

Independent LifeStyle Assistant



Home-Care Technology for Independent Living

A NIST Advanced Technology Program

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Human-Centered Systems

Information and Decision Technologies

Honeywell Laboratories



Honeywell Laboratories

U of M Colloquium 12-17-01

Independent LifeStyle Assistant



Agenda

About Honeywell
About Human Factors
ILSA Vision
Program Progress



Honeywell Laboratories

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Honeywell Businesses



120,000 employees in 95 Countries. Sales of \$25B

Automation & Control Systems



Aerospace



**Honeywell
Labs**



Specialty Chemicals



Transportation & Power Systems



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About Human Factors



Systems are comprised of people, machines, and environments

Apply knowledge of human characteristics to the design of systems and devices of all kinds

- Physical - strength, reach, response time
- Sensory - visual, tactile, auditory,
- Psychological - memory, attention, workload
- Cultural - norms, conventions, attitudes

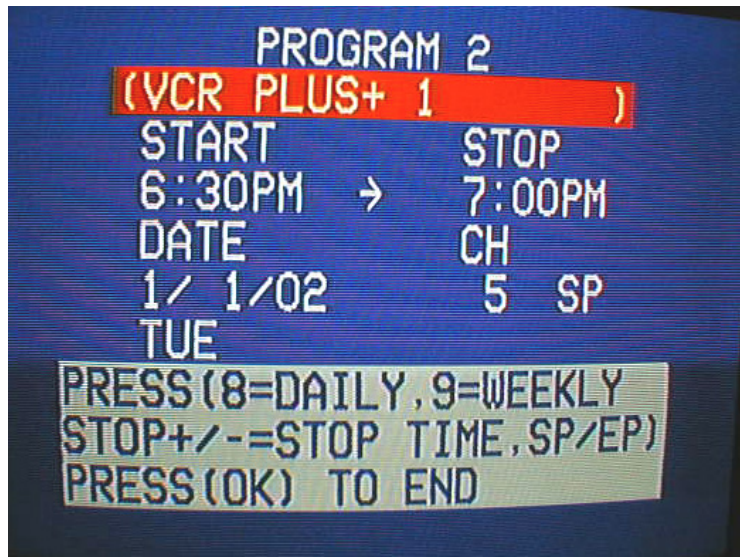
Achieve compatibility in design to ensure performance effectiveness, safety, and ease of use





About Human Factors

We make systems work the way users think, instead of training users to think the way systems work.



About Human Factors

Human-Centered Systems Development



Contributions...

requirements

Define new design concepts

- Capture "Voice of the User"
- Task, user, environment analyses
- Functional requirements

testing & evaluation

Measure design effectiveness

- Simulation
- Observation
- Usability

design

Implement design requirements

- Apply HF design standards
- Prototype for feedback
- Art, innovation, and creativity

...throughout the development lifecycle



ILSA in a Nutshell



Program Objective

Develop an intelligent home automation system with situation awareness and decision-making capability based on integration of diverse sensors, medical devices, and "smart" appliances to enable elderly users to function safely at home and live independently.

Programmatics:

- A NIST advanced Technology Program
 - » High risk research program
 - » 2.5 years (Nov 00 - Apr 03)
 - » \$5 million (HW 60%, NIST 40%)
- Led by Honeywell
 - » University of MN School of Nursing
 - » United Health Group EverCare

Benefits:

- Support elder independent living
- Provide peace-of-mind to caregivers
- Support efficient quality care for caregiving organizations
- Cost savings for government and industry
- Market growth for in-home product producers



ILSA Vision



What will ILSA look like

- An invisible **network** of **integrated** sensors, devices, and “smart” appliances
 - Sensors - motion, contact, pressure, etc.
 - Devices - thermostat, speaker, microphone, etc.
 - Smart Appliances - communicating refrigerators, stoves, etc.
- **No computer** control center or user interface needed. Users interact with the system through existing and familiar devices like:
 - Telephone
 - TV-like Remote control
 - Simple, dedicated browser devices



