ICADI Planning Workshop

26-27 June 2003

Royal Academy of Engineering

London

Notes from Michael W. Vannier

ICADI Tracks

1. Low Technology Assistive Devices
2. High Technology Assistive Devices & Environments
3. Consumer Perspective
4. Home Modification and Universal Design
5. Injury Prevention
6. Business Perspective
7. Transportation
8. Telehealth

Meetings

* London – June 2003

* Washington – ICADI

* Tokyo – January 2004

* Publication – State of the Science in Smart Technologies to Assist Elders (June 2004)

The Need

Health and Healthcare Challenges

Economic Reality

? **More than 14% of U.S. GDP is devoted to health care.**

? **Ratio of wage earners to seniors**
- **4/1 (now)**
- **2/1 (~2025)**

? **Average cost of assistive care**
? **$60,000 / year / senior adult**
? **Seniors visit the doctor 6 x more**
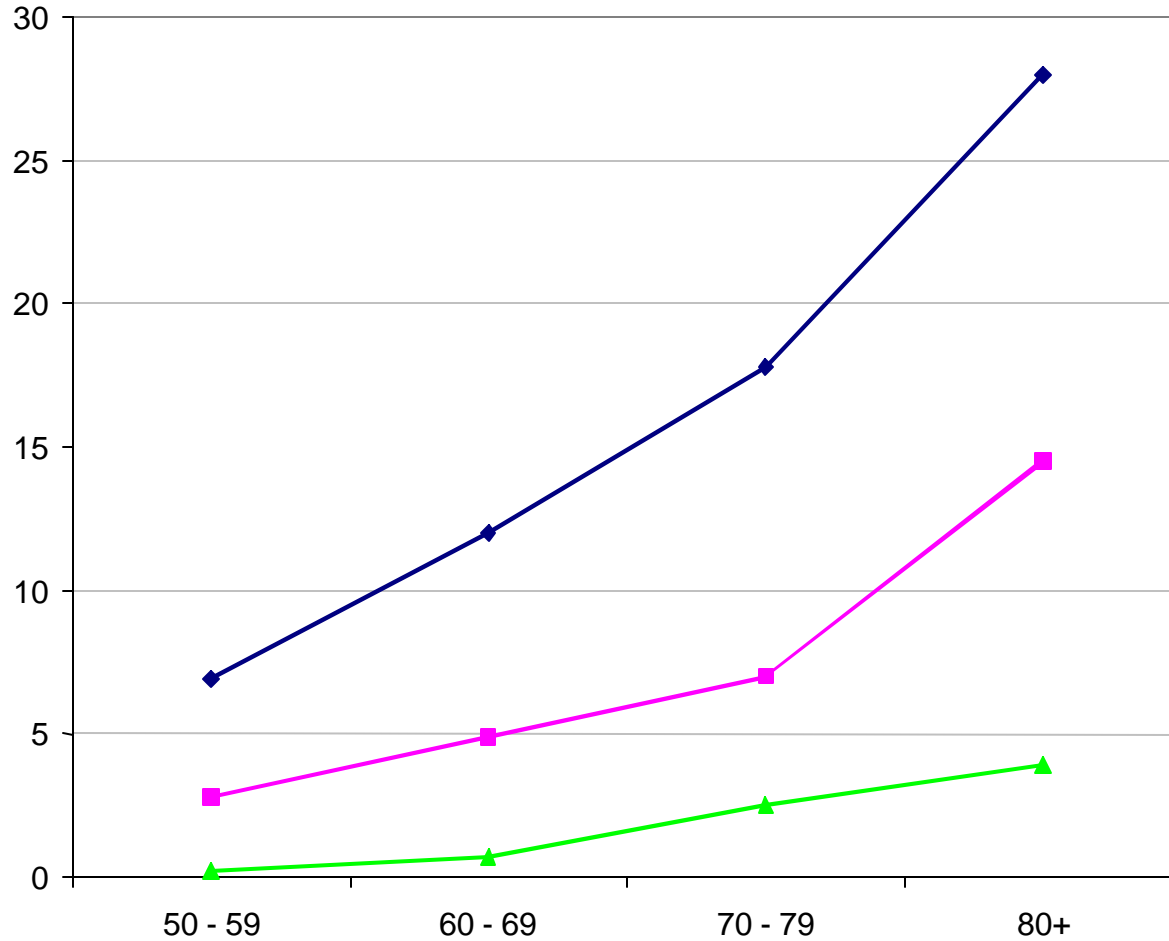? **often than younger people**

