ILSA Scenario for HOME and CARE Initial Design

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Version: 1
Date: **December 30, 2000**

1. Document History

Table 1

Version	Prepared	Description
.00	12/7/00	Erroneous, shortened version circulated to group
.01	12/5/00	Initial version. Simply the compilation of the proposal scenario, multiple previous versions of that Scenario, and the stove vignette details from the proposal CARE section all lumped into section 3.
.02	12/7/00	Formatted document, added section 4, incorporated some comments from morning meeting. Circulated to group.
1	12/30/00	Incorporated comments from group on each specialty area

2. Purpose of Document

This document provides a reference scenario to begin design work on HOME and CARE primarily, and secondarily, on ILSA's infrastructure and usability. It is not meant to be definitive, nor to cover all possible aspects of ILSA, only to ground initial design discussions.

3. Scenario

Lois Anderson is 83, and has lived alone since her husband, Albert, died a few years ago. Lately, she has been relying her cane more, and doesn't get out much. Last week, she forgot to turn off the oven, and with hearing so bad that, being down in the basement, she didn't even hear her smoke alarm when it went off. She was lucky she happened back into the kitchen before things got out of hand. Marge, Lois's daughter, lives nearby, but has three children and a full-time job. Marge worries about her mother, and lately there's been talk of a nursing home, just to be sure that Lois is safe—though no one likes that idea, least of all Lois.

Thanks to Lois's health insurer, Marge discovers there are affordable systems that could transform Lois's house into something of a full-time caretaker—or at least, could provide some support to the overworked caregivers she already has. They're easily customizable *{configuration}*{ML1} for just the support Lois needs. Two weeks later, after a consultation session *{interaction}* over the web, an installer comes out and puts Lois' ILSA system in one afternoon. Lois and Marge both feel safer and are glad that Lois can continue living at home. Lois and ILSA have been 'getting to know each other' through a series of dialogues *{interaction}*{ML2}, almost like games or conversations, and ILSA has been 'behaving better' as a result.

One night, Lois is on her way to turn off the teakettle when she's distracted by the *phone's double ring and flashing red light {interaction}* which tells her that Marge is calling. {D1}{I1}{S1} The *TV, which was loudly broadcasting the news, automatically mutes itself* so that Lois can better hear the conversation. After Lois hangs up, she forgets all about her tea and goes back to watch Jeopardy. Later, the water in the teakettle has boiled away, and ILSA senses the beginnings of a particulate buildup through the kitchen's *air quality sensor*. {D2}{S2} ILSA *readjusts the household fans* to clear out the smoke. Since Lois still has the same stove she bought in 1952, ILSA itself is unable to turn off the burner, {D3} so it must communicate with Lois directly *{interaction}*. First it must find her, {D4} though, because the insurance company didn't cover the *full motion sensor* suite. Because Lois recently used the *remote control* in the living room, and the television is still on, ILSA suspects she might still be there {S3}. It *presents a message on the TV screen*

{interaction}: "Lois, turn off the stove," along with an image of a stove and smoking pan. {I2} A *spoken message {interaction}* would have been required if Lois had been blind, or if ILSA had thought she was asleep {S4} but neither is true. Given that Lois has responded more frequently to visual text and image combinations in the past, ILSA chooses this interaction method {ML3}.

Unfortunately, Lois is no longer watching TV. She has gone to the bedroom for her knitting during a commercial. Because she hasn't responded to the alert {S5}{ML4}, and this is an emergency, ILSA *flicks selected lights on and off several times {interaction }* throughout the house to get her attention {I3}{S6}. In her bedroom, Lois checks the bedside *ILSA display {interaction}* and hurries to the kitchen to turn off the stove. She arrives just in time, too—any longer, and ILSA would have *called the next-door neighbor* {D5}*{interaction}*{ML5} or other help if necessary.

