



Using Technology to Support Wellness and Aging-in-place

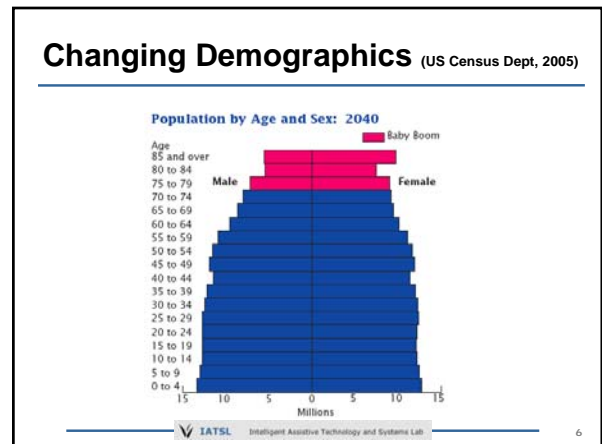
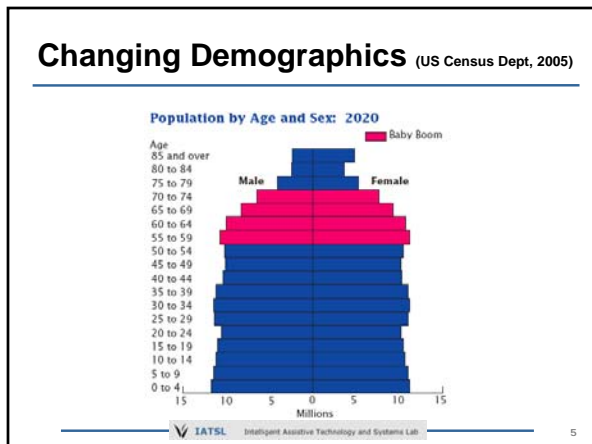
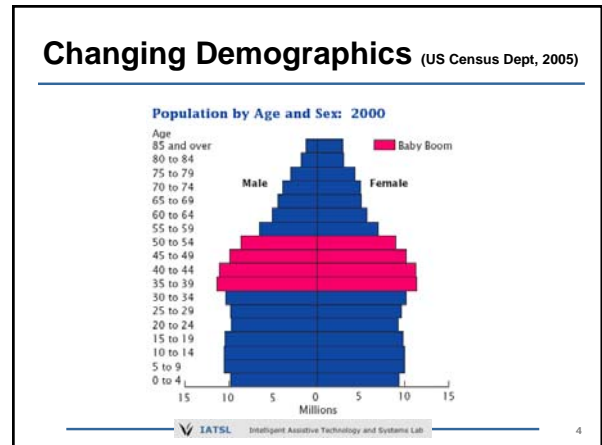
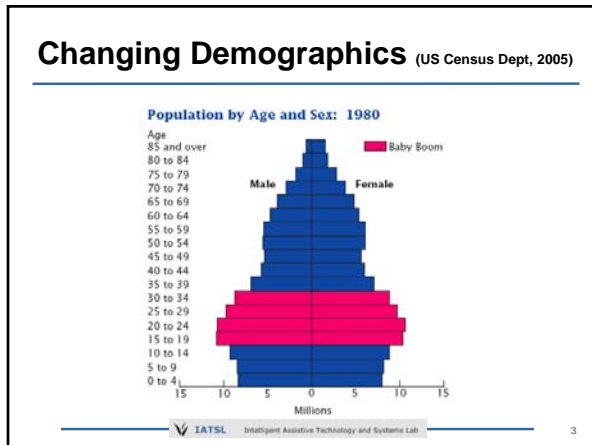
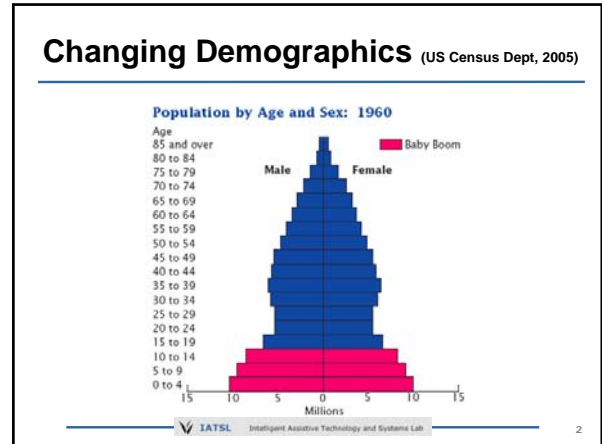
Jennifer Boger, M.A.Sc., P.Eng.