ILSA Vision



What will ILSA do

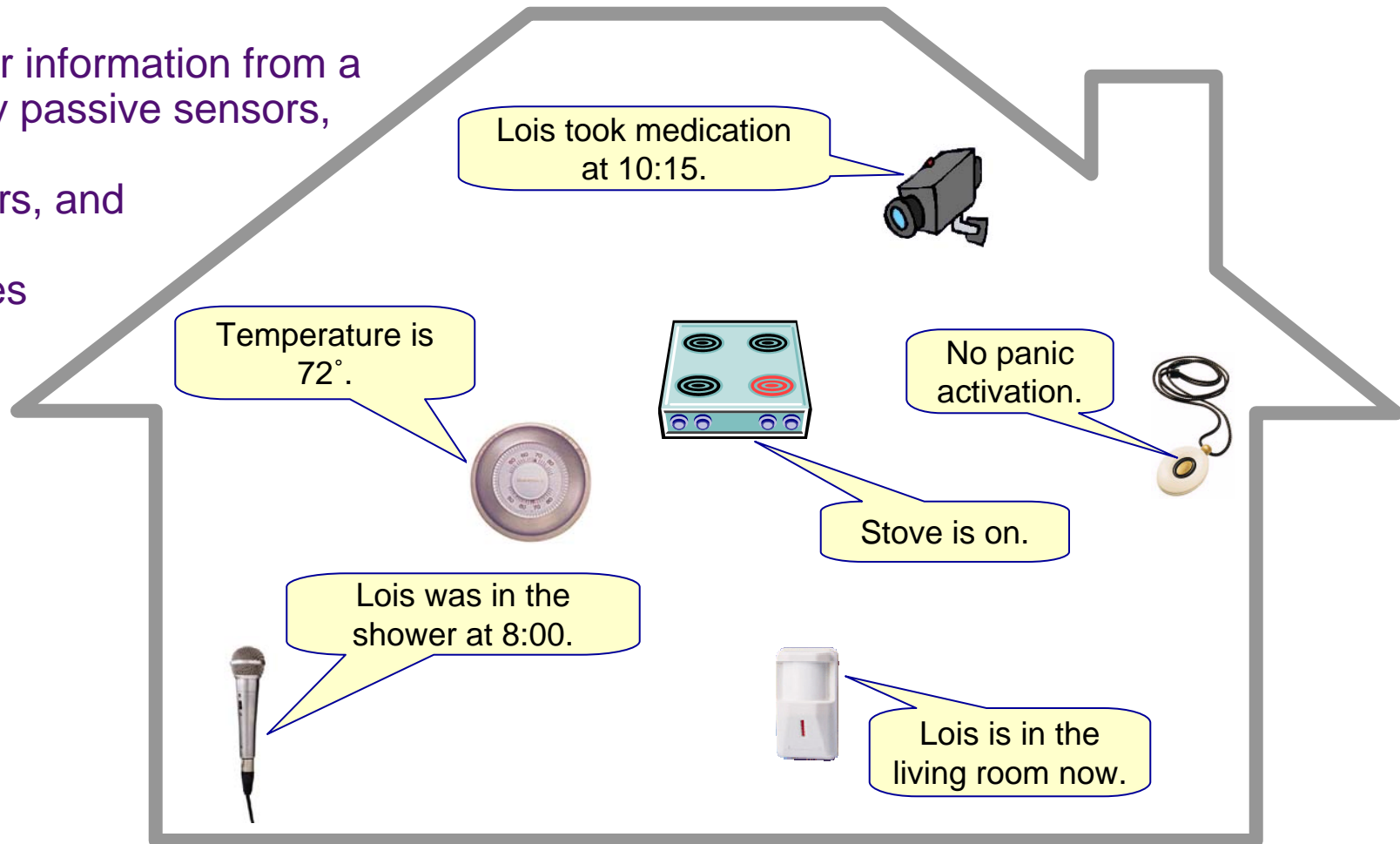
- **Gather** information about elder, activity, and home status by listening to the home and communicating with devices
- **Assess** the need for assistance based on the system's understanding the elder's condition and what activities are going on
- **Respond** to a given situation by providing assistance to the elder
- **Share** health and status information with authorized caregivers to help improve the quality and timely delivery of care



ILSA Vision

Gather Information

Gather information from a variety passive sensors, active sensors, and smart devices

