Independent LifeStyle Assistant™
(I.L.S.A.)

A NIST ATP Program
Honeywell Laboratories
University of MN School of Nursing
United Health Group EverCare
In a Nutshell

Program Goal

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 live independently at home.

Programmatics:
- Co-sponsored by the National Institute of Standards and Technology Advanced Technology Program

Benefits:
- Support elder independent living
- Provide peace of mind to caregivers
- Support efficient quality care for caregiving organizations
- Cost savings for government and industry
Quality of life

- Desire to maintain independence
- Limitations
  - Arthritis (49%)
  - Hypertension (35%)
  - Heart Disease (31%)
  - Hearing (31%)
  - Activities of daily living
  - Falling
  - Fraud

Support systems (Caregivers)

- Institutions are costly
- Remote families
- Decreased availability (aging population)

Technology developments

- Widespread, diverse products and services
- Lack overall, integrated infrastructure
- Resistance to new technology
The Elder Boom

Growth of the 65+ Population by Age Group: 1900 to 2050
• Federal government pays 57% of nursing home and home health care costs (primarily Medicaid)
• 43% of those over 65 will enter a nursing home
• Average nursing home cost per patient is $47K
• 1.6 million home care patients in 1996 will increase to 2.0 million in 2005
• 7 million Americans provide remote care to an elder (12 hours per week or more)
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 workstation needed. Users interact with the system through familiar devices or simple dedicated devices like:
  – Telephones, Pagers, email, TV
  – Webpad, Digital picture frame, PDAs, speakers/microphones
Gather information from a variety of passive and active sensors and integrated devices.

- Temperature is 72°.
- Lois took medication at 10:15.
- No panic activation.
- Stove is on.
- Lois was in the shower at 8:00.
- 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

Lois ate dinner
Kathleen Krichbaum. Annual meeting of the National Council on Aging/American Society on Aging, March 2003

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

The Stove’s been left on for 46.3 minutes!

I’ve fallen, and I can’t get up!

It’s time to take your medicine!

Linda’s calling.
Control situation so Lois’ immediate needs are met

The Stove’s been left on for 46.3 minutes!

I’ve fallen, and I can’t get up!

Lois, are you all right?

Linda’s calling.

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

It’s time to take your medicine!

Reminders - be quiet for now.

iLSA Stove - turn yourself off.
It's time to take your medicine!

Lois ate breakfast at 8:20.

Lois is doing fine. I’ll check on her again this afternoon.

Lois is fine.

It’s time to take your medicine!

10:00 A.M. Time for medicine

Lois is in the living room.

Mom’s having a good day!
Background

Focusing on Features

Precipitating Factors Analysis → Technology Opportunities → Six-Sigma Analyses

Home-Care Analysis → Technology Opportunities

Emergent Functions Analysis → Technology Opportunities

Initial Feature Set
### Correlates of Elder Institutionalization

<table>
<thead>
<tr>
<th>Higher Significance</th>
<th>Lower Significance</th>
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<tbody>
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<td>• Safety</td>
<td>• Housework</td>
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<tr>
<td>• Medical Monitoring</td>
<td>• Shopping</td>
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<td>• Mobility</td>
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<td>• Managing Money</td>
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<td>• Toileting</td>
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Home-Care Analysis

- **Functional Assessment and Monitoring**
  - Medical, as well as physical / mental function

- **Managing Information**
  - Medical history accessible to all caregivers and medical professionals

- **Coordinating Care**
  - Address the disconnect between the medical community, professional caregivers, family caregivers, and elders

- **Educating the Care Community**
  - Train informal caregivers to recognize signs of dementia
  - Train geriatricians to better recognize environmental factors contributing to dementia, especially in behavior outside the home
  - Train physicians to better communicate medication strategies
Emergent Functions Analysis

Potentially valuable features can be overlooked because they are not represented by specific interactions between the user and the system.

- Interactions between the client and the environment
  - Example: Using temperature data and door sensors to alert if an elder leaves the home without adequate clothing for the weather.
- Interactions between different aspects of the environment
  - Example: Locking windows in the home in response to the front door being locked.

