Honeywell’s LifeCare Research Directions

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Outline

- Currently Available Products
- Research Activities
Honeywell HomMed

- Telemonitoring systems for healthcare
- Over 22,000 systems currently in use; over 300,000 patients monitored—more than all other providers of home telemonitoring combined
- Customers include managed care organizations, disease management organizations, hospital specialty clinics, home healthcare agencies, senior and assisted living facilities
  - ROI within 6 months typically
- 40-67% reduction in hospitalizations and 40-65% decrease in ER visits for patients with CHF, diabetes, COPD, CAD
  - HomMed monitored patients versus matched nonmonitored cohort
- Other benefits: patients can live in their homes, clinical personnel can make in-home visits only when required, greater nursing efficiencies
Telemonitoring Unit and Parameters

- Five key parameters monitored
  - blood pressure
  - heart rate
  - weight
  - oxygen saturation
  - temperature

- Additional medical peripheral devices can be added
  - glucose meter
  - pocket size ECG device
  - spirometer
  - peak flow meter/FEV1
  - PT/INR device

- Plus yes/no questions
  - “Are you feeling any dizziness?”

- 3-5 mins, once or twice a day

- The Honeywell HomMed Health Monitoring System has two main components.
  - telemonitoring unit: in home or clinical environment; collects and transmits health status information
  - central station: receives data and presents it to clinical personnel for monitoring and tracking
  - both FDA Class II medical devices (hospital grade)
Clinical Oversight

• Nationwide network of selected home healthcare agencies and skilled clinicians
  - covers 95% of the US population
  - agencies undergo extensive training

• Several reports and applications available at central station

• Capabilities to track and trend data, record and view nursing / physician notes, generate printed or faxed reports, etc.
“Health and Wellness Kiosk”

- Targeted to corporations, health clubs, senior living communities, etc.
- Allows multiple users to securely monitor their health in less than three minutes.
- HIPAA compliant. Information sent securely over telephone lines. No user identifiers attached to data.
- Local healthcare agency reviews the healthcare data and communicates any changes to pre-set levels to the individual and their physician.
Medication Compliance

Provide Reminders & dose instructions
No handling of pills – uses bottles from the pharmacy
Prompts for the correct bottle, warns when wrong bottle accessed
Tracks expected pill count based on bottle accesses & dose
Reports once per day
Research Activities
(Big) Remaining Technical Hurdles

• Sensing
  - Passive, easy to install, accurate

• Coordination of sensing & response

• Multiple users with differing needs and goals
  - Elder client, family members, Formal Caregivers

• Ongoing configuration
  - Configuration parameters can be expected to change over time both for the client and the home
    • user entered changes
    • dynamic adaptations based on living patterns

• User Acceptance
  - Privacy
  - Usability
  - Reliability
Sensing Devices

- Easy Installation, Portability & Reliability
- Usability
- Remote configuration & control, e.g. update algs, turn off stove

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Emerging Sensing Technologies

- **Nanotechnology**
  - Nanotech describes the smallest bits of matter than humans can fashion into a device. Nano-devices are measured and studied on the same scale as single atoms a human hair is 50,000 nanometers in diameter
  - biosensors, drug delivery, molecular motors, revolutionary electronic systems

- **MEMS**
  - Micromechanical devices filters on a chip, engines, robots, measured in microns (1000 nanometers)
  - Handheld micro bolometer

- **Video processing**
  - Reliable and cost-effective facial recognition
  - Diagnostics

- **Sensing advancements**
  - Smart sensors (embedded intelligence – fall sensor)
Medication Compliance

- **Design new caddy**: leverage I.L.S.A. findings, address limitations of MedPartner

- **Thinking about doing a controlled field study of (existing) products**

**MedPartner Limitations:**
- Large footprint
- Designed for home-bound population – not portable
- Requires home nurse to set up reminders (only provided through an HHA)

**ILSA med caddy**: Flexible, Portable
Well liked by seniors, but finer-grained info would be appreciated by caregivers

**Formal CG interviews suggest Pareto's 80-20 rule applies:**

- 4% of elders need complex sensing
- 16% of elders need verification that they touched the device
- 80% of elders need only reminders
Medication Compliance

