</strong></td>
<td><strong>20</strong></td>
<td>2</td>
</tr>
<tr>
<td>Hand Washing</td>
<td>Opened cabinet</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Hand Washing</td>
<td>Turned burner on</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td><strong>Meal Preparation</strong></td>
<td><strong>Left burner on</strong></td>
<td><strong>20</strong></td>
<td>6</td>
</tr>
<tr>
<td>Meal Preparation</td>
<td>Put items back into cabinet</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>Meal Preparation</td>
<td>Went back into living room</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Meal Preparation</td>
<td>Did not turn burner on</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td><strong>Medication Use</strong></td>
<td><strong>Forgot medicine</strong></td>
<td><strong>19</strong></td>
<td>0</td>
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<tr>
<td>Cleaning</td>
<td>Did not use water</td>
<td>18</td>
<td>0</td>
</tr>
<tr>
<td>Cleaning</td>
<td>Made phone call</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Cleaning</td>
<td>Turned burner on</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Cleaning</td>
<td>Left water on</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Cleaning</td>
<td>Left items out on counter</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td><strong>All</strong></td>
<td>Wandered around apartment</td>
<td>1</td>
<td>2</td>
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</tbody>
</table>
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'll do it now
I will do it later
I've done this task
I won't do this task
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)
Contributors

Collaborators:
Diane Cook, Ph.D.; Larry Holder, Ph.D.; David Greeley, M.D.

Graduate and Postdoctoral Students

<table>
<thead>
<tr>
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<tbody>
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<td>Carolyn Parsey</td>
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<td>Rachael Jones</td>
<td>Yasamin Sahaf</td>
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<td>Carly Anderson</td>
<td>CK Narayanan</td>
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<td>Allan Drassal</td>
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Special thanks also to the many undergraduate Aging and Dementia Laboratory research assistants
Funding sources