When her shows are over for the evening, Lois goes into her bedroom and sits down on the edge of her bed. A *pressure sensor* under the mattress senses her current position, and, because it is Lois's normal bedtime {S7}{ML6}, ILSA asks her whether to shut down the house *{interaction}*. *ILSA turns off all the lights and the TV*, {D6} and checks to make sure all the doors are locked {D7}. ILSA's *bedroom speaker reminds Lois {interaction}* to use the glucose monitor that her doctor recommended {S8}{ML7}. When the device was installed, it came pre-programmed with data from the physician who ordered it and the prescribed care regimen including the devices information needs, capabilities, usage parameters, alarm levels and notification procedures *{configuration}{I4}*. ILSA integrated that knowledge automatically without needing to ask Lois or Marge additional questions (future changes will need interaction *{interaction}*{ML8}*)*. Since the device is still a bit new, ILSA provides instructions on how to use it *{interaction}{S9}*. *ILSA reads the data gathered by the monitor* and stores it for automatic transmission later, since it knows it is supposed to average glucose levels over week-long periods. {D8}

Lois goes to sleep easily. When she gets up in the night, the *pressure sensor* in her bed and the *motion sensor* in the bathroom combine to tell ILSA to *light up the hall and bathroom* so Lois won't stumble over anything in the dark {S10}. Marge gets home from work too late to call Lois. She knows that if anything serious had happened, she would have been notified *{interaction}*, but she logs in briefly to check whether there have been any problems. Lois had insisted that no information about minor home situations be reported to Marge *{configuration}*, so all Marge sees is that things are all right {I5}, Lois is sleeping and has followed her new glucose monitor regime; things could have been set up differently so that Marge would get reports of minor problems (like the stove situation) and even of progress on longer term situations such as Lois's dexterity, memory and dressing, eating, and bathroom regimes if that had been acceptable {S11}{ML9}. ILSA monitors these long-term patterns, and notices when things change. ILSA can use these "normal" behaviour patterns to figure out what Lois is probably doing (like going to bed or cooking dinner), and to notice changes in Lois. In this way, ILSA can tailor its interactions with Lois to be a better assistant; for example, as Lois' hearing continues to get worse, ILSA will use flashing lights more frequently than speakers. If Lois continues to have problems remembering her teakettle, ILSA can start reminding her before the problem starts. Some changes may need to be told to Marge or the doctor. If something serious happens that is not "normal" for Lois, ILSA can call for help.

Since ILSA doesn't flag any problems, Marge puts in a request *{interaction}* to call Lois when Lois is up the next morning *{configuration}{S12}* and logs off, going to sleep much easier in her mind than she would have a week previously. In the morning, the *pressure and motion sensors* are used by ILSA as the basis for the decision that Lois is up and moving around, and thus to initiate the call *{interaction}* that Marge requested.

3.1 Additional factors:

The items below appeared in other versions of the scenario or are things we've thought about. Putting too many of these in the scenario will make it work less well as a story, but we should still consider these in our design.

- Call screening (annoying magazine salespeople)
- Bill/financial management
- Alarm suppression—loud, unexpected alarms contribute to fear, confusion, heart attack risk, etc.
- Entertainment options—TV alerts Lois when Jeopardy is on, makes Jeopardy selections first on the scrolling favorites program for the remote, etc.
- Item tracking—TV remote, keys, purse, etc.

- Escalating alarms (initial visual presentation of stove alarm followed by visual plus flashing red light and spoken verbal message).
- Estimating time of movement and human actions within house to time information presentation (time it takes for Lois to move from TV to stove)
- Web browsing assistance—user- and task-sensitive assistance in, for example, finding information on a medical condition
- Many more extensive examples of calendar- and reminder-based interactions: medication schedules, grocery ordering, etc.
- Sensor reliability. Maybe the motion sensor gets confused when the cat moves? Ideally we want a situation where 3 sensors agree X, number 4 says Y. Learn (when) to ignore Y.

3.2 Scenario Vignettes

The above scenario can be decomposed into vignettes roughly along functional lines, each focusing on different actions or capabilities of ILSA. Here's a candidate list of such vignettes for convenience in our discussions. Other divisions of the scenario are certainly possible.

1. Installation/Set Up/Initial Configuration—paragraph 2
2. Hazardous Situation Management—paragraphs 3 and 4
3. New Device/Capability integration—alluded to in the beginning of paragraph 5
4. Medical device management—paragraph 5
5. Communication Management—end of paragraph 5 (data aggregation and reporting to doctor) and all of paragraph 6.
6. Status assessment—the basis for the report to Marge in pargraph 6.

