



Home-Care Technology for Independent Living

Wende Dewing, PhD

Human Centered Systems

Information and Decision Technologies

Honeywell Laboratories



Agenda

- About Honeywell
- About Human Factors
- Independent LifeStyle Assistant (ILSA)
- ILSA User Studies - Elder Assistance Needs
- What's Next



About Honeywell



Advanced technology and manufacturing company

Provides materials, products, and solutions

Customers in aerospace, transportation, homes, buildings, industry, and chemicals

Sales of \$24B
120,000 employees
In 95 countries

Honeywell Laboratories



About Honeywell

Human-Centered Systems

Staff of 22 professionals

Diverse Expertise - child, experimental, and neuro psychology; industrial, aerospace, and mechanical eng.; mathematics; computer science; and human factors





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



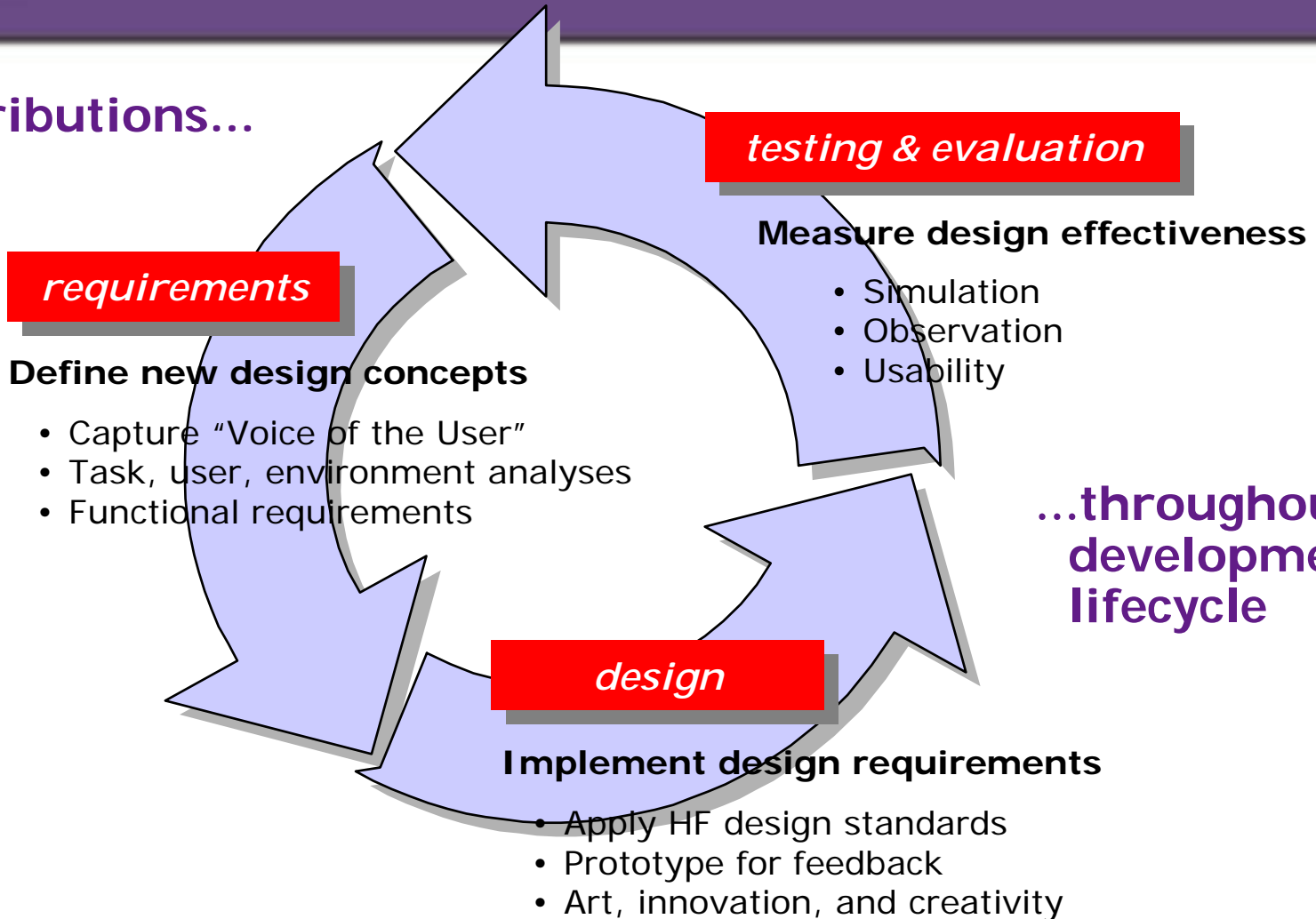
About Human factors





About Human Factors

Contributions...