Demographic Trends

? **The ratio of caregivers for at -home disabled will decrease from more than 20:1 down to less than 6:1 in 2030.**

The European 'care gap'

Percentage of EU 50 population (2001)

... expressing a need for care

... actually receiving care

... thereof cared by professional service

Source: SeniorWatch, 2002

EYPD – European Year of People with Disabilities

* Rights to protection from discriminiation

* Awareness

* Improve communication and image

* EYPD2003.org website

ICADI Meeting will be held on 4-6 December 2003 – Arlington, VA

* **www.asa.org/icadi** website

Hosts & Sponsors

* Host: University of Florida; many others
* American Society on Aging

* ICADI supported by
  * European Commission
  * US NIDDR, VA, CDC, NSF, AARP
  * And 40 others

[RERC – University of Florida]

ICADI Meeting Objectives

* Prepare a comprehensive account of state-of-the-art Assistive Technology R&D and Smart Home R&D in the U.S. and in Europe
  * Special issue of the IEEE Computer magazine
* Identify strategies for future research and development
* Prepare for Technical Program of the ICADI High Technology Track
  * Workshop outcomes will be integrated in the HTT track

Focus Areas

* Computing
* Sensors
* Service
* Design
* Smart appliances
* Interfaces
* Databases
* Tracking
* Robotics

Issues for Discussion

* Technology employed (infrastructure needs)
* Technology evaluation (user perspective; user acceptance; cost)
* Deployment status (prototype development; field evaluation serial production)
* Barriers and technology limitations
* R&D needs to overcome current barriers
* Public policy considerations (privacy issues; business models)

Differences

- Between technologies
- Between countries
  - Differing demographics; cultures; economics; social services and care
- Broad perspective; international

UK Department of Health

- **Calls for applications**
  - Co-funded by industry
  - Social care; user orientation
  - Health technology devices committee (with consumer advocate member)

EPSRC – Engineering and Physical Sciences Research Council

* Medical Engineering and Health
* Funding for Ageing and Disability research
* 7 UK research funding councils in DTI
* £ 498 77% spent on research and training
* 537 grants in healthcare – 2nd greatest category is ageing; (#1 is cancer) – 38 grants in ageing
  * Healthcare panel – multidisciplinary

EQUAL – Extending Quality of Life program

- Address needs of ageing and disabled population
  - Multidisciplinary teams
  - Collaboration
    - Include industry, intermediaties, charities, …
  - Involve older and disabled people directly whenever possible

EQUAL areas

* Transport / mobility
* Accessible environments
* Inclusive design
* Assistive technology
* Smart homes
* Rehabilitation engineering

EQUAL funding

* 34 projects – £5.4M in first call
* £30K to £300K
* www.equal.ac.uk - launched Nov 2001
* 4 calls for additions to portfolio

Common themes

* Independence

* Support mechanisms
  * Visiting fellowship
  * Overseas travel grants
  * Bilateral research workshops
  * Postdoctoral mobility (inter-disciplines)
  * Partnerships for Public Awareness (PPA)

Gil Devey, NSF

- **NSF Vision and Mission**
  - Discovery, learning and innovation

- **Strategic goals**
  - People
  - Ideas
  - Tools

NSF areas of support

* Information technology research - $145M
* Nanoscale science and engineering
* Sensors and sensor systems
* SBIR
* Program for persons with disabilities
* Human-computer interaction; universal access
* Undergraduate design projects (for persons with disabilities)

NSF ITR projects

* The Aware Home – Sustaining the Quality of Life for an aging population (Ga Tech)

* MavHome – An intelligent environment home (intelligent agent)

* A distributed programming infrastructure for integrating smart sensors (Ga Tech)

* Converging Technologies for Human Performance, NSF/DOC June 2002.