4. Scenario Scorecard

We wanted to ensure that the scenario contained at least some basis for each of the high level scenario requirements we generated in our initial meeting. Here are the categories and my assessment, personal and subjective, of how the above scenario fares:

Dimension	Score	Comments/Rationale
End to End	Pretty Good for a high level scenario	Most of the examples in the scenario provide some notion of how they are sensing, reasoning and acting. The stovetop example does this most explicitly.
Phaseable	Lousy	For this to work, I'd assume we need to show how ILSA grows through different releases and/or how the functionality in Lois's ILSA can be achieved a (small) piece at a time. Haven't done that yet.
Expandable/Improveable	Fair	The addition of the glucose monitor is our chief example of this.
Adaptable over installations	Fair	We at least allude to the notion that ILSA has to operate in specific ways in Lois's house because she only has certain sensors and certain actuators.
Grounded in Depth/Plausible	Fair	C'mon . . . it's a high level storyline.
Deals with Uncertainty	Fair	There is uncertainty about where Lois is in relaying the stove message resulting from incomplete knowledge, resulting in an erroneous conclusion. The system recovers from this. Other forms of uncertainty are not covered.
Reasons over multiple sensor	Good	Pressure sensors, smoke alarms, motion sensors, phone status, TV status

types		
Reasons over multiple actuator types	Good	Phone, lights, TV, household fans, glucose monitor equipment, door locks
Reasons over multiple UI types	Good	TV, phone, house lights, 'bedside display', smoke alarm? (suppression)
Context sensitive behaviors	Good to excellent	Stove example provides context, user, task and device sensitive behaviors. Glucose monitor is user location, time of day and perhaps user sensitive. Presumably (but somewhat implicitly) ILSA configures its data differently for presentation to the doctor monitoring the glucose situation and to Marge than it does to Lois herself.
Adaptable over time (learning)	Fair	Alluded to in set up and in the notion that the system has learned that Lois reacts more frequently to iconic displays. Maybe this is how ILSA 'knows' that Lois is going to bed in the latter vignette rather than getting her knitting (as in the former).
Temporally sequenced	Fair?	ILSA times its alarming behaviors in accord with the unfolding stove example. It behaves in time-of-day appropriate ways in the glucose monitoring example, in shutting down the house, and in communication with Marge and in brokering the later phone call from Marge to Lois. There aren't real clear examples, though, of how ILSA *plans* sequenced behaviors.
Other Tech Hot Buttons	Unknown	Not knowing thoroughly what these are makes this one hard to assess. Of a few suspected H&BC hot button technologies: We do illustrate status reports to Marge—which seems to be a core capability of 'ParentWatch'. We do illustrate manipulation of 'Home Comfort' systems via the fans to air out the house after the stove incident. We don't (except in the additions in section 3.1) discuss integration with home entertainment systems. Other suggestions?

5. Device Considerations

Potential scenario split points based on alternative sensor or infrastructure configurations:

Almost every point in the scenario where a sensor is used presents a potential split point. Most of these points have paths depending on the number and complexity of the sensors attached to ILSA. Most of the sensor configuration options can be described by a low end version with minimal sensors to do the task and a higher end version with a full sensor suite to accomplish multiple tasks.

D1 - Phone Ringing

Low End - The distinct ringing, caller ID and flashing light functions can all be accomplished with a combination of phone line features and off the shelf products. There is no need for ILSA's reasoning to do just the function as described.

High End – ILSA can intercept incoming calls and lookup the caller ID and then do different functions depending on who it is. ILSA could then alert the client in a variety of ways from ringing the phone in a distinctive way to flashing any light in the house to announcing who the caller is using voice output.

D2 – Stove Monitor

Low End - The low end could monitor air particulates, or smoke with existing sensors. These low end sensors may not give much more warning than a smoke detector.

Mid Level – A mid level could have a non-imaging IR heat sensor that could detect a hot burner. This would tell us the burner is on but not if it is being used.

Higher Level – A level higher would have a smart appliance that could communicate to ILSA when it was on.

High End – The high end approach would have an IR imaging sensor (which Honeywell makes) looking at all of the burners on the stove. With this sensor and software we could detect when a burner is on, if a pot is on the stove, the temperature of the pot and when someone was last near the stove.

D3 – Turning the Stove Off

Low End – The low end is described in the current scenario, ILSA does not have the function to turn the stove off. The client must be alerted to turn off the stove.

Mid Level – A mid level approach would have a gas shutoff valve or electrical shutoff switch that ILSA could control. These are cots devices but would require some intelligence in ILSA to know when to turn it off and when to turn it back on.

High End – The high end approach would have a smart appliance that ILSA could tell to shut off.

D4 – Locate the Client

Low End – The low end would not try to find the client but would broadcast the warning message throughout the house globally. It would flash all lights or call from all speakers.