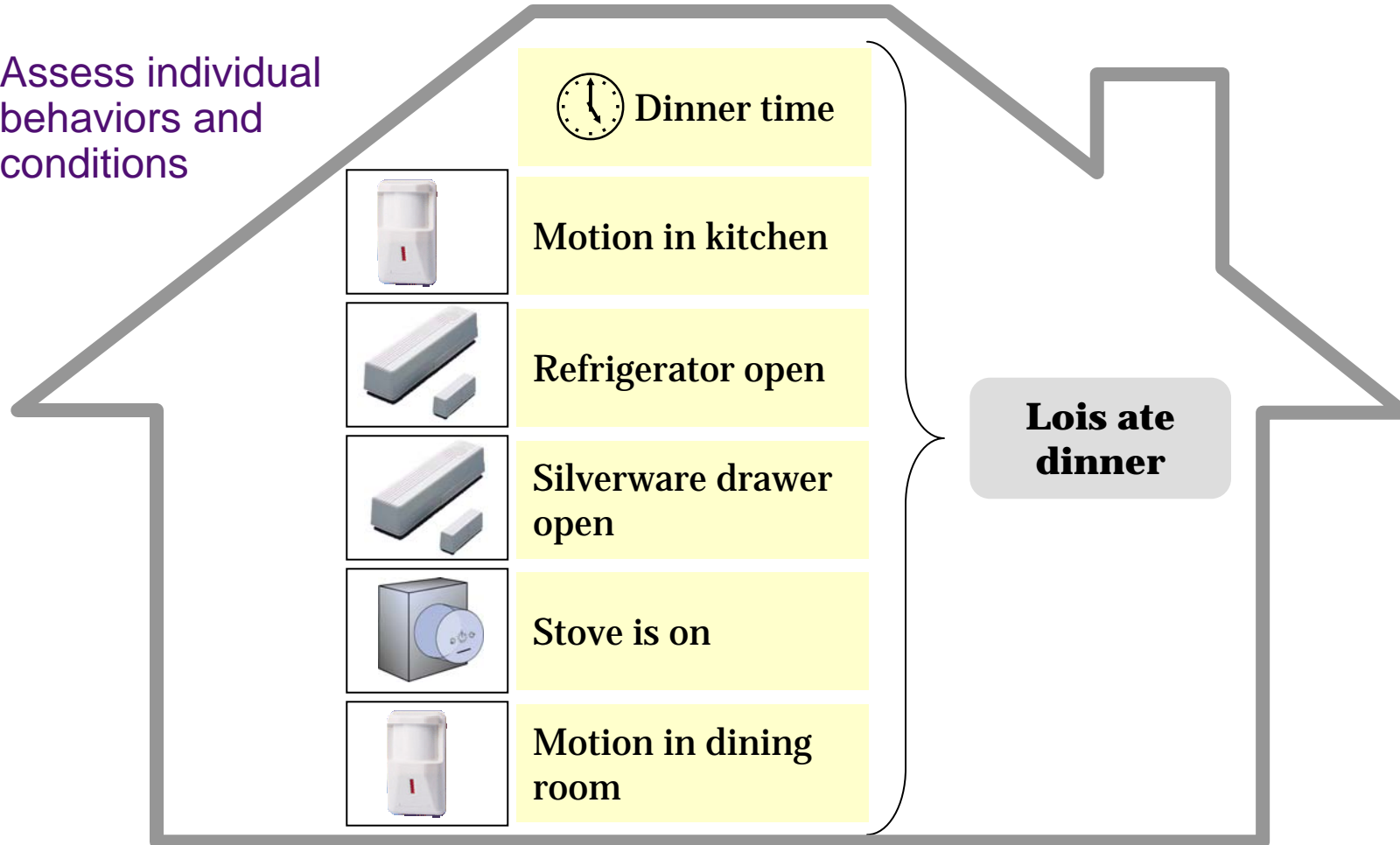




ILSA Vision

Assess Information

Assess individual behaviors and conditions

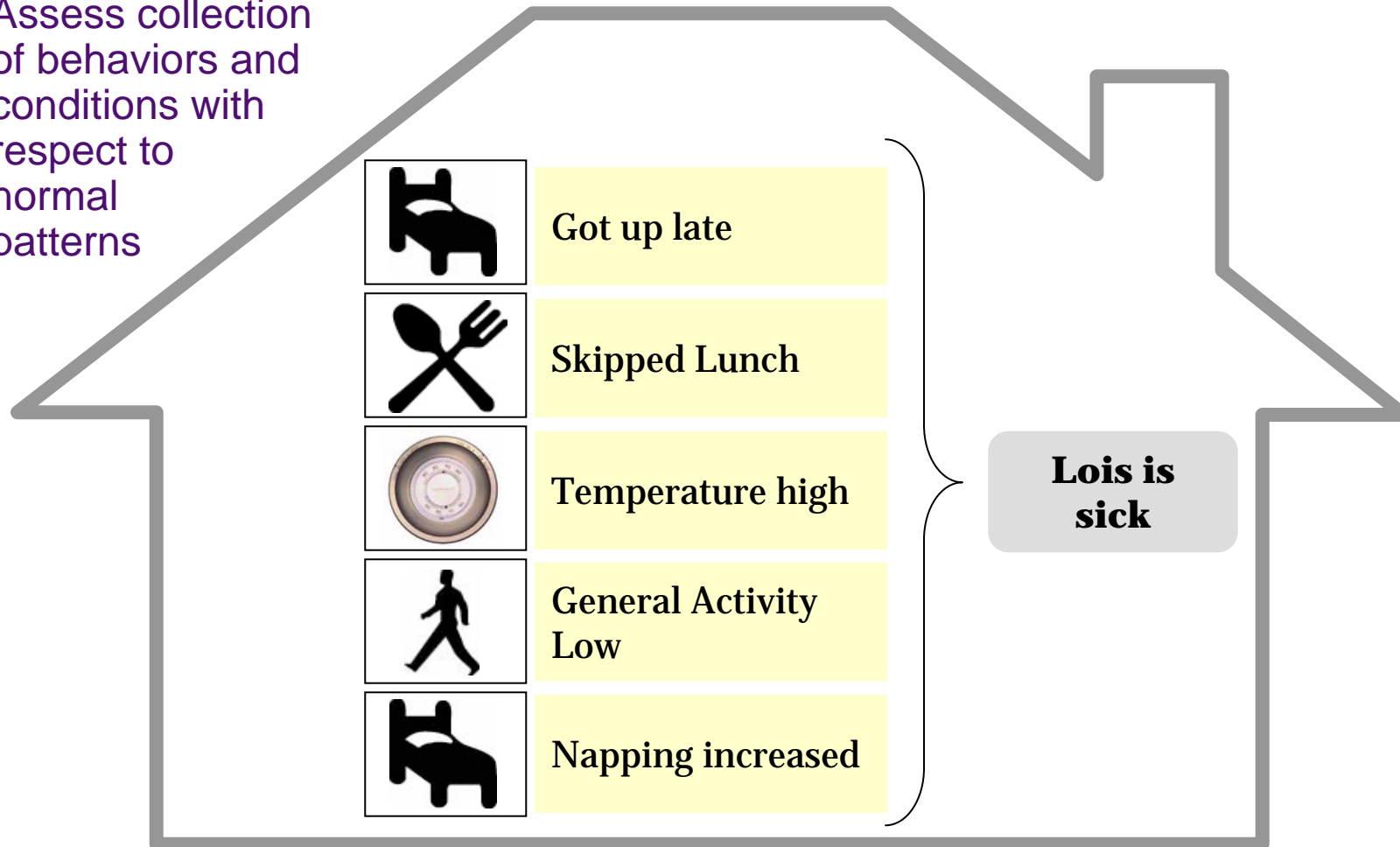




ILSA Vision

Assess Information

Assess collection of behaviors and conditions with respect to normal patterns





ILSA Vision

Respond to Information

Prioritize conditions and formulate an appropriate response plan

The Stove's been left on for 46.3 minutes!

It's time to take your medicine!



I've fallen, and I can't get up!

Linda's calling.





ILSA Vision

Respond to Information

Control situation so Lois' immediate needs are met

The Stove's been left on for 46.3 minutes!

 **Stove - turn yourself off.**

I've fallen, and I can't get up!

Lois, are you all right?