...throughout the development lifecycle



Independent LifeStyle Assistant

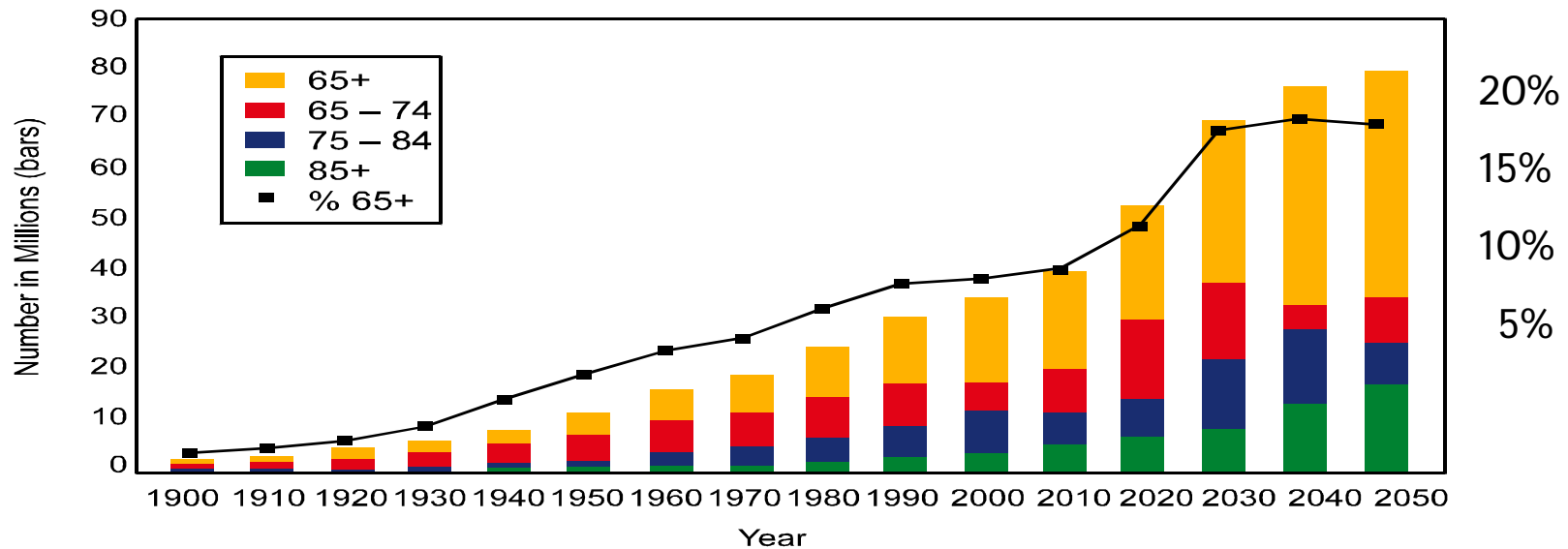
- An advanced technology **research** program
 - Sponsored by NIST
 - 2.5 years
 - 5 million dollars
 - Honeywell, U of M, Evercare
- Objectives
 - enable elderly to live and function safely at home
 - provide peace-of-mind to caregivers and family
 - cost savings for Medicare/Medicaid and industry
 - market growth for in-home product producers



ILSA Motivators

The Elder Boom

Population distribution shifting to a higher proportion of elders.



Growth of the 65+ Population by Age Group: 1900 to 2050



ILSA Motivators

Elder Preferences

Thursday
APRIL 8, 1999

Woman, 89, says relocation violates her rights

She sues her nephew and Hennepin County in an effort to remain in her home in Minneapolis rather than be moved to a nursing home in Wisconsin.

