Home-Care Technology for Independent Living

A NIST Advanced Technology Program

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Agenda

ILSA Vision
Program Progress
Evaluation Plans
Concept Web Pages
Honeywell Businesses

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

Automation & Control Systems

Aerospace

Specialty Chemicals

Transportation & Power Systems

Honeywell Labs
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, devices, and appliances to support caregivers and 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
  - Behavioral Informatics, Inc.

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
What will ILSA look like

- An invisible network of integrated sensors, devices, and “smart” appliances
  - Sensors - motion, contact, optical, acoustic, etc.
  - Devices - thermostat, speaker, telephone, medical, 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:
  - Elders
    - Telephone, Simple browser device, Speaker, Electronic Picture Frame
  - Caregivers
    - WebSite, Telephone, Pager, eMail, PDA
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 inside the home
- **Respond** to a given situation by providing assistance to the elder and getting help when necessary
- **Share** health and status information with authorized caregivers to help improve the quality and timely delivery of care
Temperature is 72°.

Lois was in the shower at 8:00.

Stove is on.

Lois took medication at 10:15.

No panic activation.

Lois is in the living room now.
Assess individual behaviors and conditions

- Dinner time
- Motion in kitchen
- Refrigerator open
- Silverware drawer open
- Stove is on
- Motion in dining room
Assess collection of behaviors and conditions with respect to normal patterns

- Got up late
- Skipped Lunch
- Temperature high
- General Activity Low
- Napping increased

Lois is sick
Prioritize conditions and formulate an appropriate response plan.
Control situation so Lois’ immediate needs are met

The Stove’s been left on for 46.3 minutes!

The Stove - turn yourself off.

I’ve fallen, and I can’t get up!

Lois, are you all right?

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

Linda’s calling.

It’s time to take your medicine!

Reminders - be quiet for now.
Lois is doing fine. I’ll check on her again this afternoon.

Lois ate breakfast at 8:20.

It’s time to take your medicine!

Mom’s having a good day!

Lois is fine.

Lois is in the living room.

10:00 A.M. Time for medicine
ILSA Vision
Example Assistance Scenarios

● Safety
  ■ Smoke is detected in home
    » Alert elder and provide exit path lighting and instructions
    » Notify caregivers and emergency personnel

● Functional Assessment
  ■ ADL/IADL monitoring - task completion, duration, and consistency
    » Provide cognitive support for elder by offering reminders or task instructions
    » Notify caregivers of changes in behavior

● Health Monitoring
  ■ Track vitals and ADL activity to detect and prevent health crises
    » Query elders about how they are feeling daily
    » Communicate with 3rd-party medical devices
    » Share health data with caregivers to improve diagnosis and treatment
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
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 prototype systems in home settings

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

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

Response

- Alarms, alerts, notifications, and reports
- Path lighting

Services

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

Usability Features

- Queries
- Operational modes (off, vacation, guests, sick...)
- Muting (cameras, reminders...)
- Password-free elder interactions
Evaluation Plans

Evaluation Areas

- **Interface & Interaction design**
  - Ease of use, organization and access to information
  - Intuitiveness, match with expectations
- **Attitudes and perceptions**
  - Trust, levels of monitoring, privacy
- **Patterns of behavior**
  - Accuracy of identification, inferences and learning from
- **System operation**
  - Integration and communication between components
  - Quality of data from various sources
  - Configuration and installation

Evaluation Methods

- **Interviews**
  - User needs, understand task, environment, and processes
- **Usability evaluations**
  - Interface and interaction design issues, some attitudes and perceptions
- **Intermediate and Long-term installations**
  - System operation, patterns of behavior, and higher-level interaction issues
- **Focus Groups**
  - Attitudes and perceptions
Evaluation Plans

Short-term
- **Usability Testing** - focus on interface design
  - Web browsers, telephones, pagers, speech systems
  - 1-2 Elder studies in 2002
  - 1-2 Caregiver studies in 2002

Intermediate
- **HW House Testing** - focus on interaction design and patterns
  - 1-2 evaluations in 2002
  - Elder understanding of system behavior
  - Usefulness of information for caregivers
  - Focus group to explore attitudes toward concept

Long-term
- **Pre-Alpha Testing** - focus on data quality, pattern recognition, and device integration
  - 4 sites
  - 1 ongoing evaluation in 2001-03
- **Field Testing** - focus on patterns, interaction design, and system operation
  - 1-3 evaluations in 2002-03
  - User understanding of system behavior, preferences, concerns
  - Accuracy of monitoring components, inferences, etc.
  - Integration of communication devices
  - Focus group to explore attitudes toward concept
Evaluation Plans

Honeywell House Laboratory
It's time to take 2 coumadin tablets. Remember to take out the trash before bed.

Did you take your 3:00 pm dose of Coumadin?
Activity goals are good today:
- Mobility is low
- Medications have been taken
- Toileting is normal
- Eating is normal

Toileting activity is **normal** today:
- ✔ Morning 7:15 am
- ✔ Afternoon 2:10 pm
- ✔ Evening 5:47 pm
- Bedtime 9:30 pm
Eating Details
Sensor activity associated with eating between 10:00 am and 2:00 pm. Hit OK when done.

<table>
<thead>
<tr>
<th>Lunch</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motion in kitchen</td>
<td>12:05 pm</td>
</tr>
<tr>
<td>Silverware drawer open</td>
<td>12:09 pm</td>
</tr>
<tr>
<td>Stove on</td>
<td>12:15 pm</td>
</tr>
<tr>
<td>Motion in dining room</td>
<td>12:30 pm</td>
</tr>
</tbody>
</table>

Mobility Level Trends
Select desired time period to view mobility levels over time. Hit OK when done.

Monday, January 21
Average movement for today: 10 events