This analysis produced 85 potential functions, either to generate alerts to caregivers, or provide direct assistance to the client. No emergent functions are in the initial features because environmental factors were rated low in priority.
What I.L.S.A. Looks Like

Control Boxes

• **Home & Away** - Hidden in closet, talks to sensors and devices

Devices to communicate with I.L.S.A.

• **Telephone** - I.L.S.A can call you with a message
• **WebPad** - You can get information from I.L.S.A.

Sensors

• **Motion Sensors** - Sense motion in a room
• **Call Button** - Same as your current call button
• **Medicine Caddy** - To tell I.L.S.A. when you take your medications
The web site was designed with professional and family caregivers in mind, since many people may eventually share in the maintenance of your parent’s independence.
What I.L.S.A. Will Do

Functions\(^1\)
- **Reminders:** Notes to help you remember what you should do today
- **Mobility\(^2\):** Summary of your activity level for each time period of the day
- **Medicine\(^2\):** List of the medications you should take and whether you opened the caddy at the correct time
- **Controls:** The status of I.L.S.A. for your home
- **Help:** What to do in an emergency and who to call if you require assistance

Support
- **Caregiver/family member, user guides, and technical support**

\(^{1}\text{Critical to have accurate information}\)
\(^{2}\text{Thresholds have been established to issue alerts for these functions}\)
Messages

Alerts

An alert suggests that you may want to check on your parent at your convenience. You will be called with alerts, and will see them in your web browser.

- No Mobility for more than 4 hours during normal wakeful times
- A 50% increase or decrease in mobility (activity) from normal levels over the course of three days.
- Missed medications for a period of at least 24 hours.
Managing Prescription Information

As the designated caregiver for your parent, you will have access through your web browser to change medication schedules. If you are uncomfortable with this, you may call the support number we will provide and we can manage this data for you.
Field Test Aims

- 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
Field Test Methods

Design

• Longitudinal, repeated measures
• Sample: 9 elders
  Takes one or more medications
  Needs assistance with IADLs
  Has family or formal caregiver who provides regular assistance
  Caregiver willing to participate in study

• Sites
  MN & FL: ALFs, Apts, private homes

• Data Analyses
  • Frequencies
  • Correlations
  • Chi square
  • T-tests
  • Friedman’s ANOVA
Field Test Measures

Evaluation Scope

• **Interface & Interaction design**
  – Ease of use, access to information, intuitiveness, match with expectations

• **Attitudes and perceptions**
  – Trust, levels of monitoring, privacy

• **Patterns of behavior**
  – Accuracy of identification, inferences, and learning

• **System operation**
  – Quality of data from devices, appropriateness of behavior

• **System effects**
  – Elder health, cognition, caregiver effectiveness and burden, elder sense of independence

• **6-10 month duration**
Field Test Data: Baseline

Demographics

• Age: 83.42 (range 76-96)
• Gender: 1 male, 6 females
• Marital Status: 6 widowed; 1 married female
• Level of Education: 4 high school; 2 college grads; 1 masters’
Field Test Data

Baseline

Health (SF-36)

• General Health: mean=61.5
• Physical Function: mean=65.38
• Mental Health: mean=75.88

Cognition

• MMSE: mean=27.85 (range 23-30)
## Field Test Data Baseline

### Mobility:
- One uses wheelchair for long distances, walker in apt.
- Others very active; all but two still drive

### Med Adherence:
- One has meds set up;
- Others set up own weekly
- Number of meds range from 1-16 per day
Field Test
Preliminary Findings

- Elders are living independently; one in ALF
- All are physically active, mobility is high
- All are “healthy” with at least one chronic illness
- All are comfortable with remotes, programmable appliances
- Five have some computer literacy—wide variation in abilities
Example: Integrated Assistive System

- Lois is doing fine. I’ll check on her again this afternoon.
- Lois ate breakfast in the kitchen at 8:20.
- It’s time to take your medicine!
- 10:00 A.M. Time for medicine
- Lois is fine.
- Lois is in the living room.
- Mom’s having a good day!

Honeywell e-services Applications

Kathleen Krichbaum. Annual meeting of the National Council on Aging/American Society on Aging, March 2003