It's time to take your medicine!

 **Reminders - be quiet for now.**

Linda's calling.

Phone - disconnect Linda and call caregiver. I'll talk when you connect.



ILSA Vision

One Possible Scenario



ILSA locates Lois in kitchen with the stove turned on.

Lois leaves kitchen, enters Living Room and turns on TV.

15 minutes elapse . . . ILSA concludes the stove has been left unattended.



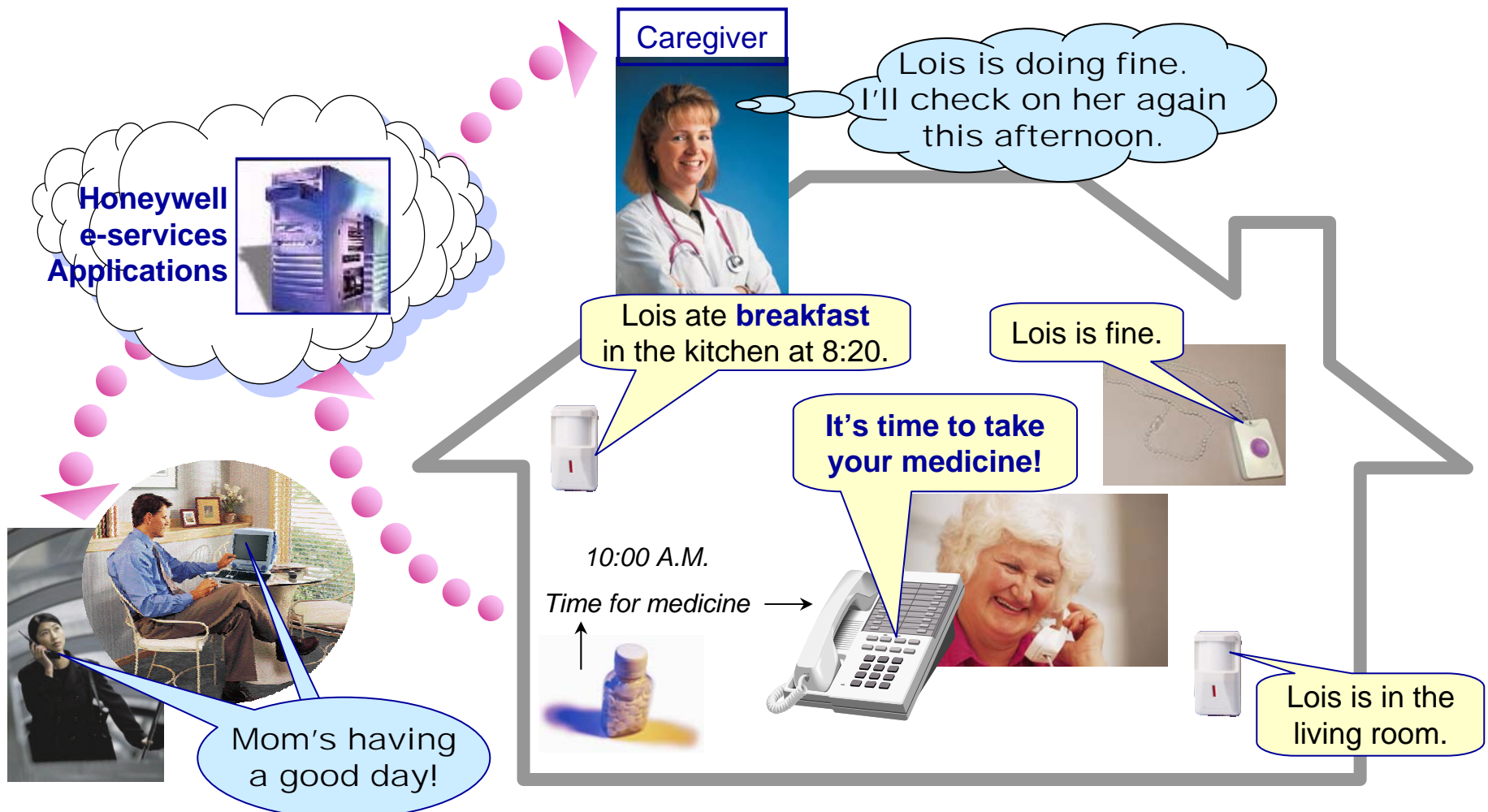
ILSA tries to get Lois's attention by displaying an alert on the TV - "Lois, should the stove be on?"