Mid Level – The mid level for locating the client is described in the current scenario. It uses information from other sensors in the home to find the client based on their last interaction with the system.

Higher Level – This level would augment the above sensors with specific room occupancy sensors. There are a wide range of coverage options here depending on how many sensors were installed.

Even Higher Level – This approach use acoustic sensors situated throughout the home to track the movements of the client, and anyone else in the house. The sensors would provide full coverage of the house.

High End – The ability to detect room occupancy and even identify who is in the room is a big payoff function for home automation systems but the ideal solution has not yet been found. ILSA could also benefit by knowing who is in a particular room. The approaches used for person identification and tracking fall into two categories depending on whether or not the client is required to carry or wear an identification device. RF tracking approaches accurately track multiple people around a house but require them to carry or wear a small transmitter device.

The other category of approaches does not require an id tag but uses a large number of sensors to identify and track people at key locations around the home such as hallways and doorways. Technologies in this category are less accurate and include face recognition imaging sensors and smart floor sensor that identify people based on their walking patterns.

D5 – Call the Neighbor

Low End – The neighbors number is called and they hear a prerecorded message that is general enough to be used in multiple situations.

High End – The neighbor receives a call that gives them a fairly specific voice synthesized message and asks for confirmation that they received the message and are responding.

D6 – Turn Off Lights at Night

Low End – This level consists of turning off a select couple of light that are connected to remote modules so they can be controlled.

High End – This could be a whole house sleep mode where all lights are turned off, the HVAC is put into sleep mode, the security system is armed and the water heater is turned down.

D7 – Check to See the Doors are Locked

Low End – ILSA can arm the security system.

High End – ILSA can actually lock doors, arm the security system and put the whole house into sleep mode (as in S6).

D8 – ILSA Reads Data Gathered By Glucose Monitor

Low End – ILSA would be a gateway to transfer the medical data to the doctor or ILSA could store it for a short time. At this level ILSA does not understand the data it just knows how to pass the data packet on.

High End – ILSA reads and makes inferences on the data from medical sensors. This has more implications for the ILSA reasoning modules but also has some implications about the data transfer, data formats and connectivity to ILSA.

6. Interaction Split Points & Issues

I1 – Lois does not pick up the phone when Marge calls.

If Lois isn't home, then ILSA can answer & tell Marge. If Lois is home, then her failure to pick up might indicate an emergency.

I2 – Lois falls asleep in front of her TV.

Perhaps an escalating process of interactions – first the graphics, then add sound to TV, then add other noises around the house. If Lois is deaf, will need to consider other actions.

I3 – Lois ignores the flicking lights

Escalate the attempts to reach her. Maybe go to a neighbor?

I4 – Configuring the Glucose device

Configuration needs to be dynamically uploadable; e.g. Marge or the doctor updates alarm levels remotely. Update from afar.

I5 – Reporting to Marge

Trust issues a problem to keep in mind. Marge may want everything reported, but Lois will not trust (hence will not use) a system she does not trust.

Issues
Several different types of interactions are conveyed in the scenario:

1. Filtering incoming messages
   - Color code Marge's call with double ring
2. Initiating outgoing messages
   - Call neighbor in emergency situation
   - Broker call for Marge when Lois wakes up
3. Displaying information to human
   - Display information on TV
   - Display information on bedside ILSA display
4. Alerting
   - Phone call comes in, flash red light and ring
   - Multiple modes to display warnings to Lois, on TV, via speakers
   - Alert Marge/neighbor if situation demands it
   - Remind Lois to check glucose levels
5. Interaction
   - Consultation session to decide on type of system to install
   - Training newly installed system to Lois' behavior patterns
   - Ask Lois if ILSA should shut down house

Some examples of high-level requirements are presented below:

- ILSA shall have a set of unique telephone ring patterns, mapped to unique caller ids or caller id sets.
- ILSA shall provide a redundant cue that the telephone is ringing by flashing a light on the phone.
- ILSA shall display both graphical icons and text on the TV.
- ILSA shall communicate with client via speech generation.
- ILSA shall have multiple modes of displaying information with the client, including but not limited to aural and visual modes.
- ILSA shall be able to communicate with persons outside the home to convey emergency information, with the ability to recognize when the information has been successfully communicated.
- ILSA shall have dedicated displays/controls that allow it to communicate with client to convey information. The display graphics (font, font size, color) shall be appropriate to the user's capabilities.
- ILSA shall have a set of training modules that allow the client(s) to train it to the client's capabilities/preferences.