Interagency Committee on Disability Research

* www.icdr.us - US Govt interagency
* " to promote coordination and cooperation among Federal departments and agencies conducting rehabilitation research programs."
* Annual report is forthcoming; imminent

* Workshop - cell phone interference with hearing aids
* Website for all US funded disability research projects
* Report: US Assistive Technology Industry

Questions

* Effect on public policy

* Research project results are "left on the shelf"

* Interconnection – public policy for implementation of "smart home", for example

* Review criteria – broader impact

The death of competence

- Edinburgh's enfant terribile
- New technology may require changes to the "system"
- Not clear how to connect benefits with costs; overcome inertia
- Effectiveness and efficiency
- Hospital stay vs. smart home costs
  - There may be a tradeoff, but unclear any savings are real.

Aunt Millie

98th Birthday in 2003

Ga Tech – Aware Home

- How can your house help if it is "aware"
- How to construct such a house?

- Approach
  - Technology
  - Applications
  - Construction
  - Socio-legal, ethical

Smart structures, materials

* Sick building

* Radon daughters

* Most health problems are due to lifestyle; reflected in behaviors; risk factors

* Most health information on the internet is of doubtful value

Problem statement

* Healthy aging
* Rehabilitative assistance
* Preoccupied with interventions
* Good intentions, but not very specific about needs
* Few numbers; graphs of indicators
  * Not like economics, epidemiology
  * Epidemiology of healthy aging?
  * Screening studies of frail elderly
    * When stop screening mammography?
  * Piecemeal strategy; fragmented approach
    * Not like cancer (count the dead)

Assisted living

* How can independent adults live alone as they age?
    * Digital family portrait
    * Sense, measure, monitor?

    * Need for interaction with others
    * Meals?
    * Smart floors
    * Webs of cameras to track motion; ceiling sensors
    * Room mapping
    * Gesture pendant – simplified home control
    * Eye tracking

Recognize what a person is doing

* Recognize complex interactions
* Relate human motion and object context
* Extend appearance-based representations

* Potential for abuse; loss of privacy, intrusive machines
* Behavior analysis – blackjack game
* Example – What was I cooking?
  * ADL = activities of daily living

2001 – A Space Odyssey

- ☀ The Cook's Collage

- ☀ Medical aids
  - ✳ Glucose meter
  - ✳ KISS

Millennium Homes

* A Foresight/Link project by a consortium of (Brunel Univ, British Telecom, Huntleigh Healthcare Ltd, Beaver Housing Assn, Plextek Ltd, Special Security Products)
* Metastatble people
  * No condition requiring constant nursing
  * Ability to manage the activities of normal life within the community with only minimal support
  * Possibly some deficiency in short term memory
  * Inability always to respond to challenges pose by domestic conditions

Goal

* Allow "metastable" people to be able to remain in their own homes for longer

* In appropriate circumstances to allow the community to operate the system

* To make it possible to fit the required technology in any home in one day

Floorplan for Millennium Home

* Typical arrangement of occupation, PIR and switch sensors, telephones and speakers, in a one bedroom flat
* Huntleigh Research Institute

Big difference

* The system is interactive and able to negotiate with the occupant, using speech, screens or other means to issue warnings and to accept responses from the occupant. These will acknowledge a warning, or modify the action taken by the system.

* Failure to remove the hazard after a warning, such as locking the back door, …

Sensors

- Real
  - Location, activity, state of doors, windows, domestic appliances, time, special actions, like taking of medication

- Virtual
  - Any combination of the state of any of the above, taken in conjunction with what has happened previously

Flexibility

* The system is not designed merely to detect a few pre-determined conditions, but is adaptable and extensible.

* Embedded computer

* Many similarities to automotive computers
    * That manage fuel system, emissions control, multiobjective optimization, monitors, safety, accidents, …
    * And this is done with compliance to standards, modular components, real time software OS

Incentives

* Honor; money; discounts; access to training; access to exclusive facilities
* Entitlement to care or pension in the future for the supporters or their family

UFL – RERC - NIDRR

- ☀ Sumi Helal, Ph.D.