Lois doesn't respond, so ILSA broadcasts a speech message - "Lois, should the stove be on?"

Still no response, so ILSA checks Lois's vital signs and concludes Lois is sleeping. ILSA turns stove off.

ILSA Vision

Share Information





Technical challenges require innovations in:

- **Home automation** - Ability to centralize, automate, and/or integrate control of home functions like security, comfort, lighting, entertainment, etc.
- **Situation Assessment** - Ability to identify and infer specific behaviors and patterns of activity
- **Machine Learning** - Ability to recognize changes in patterns of behavior over time
- **Adaptive Interaction Design** - Ability to dynamically format content and presentation style for different devices, users, tasks, etc.
- **Human-Centered Systems Design** - Ability to design automated systems that match elder abilities & expectations

Program Progress



2001 Accomplishments

- Study users to identify what leads to institutionalization and what are the greatest monitoring & assistance needs
- Develop infrastructure to support hardware-software communications and speech recognition capabilities
- Develop system architecture, situation assessment capabilities, and begin learning capabilities
- Implement and test a prototype system in laboratory setting

2002 Activities

- Address configuration and set-up issues
- Refine and enhance machine learning capabilities
- Expand system's ability to communicate with various types of sensors and devices
- Evaluate user interfaces and user interaction issues

2003 Activities

- Evaluate overall system in field settings over extended period of time



Program Progress

Initial Functionality



Monitoring

- Intrusion detection
- Mobility (general activity level)
- Toileting
- Falls
- Verify medication taken
- Home and away
- Panic button activation
- Environmental conditions

Response

- Alarms, alerts, notifications, reports
- Auto-contact help
- Path lighting

Services

- Reminders
- To-Do lists
- Remote access to information
- Coordinate multiple caregivers
- Reduce false alarms

Usability Features

- Acknowledge with exceptions
- Operational modes (vacation, guests, sick...)
- Muting (cameras, reminders...)
- Password-free elder interactions



Program Progress

User Evaluations



Issue to be Addressed

- Interface design
 - Ease of use, look-and-feel
- Interaction design
 - User understanding of underlying functionality
- Attitudes and perceptions
 - Perceived need, predispositions to technology
- Privacy and sharing
 - Openness to being monitored, who to share information with
- Control, sensitivity and trust
 - Attitudes toward automation, willing to give control over to a system, trust in automation, tolerance for errors

Data Collection Methods

- Literature review
 - Existing research
- Surveys
 - Patterns of behavior, range of conditions, desirability of features
- Interviews
 - User needs, understand task, environment, and processes
- Usability evaluations
 - Interface and interaction design issues
- Field testing
 - System operation and higher-level interaction issues
- Focus Groups
 - Attitudes and perceptions



Program Progress

User Evaluations



Usability Testing - Lab

- Focus on interface design for Web browsers and telephones
- 2 evaluations in 2002
 - Elder user interfaces
 - Caregiver user interfaces

Usability Testing - House

- Focus on interaction design for a collection of functionality
- 1-2 evaluations in 2002
 - Elder understanding of system behavior
 - Usefulness of information for caregivers
 - Focus group to explore attitudes toward concept

Alpha Testing

- Focus on sensor output and inference accuracy
- 1 ongoing evaluation in 2002-03
 - Build inferencing and learning capabilities from real data

Field Testing

- Focus on interaction design for a complete system
- 1 evaluation in 2002-03
 - User understanding of system behavior
 - User preferences and concerns
 - Accuracy of monitoring components, inferences, etc.
 - Focus group to explore attitudes toward concept