May 27, 2009

Occupational Science & Occupational Therapy
UNIVERSITY OF TORONTO

Toronto Rehab
Everything Humanly Possible

IATSL Intelligent Assistive Technology and Systems Lab



The Problem

- ↑ Number of older adults
 - ↑ Health challenges with age
 - ↓ Number of caregivers
-
- ↓ Environmental support

This true in terms of both the built environment and medical care

The Need

- Support for aging needs new and different approaches
- These solutions need to:
 - enable aging-in-place
 - be easy to use
 - be robust, yet sensitive to the changing needs of all users

Technology as a Solution

- Researchers have been looking at the use of technology as part of the solution
- Once installed, technology can provide affordable, dynamic, customisable, 24/7 support...
...if it's appropriate, that is!

Our Goal

To develop intelligent assistive technology that can promote wellness and aging-in-place, without extra burden to the users

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Some Definitions...

- Wellness and aging-in-place:

The quality or state of being in good health especially as an actively sought goal.

Merriam-Webster's Medical Dictionary

Some Definitions...

- Wellness and aging-in-place:
 - "...means growing older without having to move."
BCACL
 - "...is not having to move from one's present residence in order to secure necessary support services in response to changing needs."
Journal of Housing for the Elderly
 - "...is the ability to **live** in one's own home - wherever that might be - for as long as confidently and comfortably possible."
Wikipedia

Some Definitions...

- Wellness and aging-in-place:
...is growing older in the home of ones' choice.

Some Definitions...

- Wellness and aging-in-place:
The quality or state of being in good health especially as an actively sought goal in the home of ones' choice.

Our Goal

To develop intelligent **assistive technology** that can promote **wellness and aging-in-place**, without extra burden to the users

Assistive Technology

"Any item, piece of equipment, or product system, whether acquired commercially or off the shelf, modified, or customized, that is used to increase, maintain, or improve functional capabilities of individuals with disabilities"

Cook & Hussey (2000)

Some Examples



Some Examples



Some Examples



Some Examples



Our Goal

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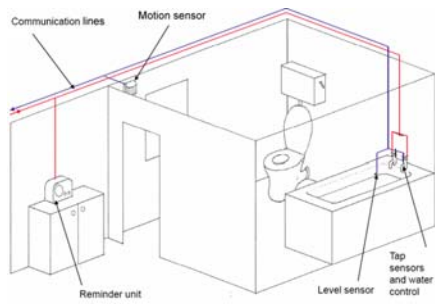
Our Design Philosophy

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

Zero-Effort Technologies

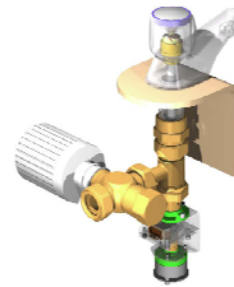
- Technology should operate without any effort from the users
- This means the systems must autonomously:
 - Interact with users and their environment
 - Continuously collect and redistribute data
 - Use contextual information to operate and make good decisions
 - Dynamically address to changes in user requirements

Example of Assistive Technologies



Courtesy of BIME (<http://www.bath.ac.uk/bime/>)