By Warren Wells
Star Tribune Staff Writer

- 30% of elders prefer to remain in home until death
 - *Health Care Financing Administration*

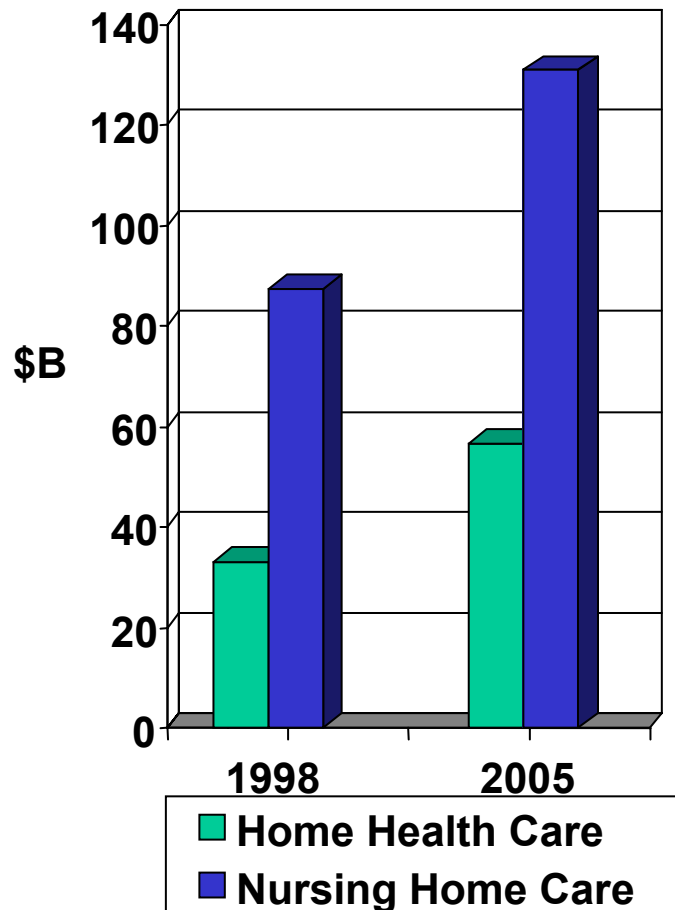
- Decreasing number of caregivers
 - families are more distributed
 - families are smaller

- Nursing home capacity limited
 - 43% of those over 65 enter a nursing home



ILSA Motivators

Elder-Care Costs



- Nursing home costs of \$78 B
 - 1.6 M receive care
 - \$47 K per person per year
 - government pays 57%

- Home health care costs of \$30 B
 - 1.6 M receive care

- Informal caregiving costs \$11 B
 - 23% of households provide care
 - 7 M long distance caregivers
 - 35% of employees have lost time



ILSA Vision

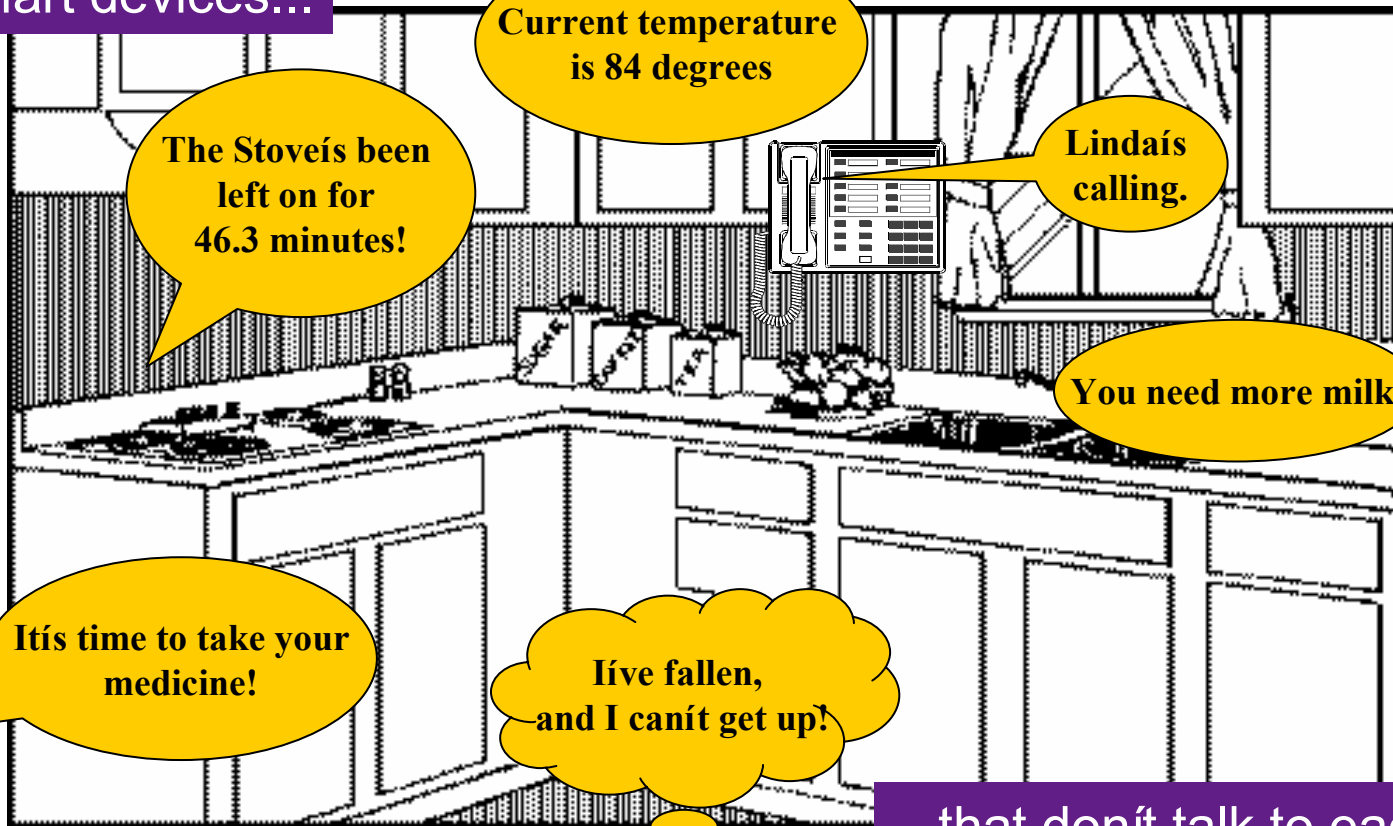
- What will ILSA do
 - “listen” to the home and “talk” to devices
 - understand what activities are going on
 - look for unusual events
 - interact with elder
 - alert
 - query
 - instruct
 - control
- What will ILSA look like
 - invisible network of sensors and devices
 - no central computer workstation needed
 - use existing devices to communicate with elders
 - remote access for caregivers