This set is an example, and is by no means complete, since they cover only what was discussed in the scenario.

Impact of Machine Learning
In general, ML can affect the type of response that CARE performs when faced with a situation. Models of what response modes were more effective will predispose CARE towards those modes when reacting to a situation. Additionally, ML can impact the models in HOME that reason about what the current situation is, and what probability (based on past experience) that a certain situation exists.

There has also been some discussion lately of utilizing interaction with Lois in order to probe or test some of her cognitive capabilities. Thus ILSA would tailor its interactions to not only satisfy the immediate goals, but also to "sample" for information to inform long-term trend models of Lois' abilities and capabilities.

7. Situation Assessment (SA) Issues & Considerations

S1 – Turning down the TV

Page: 8
I assume that this is not actually the TV but ILSA turning down the TV. We might even note that the TV is turned down before Lois answers (so that Lois can hear the ringing better). Even this will require some basic state assessment. Since the ringing of the phone has to be combined with the fact that the TV volume is too high for Lois to hear.

S2 – Particulate Buildup

Page: 8
To know this we again need some state assessment. We need to know that not only is the water al gone but also that Lois is not doing anything about it. So we pretty much need to be monitoring Lois and what the fact that she is not going to fix the problem.

S3 – Where is Lois?

Page: 8
Clearly a case of state assessment. The combining of the used remote with the TV being on is state assessment.

S4 – Lois is asleep?

Doing the SA for telling when Lois is asleep is an interesting (difficult) task.

S5 – Lois has not responded to the alert

Page: 8
Doing the SA to tell that she hasn't responded is another interesting problem. Will we be providing a method for Lois to acknowledge the alerts that she is given? Will it just be important to reason from the fact that she leaves the living room that she might be (thought not necessarily) going to the kitchen to take care of the problem.

S6 – Flashing Lights

Page: 8
Even being smart about the flashing lights would involve some SA. Don't start by flashing the lights in the basements if Lois almost never goes down there and the basements door sensor hasn't been tripped recently.

Understanding whether to flash lights or use some other technique is also hard. Depends on subject capability, e.g. if subject is blind, consider beeps.

S7 – ILSA shuts down the house

Page: 8
Looks like Sa to me. Time is really too limiting. The more general case of figuring out that the action is appropriate opens a big can of worms on the SA front.

S8 – Glucose Reminder

Reminder could be triggered by time, but that's very limiting. There are some SA issues here so that the reminder might not need to be issued if she had been remembering. And how much flexibility do you give her?

S9 – Instructions

Intelligent instructions would be really cool. e.g. Page: 8
Might want to have SA contribute to how much help is provided. Maybe Lois always forgets just one step of the process. Knowing the difference between the whole and just the one step that she needs to be reminded of sounds like SA to me… but maybe that's more user modeling…

S10 – Path lighting

Need to understand where she is, where she's going, that she needs lights, etc.

S11 – Long Term Situations

Page: 9
These could require significant issues in SA since even simple (non alarmed) situational information should be providing information to these long term trending tools.

S12 – Lois is awake

Page: 9
Again will require an interesting question of how long does Lois have to be out of the bed (or does Lois have to be out of the bed?) for her to be considered "up" to receive the phone call.

8. Machine Learning Points

ML1 – Configuration

ILSA can use an "aggregate" concept of a "typical" elder as a starting point to make it easier to configure.

ML2 – Getting to know each other

The first couple of weeks or so are time for ILSA to learn about Lois (& Marge). At the end of this period, ILSA can either automatically update the configuration, or ask whether it's appropriate to do so. ILSA's reminders and other interactions are a lot more appropriate.

ML3 – Understanding changing capabilities

As Lois ages, the ML will need to update the concepts of what interactions are most effective.

ML4 – Lois isn't Responding

ILSA learns how quickly Lois responds to events

ML5 – Just in Time

ILSA learns how long it takes Lois to move around the house

ML6 – Normal Bedtime

ILSA uses patterns of activity to figure out when normal bedtime is.

ML7 – Reminder for Glucose

ILSA learns how much flexibility is appropriate on “scheduled” activities like taking medication and glucose readings.

ML 8 – Configuring the Glucose Monitor

ILSA learns over time what glucose readings are normal, and can automatically calculate whether alarms are appropriate by comparing it to normal (trends or sudden changes)

ML9 – Long term trends

All long term trends (and deviations from trends) are ML. The paragraph following has a bunch of examples.