Example of Assistive Technologies



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Our Goal

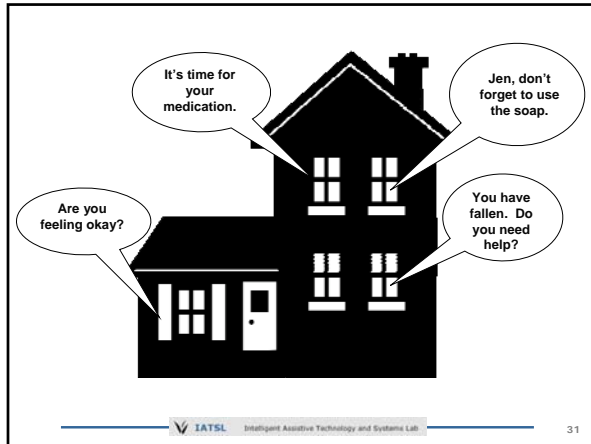
To develop **intelligent** assistive technology that can promote **wellness** and **aging-in-place**, without extra burden to the users

Smart vs. Intelligent

- **Smart:** Performing actions based on direct input of information or data
- **Intelligent:** Performing actions based on common sense, experience, and the ability to adapt, taking **context** into account

Intelligent Systems

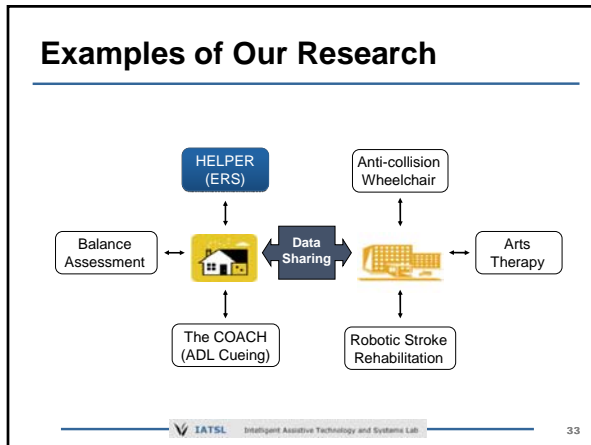
- **Sensing:** Contextually rich information is collected about the person a rational manner (develop task, user, and system models)
- **Planning:** System decides what the state of the environment is, what the person is doing and how best to react
- **Response:** System reacts to its environment in a contextually-appropriate manner



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The Problem

- With age, events such as heart attacks and falls become more likely
- A fast and appropriate response drastically increases a person's probability of recovery (and survival!)

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Existing Solutions

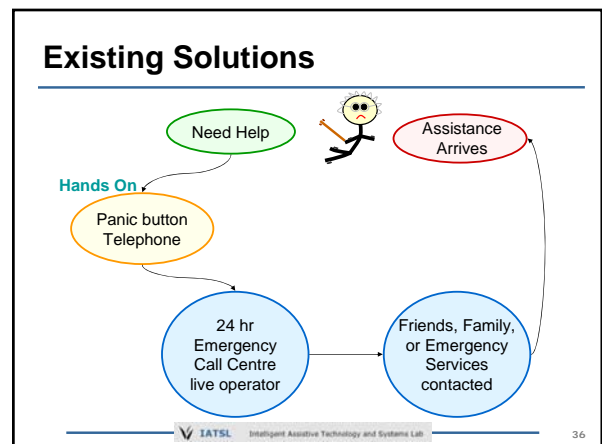
Call Buttons & Communicator

<http://www.lifelinesys.com/howworks/index.php>

Fall Detector

<http://ntec.org.uk/gm2.doc>

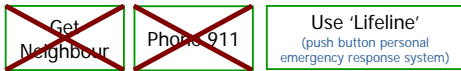
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Example Scenario

- You are a 86 year old female, living alone
- High BP – Asthma – Coronary Vascular Disease
- On edge of bed – clammy, accelerated heart beat, sweating, light headed, trouble breathing

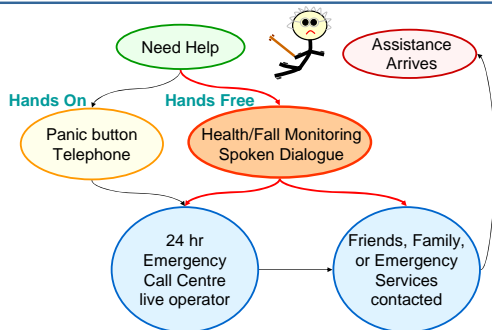
Choices:



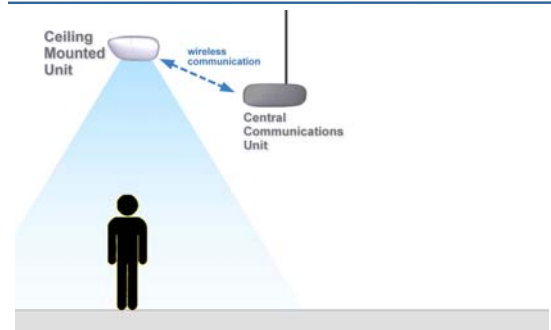
Example Scenario

- Breathe and stand up to grab for it
- Legs give out - you fall to the ground
- Hear a crack at your hips
- Can't move without feeling intense sharp pain
- Try to get up several times - but cannot
- Your friend is coming in 3 hours
- So you wait...

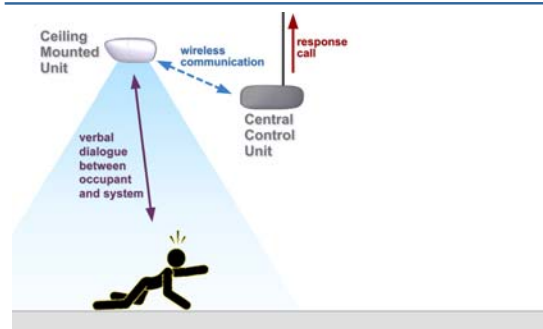
HELPER: A New Solution



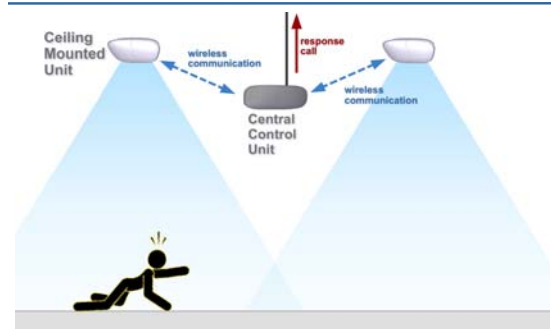
HELPER: System Overview



HELPER: System Overview



HELPER: System Overview

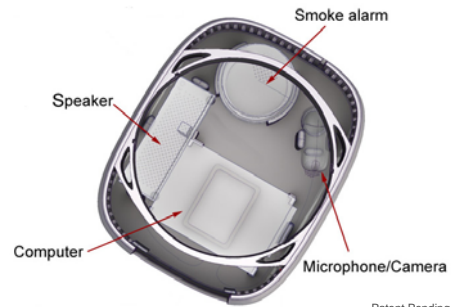


HELPER: System Overview



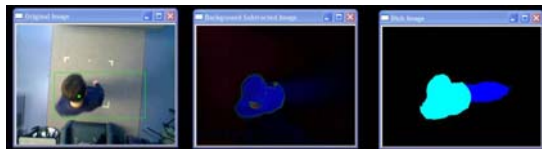
Patent Pending

HELPER: System Overview



Patent Pending

HELPER: Tracking



Original Image

Background Subtraction

Blob with shadow

HELPER: Planning

- Short-term health:
 - Decide if there is an acute (emergency) event

HELPER: Planning

- Long term health:
 - Learn the occupant's normal patterns of activity
 - Detect abnormal, non-emergency events that might signal a health change
 - Ability to share trends with user, family, and care professionals

HELPER: Response

- Adverse event actions the system can take include:
 - Call a neighbor
 - Call a family member
 - Call an operator (e.g. Lifeline)
 - Call an emergency service (e.g. ambulance)
 - Share data with family and health professionals

HELPER: Example

A video of the fall detection system was shown here

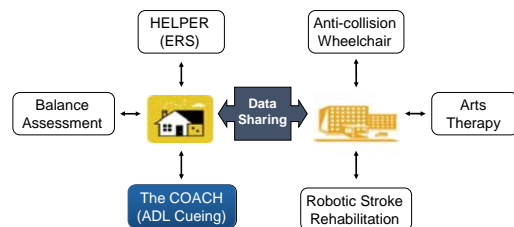
HELPER: Pilot Study Results

- Twenty-one subjects simulated various postures and falls within a mock-up of a home environment
- Total of 315 postures (126 “falls”)
- 100% correct assistance decision (88% correct recognition)