ILSA Vision

Smart Devices

Smart devices...



The Stove is been left on for 46.3 minutes!

Current temperature is 84 degrees

Linda is calling.

You need more milk.

It's time to take your medicine!

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

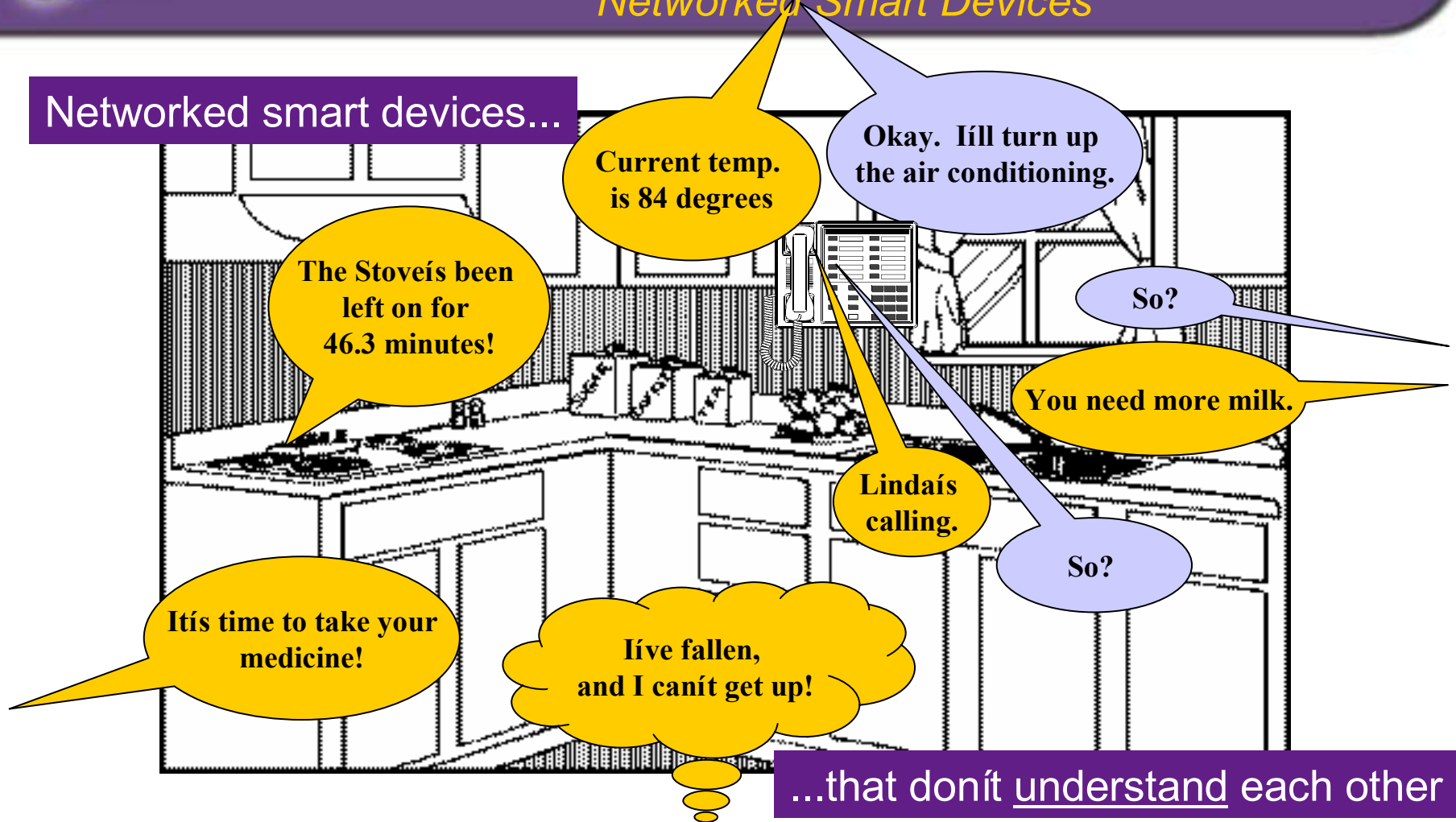
...that don't talk to each other



ILSA Vision

Networked Smart Devices

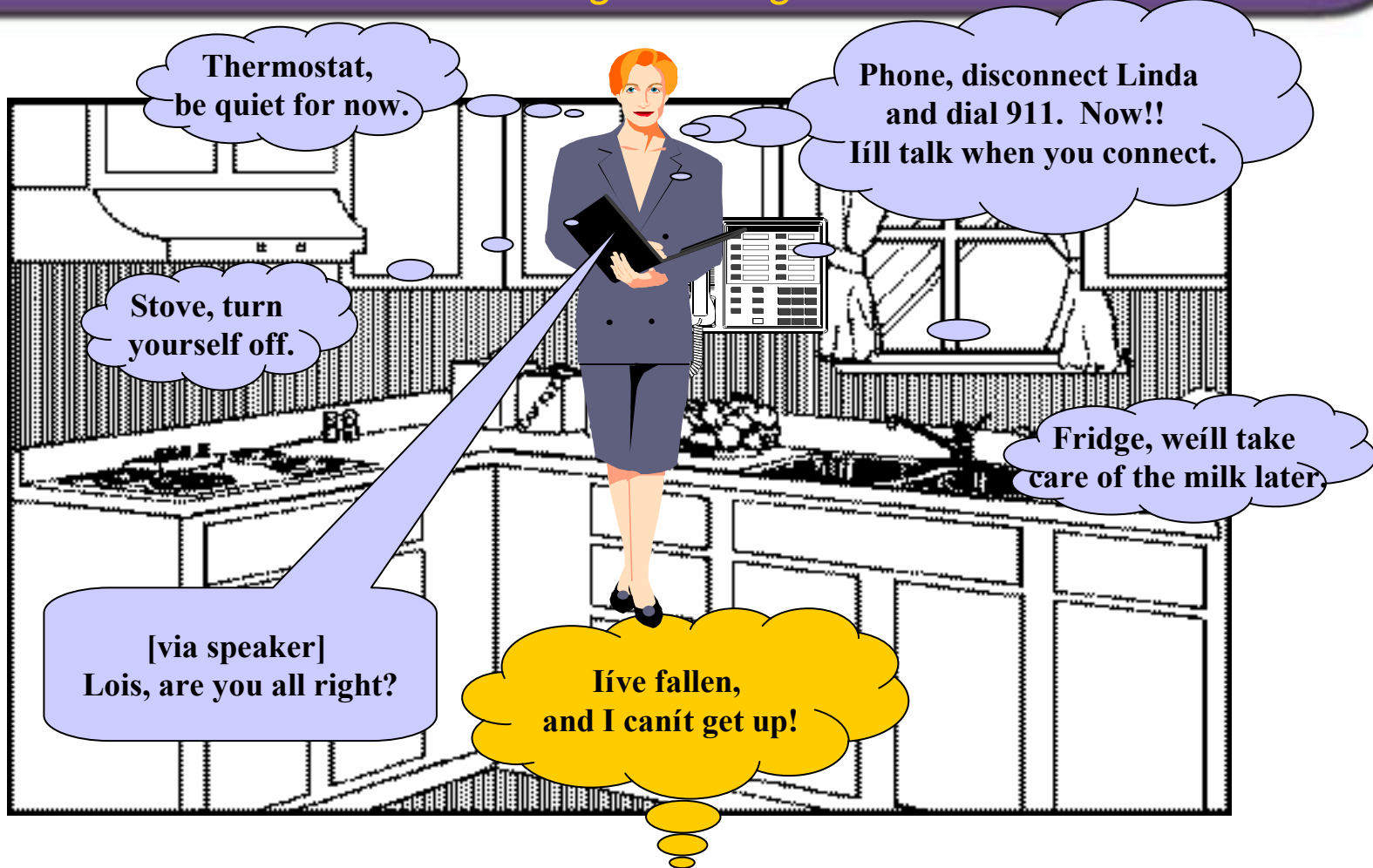
Networked smart devices...