Kent Larson – MIT Media Lab

- Proactive Health
  - Social performance: community, household, body
  - Focus on behavior
- Research at MIT
  - Switch/bend sensors
  - Wearable sensors
  - Multi-purpose sensors
- Simple messages
  - Right time; right place; non-disruptive
  - Translates to "big gains"
  - Will behavior change persist?
- Swappable sensors (store 2 weeks of data)

Monitors

* Shower, drawers, jars, etc.
* Fixed interval queries – PDA experience sampling
* MIT Changing Places Consortium
* Image-based experience sampling
* Heart rate / accelerometer-based context aware experience sampling
* Patterns of movement; comprehensive timelines

Activity link (product)

* Gadgets for "peace of mind" to monitor elderly parent
* Looks like the home monitor; ankle monitor for prisoner
* MIT PlaceLab – technology development is the "easy part"
* How can we develop effective strategies that people will accept into their lives
* Shared research facilities – study life in the home for real people
  * Test infrastructure
  * Test with people

Watch the Osbornes on MTV !

* Reality TV
* PlaceLab is in a new condo bldg in Cambridge, MA
* Modular interior cabinetry with embedded technologies
* No walls; cabinets have sensors
* Service chassis links to cabinets and sensors
* Will be finished in October 2003
* Tools for identify and location of people, their activities, physiological and psychological states

Wireless and IR sensors; environmental sensors

* Communicating with directed audio – speakers and microphones
* Addressable LED 24 bit lighting
* Sensor networks in prefab cabinets
* Pixels everywhere to deliver messages
* PlaceLab attributes:
  * Common infrastructure
  * Smart occupants (not smart homes)
  * AI problems of a "smart home" are insurmountable
  * Volunteer subjects will live here for 1-2 wks
  * Context of life
  * Agile

Possibilities

* Techniques to encourage healthy behaviors

* Kll@mit.edu

What are the most important needs?

- Heinz Wolff – Must have a strong business case to succeed and overcome financial constraints.
- Compare alternative medicine to conventional medicine
- Government isn't the only customer
- Where does the technology need to go?
  - Call a moratorium on tech devt and focus on applications

Are there enough technologies already?

* NSF doesn't want to develop products
* Where is the science in developed technologies? Doesn't appeal to NSF

GE Global Research

* Expanding – 2100 employees worldwide (750+ PhDs)

* Chemistry / mechanical / physics / electrical / computer science / other

GE Businesses

* A diversified technology, manufacturing and services company with a commitment to achieving world leadership in each of its key businesses
    * Aircraft engines, commercial finance, consumer finance, consumer products, equipment management, industrial systems, insurance, medical systems, plastics, power systems, specialty materials, transportation systems, NBC
* GE sells long term care insurance
* There have been many telemedicine disasters, with deployment of systems before it is ready

Feasibility analysis

* Need to show that smart home technology is useful

* GE RM&D leveraging total GE diagnostics technology experience and over $100M of investments to date

    * Sensors for power systems, aircraft, medical systems, industrial systems

GE Interlogix

- Security and Life Safety
  - Magnetometer, transmitter and battery in compact package
  - Security; access control; CCTV, fire detection, residential and commercial

Security & Caregard

* Security system; wireless; cell modems
* Home monitoring systems
* Concern for reliability of cell networks
* Seek to create a new service market (business model) for home health care

Home monitoring by WWW

* North East Health – uses systems to monitor elderly at home over WWW
* Significant field testing – 20 homes serve as test systems

Home Assurance

- Remote monitoring caregiver
  - Motion, doors, kitchen
  - Web interface
- Interlogix wireless security
  - Wireless sensors and communications
  - Cost-effective
  - Easy to install
  - Tested and accepted

What is the price point for this type of technology?

* Liability concerns by MD's who receive monitoring data
* AD Caregiver Study
    * 20 early Alzheimer's or dementia
    * Living alone in their homes
    * Informal caregivers
    * Caregiver satisfaction & geriatric depression
    * Currently enrolling and installing

Current Users

* Caregivers of elderly who live along
* Model: paid by their children
* Other research areas –
  * Detecting behaviors and trends
  * Cost-effective multi-person monitoring
  * Higher granularity activity monitoring
  * Effective medication compliance
  * Kitchen accident prevention