HELPER: Current/Future work

- Build an older adult speech database
- Test system with older adult actors
- Test system in community
- Make system available to consumers

Examples of Our Research



Alzheimer's Disease

- The number of people with Alzheimer's worldwide is expected to grow from 18 million to 24 million by 2050
- There is approximately **one new case of Alzheimer's every 7 seconds!**
- 70% of people with Alzheimer's and other dementias live at home

Alzheimer's Disease

- Alzheimer's impairs explicit memory, making activities of daily living difficult to do
- Currently, a caregiver must always be with the person to provide prompts, support, and monitoring
- This is a very difficult and frustrating experience for everyone

However...

- Procedural memory is generally relatively spared
- While completion of a **task** can be difficult, completion of a **step** is much easier

The COACH



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



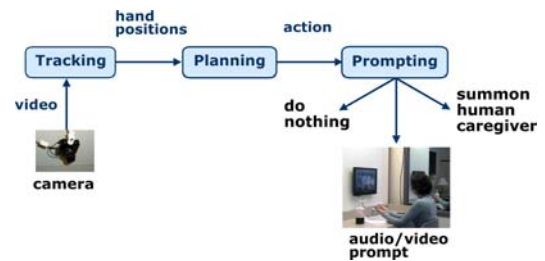
The COACH

Digital Video Camera

Flat Screen Monitor & Speakers



COACH: System Overview



COACH: Tracking

A video hand tracking was shown here

COACH: Planning

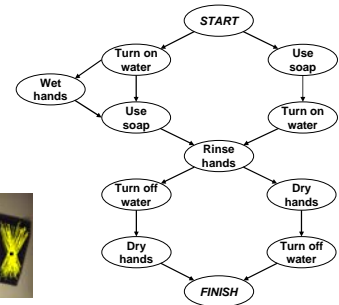
- System chooses the best action to take based on the state of the environment, such as:
 - Current user action
 - Progress through task
 - Preferred pathway
 - User attitude / responsiveness
 - Dementia level

COACH: Response

- Do nothing
- Give a prompt
 - e.g. "Dawn, you're doing great. Try turning on the water"
 - 3 levels of specificity (minimal, moderate, maximum)
- Call the caregiver

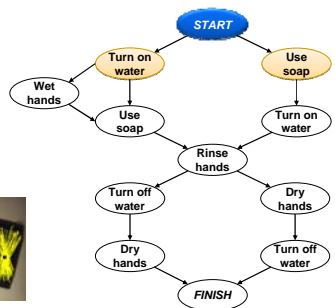
Putting it all together...

Hands = ?
Water = ?



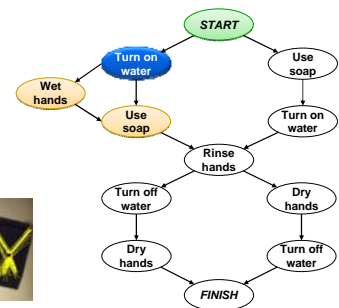
Putting it all together...

Hands = sink
Water = off



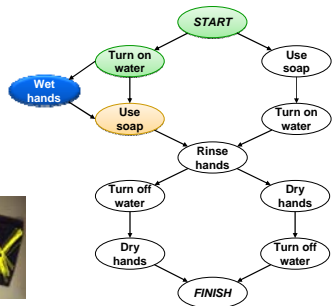
Putting it all together...

Hands = tap
Water = on



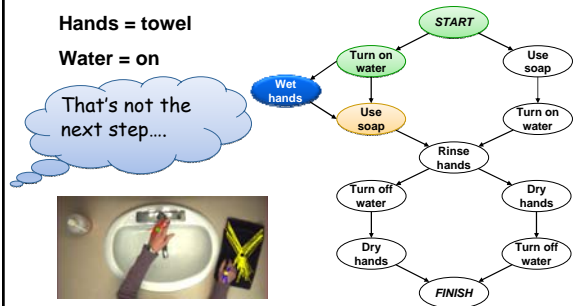
Putting it all together...