ILSA Vision

Intelligent Integration and Assistance





ILSA Example

Feature Detectors locate Elder in kitchen with the stove turned on.

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

15 minutes elapse . . . Situation Assessor concludes the stove has been left unattended.

ILSA tries to get Elder's attention by displaying an alert icon and message on the TV - "should stove be on?"

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

Still no response, so ILSA checks Elder's vital signs. Situation assessor concludes Elder is sleeping. ILSA turns stove off.





ILSA Innovations

- Home automation
 - Intelligent, coordinated (not just networked) integration of multiple sensors, effectors, and displays
- Situation Assessment
 - Situation awareness from low cost, fault-vulnerable sensors of disparate types
- Machine Learning
 - Application to a difficult, real world domain
 - Extensions to huge data sets, faulty data, and multi-source data
- Adaptive Interaction Design
 - Deepen first principles knowledge of interaction planning
 - Incorporate many more divergent multi-modal devices than previously
 - Operate for a more demanding, potentially less capable audience
 - Integration of machine learning to improve interaction designs
- Human-Centered System Design
 - Improved understanding of elderly interactions with computers and automation



ILSA Research Plan

- Identify Assistance Needs
 - what do elders and caregivers need in order to continue living independently

- Model User, Home, and Situation Characteristics
 - model capabilities, traits, behaviors, activities, and environments as a foundation for ILSA intelligence

- Assess Technology State-of-the-Art
 - what sensors, devices, technologies, and services does ILSA need to integrate and communicate with

- Demonstrate Technology
 - build and evaluate a prototype system



ILSA User Studies

- Elders
- Informal caregivers
- Formal caregivers
- Formal care institutions
- Insurance companies
- Government agencies
- NIST
- Honeywell
- et al



ILSA User Studies

- Identified precipitating factors for elder institutionalization
 - literature reviews
 - interviews with caregivers
 - discussions with geriatric and gerontology specialists
- Identified assistance needs
 - what activities do elders and their caregivers need assistance with
- Identified technology opportunities
 - how might ILSA assist with these activities



ILSA Assistance Needs

- Medication Management
 - recording drug use and assessing ADRs; correct meds in correct amount at correct time; reordering
- Eating
 - monitoring food quality; preparing grocery list; planning nutritionally balanced meals; preparing food
- Mobility
 - preventing, detecting, and responding to falls
- Cognitive Disorders
 - monitoring decline in cognitive capabilities; providing reminders and task completion assistance
- Safety
 - prevent, detect, and respond to fires, burns, scalds, and poisoning



ILSA Assistance Needs

- Caregiver Burnout
 - help prioritize activities; reduce demands to and from elder's home; improve remote communications
- Isolation
 - increase elder's ability to communicate with folks outside the home; preventing, detecting, and responding to predators
- Transportation
 - planning routes; accessing transportation schedules; arranging transportation; monitoring driving
- Money Management
 - paying bills, managing account balances; monitoring for fraud and solicitations



What's Next

- Identify Assistance Needs
 - perform formal knowledge acquisition
 - define requirements
 - design user interface concepts
- Model User, Home, and Situation Characteristics
- Assess Technology State-of-the-Art
- Demonstrate Technology