- Improved devices and techniques for self-management
- ACLAR™ film from Honeywell Specialty Materials
  - New modes of delivery
  - Superior protection for humidity sensitive medication
  - Supporting new concepts in compliance packaging
• **Honeywell Ademco working with Meredeth Rowe (UFL)**

• **Goal:** Prevent unintended exits of persons with cognitive impairment (e.g., Alzheimer’s patients and children with autism)

• **To improve caregiver QoL:** wakes the caregiver when patient wanders

Photos used with permission of Meredeth Rowe
More info: http://nursing.ufl.edu/dementia/resources.html
Activity Sensing

- **Goal:** Employ a variety of sensors for detecting action, motion, or physical presence to recognize normal activities and identify potential symptoms of decline.
  - Traditional security sensors (motion, door switches)
  - Pressure pads
  - Weight detectors
  - Water flow, heat, other home safety
  - Practical only for those living alone

**Current Shortcomings:**
- Accurate configuration to individual living patterns is problematic. Makes systems expensive to deploy.
- Need many sensors and other types of evidence to confirm what motion sensor data really means
- Difficult to filter out evidence associated with visitors vs. the occupant
- Simple reliable means of tracking individuals
Method 1: Coarse Location

- The Beacon’s transmission is heard at some or all of the beacon receivers
- All signal strengths are reported to a central location
- The Location is determined as in vicinity of the Beacon receiver with strongest signal strength
Method 2 : Multilateration

- Motivation: How can we use the signal strength measurements at all points.
- Can we get a “rough” estimate of distance from signal strength?

![Signal Strength Vs Distance](image)

\[ y = -84.172 \ln(x) + 859.96 \]

\[ R^2 = 0.7953 \]

\[ S_{Rx} = \frac{g \times S_{Tx}}{d^\alpha} \]

- Sensing
- Medication
- Up at Night
- Activity
- Location
- Medical Records
- CAST
- Usability
- Trust
- Socialization
- Demonstrations

Note: Fit Equation Compatible with:
Results (Honeywell House - Garage)

Sensing
Medication
Up at Night
Activity
Location
Medical Records
CAST
Usability
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Socialization
Demonstrations
Results (Bedroom 1 – Honeywell House)

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Split level House – Bedrooms are in upper level, office lower level, living main level
Summary and Path Forward

- Tests conducted using Honeywell’s Ademco Security products.
  - Key fob moved to different places to record the signal strength from different locations.

- Simple signal strength comparison (method 1) works well for coarse location
  - Incorporating PIRs

- Multilateration seems to be promising for more accurate location.
  - Accuracy within 4 to 5 feet
  - Ademco has a good signal strength vs distance map
  - Installations issues with this method
Medical Records: CAST participation

CAST Upcoming Events we plan to participate in:
• White House Conference on Aging Exhibit Dec 11-14
• CAST/NIST Symposium February 14, 2006

Business Economics Task Group
• Economic impact model for telehealth technology on CHF treatment costs
  - Completed lit review on this topic/reviewed CMS data on sources of costs
  - Working with a technical writer to document our findings as a white paper.
• Expanding technology impact analysis to consider additional technologies (like med management)
• Will be featured on a poster presentation at the WHCOA
• Currently conducting diabetes lit review and econ impact analysis which also will come out as a CAST white paper;
• Currently conducting COPD – econ impact lit review

EHWR Task Group
• AHIMA HIT Summit kick-off event for this team
• Hiring IT consultant to further CAST consortium interests in HIT standards (HL7 top priority) CAST
Model of Technology Use

Sensing
Medication
Up at Night
Activity
Location
Medical Records
CAST
Walker?
Usability
Trust
Socialization
Demonstrations

Automation

Manual Performance

Checking Automation

Decreased Efficiency

Interpretation Of Outcome

Ability to Interpret Stochastic Information

Primary Task
Secondary Task

Primary Task
Tertiary Task
Secondary Task

Decision Making

Trust Perceived Workload
Perceived Risk
Self-Confidence
Perceived Reliability

Yes

No

Automation Event

Acquiring Data from Automation

Is the Automation Correct?