Hands = water
Water = on



Putting it all together...

Hands = towel
Water = on

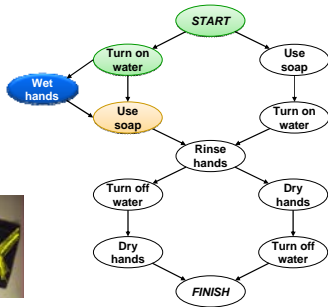


Putting it all together...

Hands = towel

Water = on

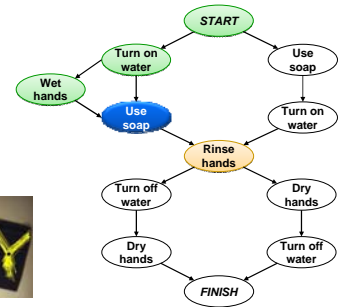
Down, try using the soap



Putting it all together...

Hands = soap

Water = on



Putting it all together...

Hands = water

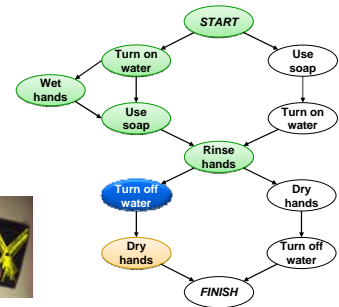
Water = on



Putting it all together...

Hands = tap

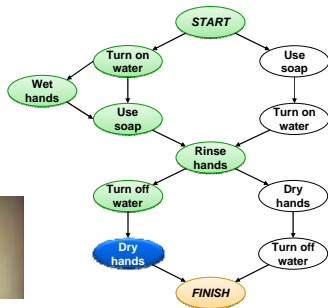
Water = off



Putting it all together...

Hands = towel

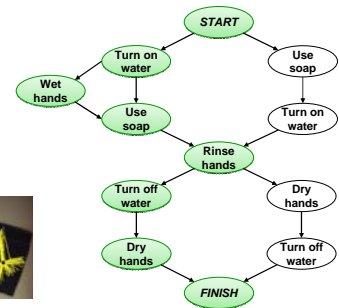
Water = off



Putting it all together...

Hands = away

Water = off

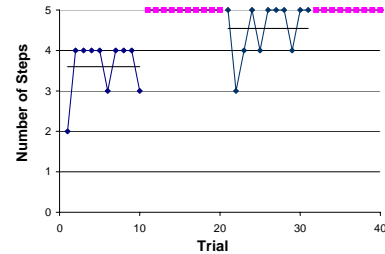


Examples of Use

Two videos of clinical trials were shown here

Does it work?

Number of steps completed without human assistance for S4



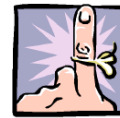
Conclusions

- 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
- In addition to technological challenges, development must focus on the social and ethical implications

Conclusions

- In a nutshell:
“Can technology help us age in place?”

YES!



We think high-tech technologies can, too
But...

Considerations

- When and where is this type of technology appropriate?
- What funding programs are required?
- Who chooses when this technology is used?
- Who installs and supports it?
- How do we educate potential users (including user, nurses, family members) about these systems?
- How will these issues be affected in the future when new user populations exist (e.g. baby boomers)?

Team Members / Contributors

- Alex Mihailidis, Sony Allin, Axel von Bertoldi, Tammy Craig, Kate Fenton, Dave Giesbrecht, Tuck-Voon How, Tracy Lee, Melinda McLean, Jasper Snoek, Tony Tam, Vicky Young (IATSL)
- Craig Boutilier (University of Toronto)
- Jesse Hoey (University of Dundee)
- Pascal Poupart (University of Waterloo)

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Contact

Tel: (416) 946-8573
Email: iatsl@utoronto.ca
Web: www.iatsl.org