Program Progress

User Evaluations



Honeywell House Laboratory

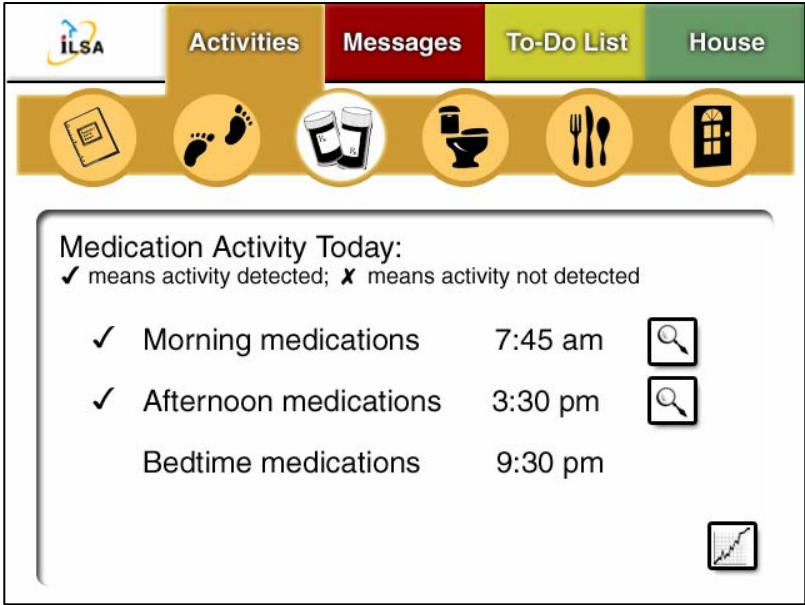
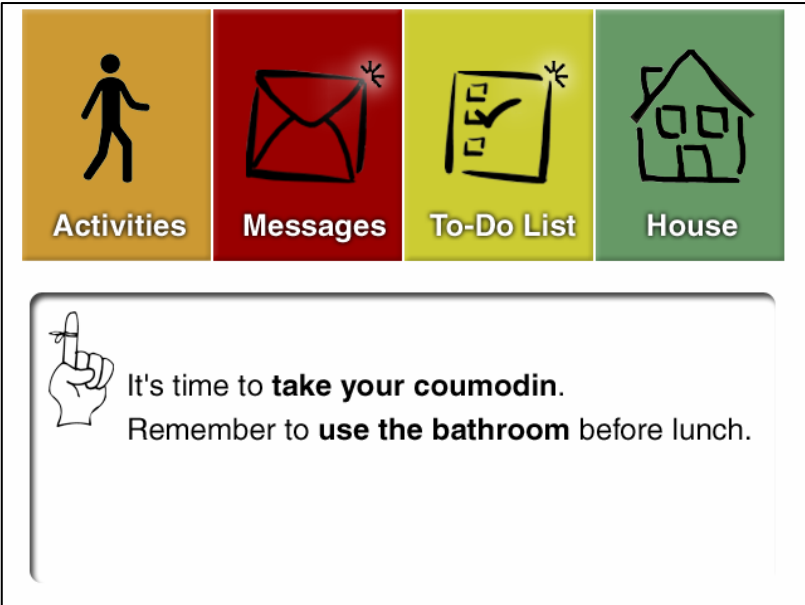




Program Progress

User Evaluations

Concept Elder Browser Interfaces



Program Progress

User Evaluations



Concept Elder Browser Interfaces

This screenshot shows the 'Messages' tab selected in the ILSA browser. The navigation bar at the top includes 'Activities', 'Messages', 'To-Do List', and 'House'. Below the navigation bar, there are three circular icons: glasses, a pencil, and a folder. The main content area displays a notification: 'You have 4 new messages:'. Below this, a message is shown with the following details:

- # 1** | Hi Mom-
Just wanted to let you know Suzie will stop by on her way home from school.

Navigation and action options include:

- Back**: Upward arrow icon
- Next**: Downward arrow icon
- Save**: Folder icon
- Delete**: Trash can icon

This screenshot shows the 'House' tab selected in the ILSA browser. The navigation bar at the top includes 'Activities', 'Messages', 'To-Do List', and 'House'. Below the navigation bar, there are five circular icons: a document, a thermometer with 'F', a padlock, a triangle, and a map. The main content area displays thermostat information:

- First floor temperature is **72°**
- Thermostat settings:

Setting: 72°	Mode: Heat	Fan: Auto
Warmer (Up arrow)	Heat (Selected)	On (Selected)
Cooler (Down arrow)	Cool	Auto
	Off	Off