Attention
Working Memory
Trust

- People need to be able to determine whether technology is helpful.
  - Older adults are less able to keep a mental record of outcomes
  - Older people may miss relevant cues that tell them that the technology is not behaving correctly.
- As technology improves and reliability improves, there is a danger that older adults will rely too much on technology.
- As user interfaces become more human-like, there is a danger that older adults will also place too much trust on technology.
- Currently, we are far from this goal, but as our technologies improve, we need to be mindful of other problems that need to be addressed concerning older clients.
Socialization

- How do we find out what is engaging and fun to elders?
- Discover what activities seniors who are still independent like to do (gardening, knitting, golfing, fishing, games….)
- Find or invent virtual analogues for these activities that scale to the mental and physical limitations of older, more frail seniors.
- Discover and characterize their current social circle and how they can maintain social contact through technology.

Interview ➔ Prototype ➔ Focus group or test ➔ Refine Concepts
Group Interviews With Seniors

• Strong recurring themes (topics that raised the decibel level in the group discussion)

- **Volunteer activities** (organizing and doing) are a major source of social interaction and occupy a great amount of their time. Seniors also believe that these are among the first activities they would have to stop if they became homebound.

- **Sharing personal perspectives** on history is a way they connect with their peers and with younger generations.

- **Games and puzzles** are great if they provide the opportunity to interact with other people (by means of organizing the game or playing the game)
Socialization technical challenges

- Do our analogue forms of interaction really capture the essence of social interaction? What’s good? What’s missing? Does audio help? Does video help?

- Need to replicate some of the dynamics of social interactions in much the same way as happens spontaneously in real life.
  - e.g. Provide users the ability to turn down invitations to join an activity or event, contingent on who else is invited; automatic matching with people of similar interests; provide capability to initiate and organize activities with others.

- User interfaces need to be adaptable to the changing psychomotor and cognitive abilities of aging people
  - UI’s need to be simple
  - Games need to be “decelerated”

- Auditory interface may be necessary

- Screen size is issue for some applications

- Security for vulnerable participants
The Virtual Community Center

December 16th, 2005

St. Andrew’s community center

- The daily jigsaw
- Play bingo
- Organize A game
- Send a greeting
- Share a story
- Go home

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On this day in 1951
President Truman signed a treaty that ended
The Korean War.

Where were you at the time?
Speak into the microphone and
tell your story
The daily Jigsaw

December 16th, 2004

Here is what Mabel did today

Puzzles can be solved jointly
Increased Connectivity (CAST demo 2004)

Connecting the Support Network

• Simplified internet-enabled communication for the elderly
• Concise reports for concerned family members
• Direct connect to primary professional caregivers
• 24x7 remote monitoring

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ELDER CLIENT AT HOME

CAREGIVERS ON-THE-GO

CAREGIVERS’ HOME OR OFFICE

Safety Status
Medication Compliance
Messaging to/from Elder

Day and Time Orientation
Appointment Reminders
Two-Way Communication
Activity Prompts
Feedback

Activity Details
Trends and Reports
Medication Compliance
Configuration Options

CENTRAL MONITORING

Increased Connectivity (CAST demo 2004)
• We will have a demonstration at the White House Conference on Aging, December 2005 in Washington
  - HomMed biometrics products
  - Meredith Rowe’s “Up at Night” concepts
  - Socialization concepts
  - Localization concepts
Conclusion

• Need better sensing technologies
  - Passive, reliable, accurate
• Need better inference technologies
  - Situation assessment, behavior modelling
• Need better interface technologies
  - Engaging interfaces & Socialization
• Need to solve the installation & configuration issue
  - Cheap, fast, accurate. Can a nurse do it in an hour?
  - Ongoing changes.
• Need good clinical studies to determine cost savings & quality of life improvements
• Need to figure out how to market & sell the ideas
  - Privacy
  - Who will pay?
  - Who will service?
  - Where are the incentives now, what will change them in the future?
Honeywell

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