Internet and Pervasive Technologies for Successful Aging

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Aging

The gradual changes in the structure and function of humans and animals that occur with the passage of time, and that eventually lead to the increased probability of death as the person or animal grows older.
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Age Related Diseases

Those diseases that appear late in life, such as Alzheimer’s, osteo-arthritis, stroke, diabetes, cardiovascular disease, Parkinsons Disease.
Model for Viewing R & D and Clinical Interventions

- Pathophysiology—Diseases/Trauma—Cellular Level
  - Impairment—Organ Level
  - Functional Limitation—Action Level (moving, seeing, hearing)
  - Disability—Task-Role Level
  - Societal Limitations—Barriers resultant from attitudes and policy
Why support research and development in technology and aging?
Population 85+ 1910 to 2050 (in millions)
Percent of Population by Age Group Who Need Assistance with ADLs

Age Group: 15-64, 65-69, 70-74, 75-79, 80-84, 85+

Percentages:
- 15-64: 2.4%
- 65-69: 9.2%
- 70-74: 11%
- 75-79: 19.5%
- 80-84: 31.2%
- 85+: 49.5%
Number of Men per 100 Women by Age Group

- 65-69: 82.3
- 70-74: 76.3
- 75-79: 67.4
- 80-84: 55.4
- 85-89: 43.7
- 90-94: 33.5
- 95+: 26.5
Projected Increase in Number of People 65+ living Alone: 1990 - 2220

- **1990**: 9.0 million
- **2005**: 10.9 million
- **2220**: 15.2 million
Aging Population is a world concern

Figure 2-3.
The World's 25 Oldest Countries: 2000
(Percent of population 65 years and over)

<table>
<thead>
<tr>
<th>Country</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Italy</td>
<td>18.1</td>
</tr>
<tr>
<td>Greece</td>
<td>17.3</td>
</tr>
<tr>
<td>Sweden</td>
<td>17.3</td>
</tr>
<tr>
<td>Japan</td>
<td>17.0</td>
</tr>
<tr>
<td>Spain</td>
<td>16.9</td>
</tr>
<tr>
<td>Belgium</td>
<td>16.8</td>
</tr>
<tr>
<td>Bulgaria</td>
<td>16.5</td>
</tr>
<tr>
<td>Germany</td>
<td>16.2</td>
</tr>
<tr>
<td>France</td>
<td>16.0</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>15.7</td>
</tr>
<tr>
<td>Portugal</td>
<td>15.4</td>
</tr>
<tr>
<td>Austria</td>
<td>15.4</td>
</tr>
<tr>
<td>Norway</td>
<td>15.2</td>
</tr>
<tr>
<td>Switzerland</td>
<td>15.1</td>
</tr>
<tr>
<td>Croatia</td>
<td>15.0</td>
</tr>
<tr>
<td>Latvia</td>
<td>15.0</td>
</tr>
<tr>
<td>Finland</td>
<td>14.9</td>
</tr>
<tr>
<td>Denmark</td>
<td>14.9</td>
</tr>
<tr>
<td>Serbia</td>
<td>14.8</td>
</tr>
<tr>
<td>Hungary</td>
<td>14.6</td>
</tr>
<tr>
<td>Estonia</td>
<td>14.5</td>
</tr>
<tr>
<td>Slovenia</td>
<td>14.1</td>
</tr>
<tr>
<td>Luxembourg</td>
<td>14.0</td>
</tr>
<tr>
<td>Ukraine</td>
<td>13.9</td>
</tr>
<tr>
<td>Czech Republic</td>
<td>13.9</td>
</tr>
</tbody>
</table>

Source: U.S. Census Bureau, 2000a.
Addressing Functional Limitations of Aging Population

Applying Technology

“Low” and “high”
Examples of “Low Technology”
- Assitive Devices

Cognitive Device

Hearing Device
Powered Window Opener

Button hook / Zipper Pull
Can you support elders with technology?
A Randomized Controlled Trial of Assistive Technology / Home Modification Service Delivery
Mean Percent Decline on Measures of Functional Status by Group In Standard Scores

At 18 Months Post Initial Intervention
<table>
<thead>
<tr>
<th>Treatment</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>$2620</td>
<td>$443</td>
</tr>
</tbody>
</table>

**Mean Intervention Cost/ Participant over 18 Months**
Mean Total Institutional Cost/ Participant for 18 Months

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>$5,630</td>
<td>$21,847</td>
</tr>
</tbody>
</table>

Mann, W.C., Ottenbacher, K.J., Fraas, L., Tomita, M., & Granger, C.V. (1999) *Effectiveness of Assistive Technology and Environmental Interventions in Maintaining Independence and Reducing Home Care Costs for the Frail Elderly: A Randomized Trial; Archives of Family Medicine*; May/June, 8(3):210-217
With Advances in Technology –
Can we do even better?
Technology – Advances:

Wheelchairs
1300 B.C.

- Oldest evidence of a wheeled chair – spoked wheels on chairs.
1595

- King of Spain had his own rolling chair with foot rest.
1655

- Self-propelled chair built by a watchmaker with paraplegia.
1933

- First folding wheelchair, manufactured with metal.
Today

- “High Tech,” light-weight materials
- Improved design
- Wheelchairs used for sports
Advances

- Power Assisted Wheelchairs
- Stair climbing wheelchairs
- Smart Wheelchairs with Internet connections, wireless local connectivity and adaptive user interfaces
Why support research and development in this area?

Hearing Aids
Early 1700’s

An ear trumpet. Similar devices were used for thousands of years.
1850’s

Acoustic table urn.
Meant to capture sound from any angle in the room.
1930’s

First electrical hearing aid.
1930’s

Wearable multiple part hearing aid.
1940’s

Vacuum tube model.
1953

Oticon Pocket model.
1957

Ear aid that could hang over the ear from the wearer's eyeglasses.
1950’s – 1960’s

Combination of a microphone with a battery and transistor in one unit.
"In-the-Canal," or ITC, aids - fill the ear canal without anything worn outside the ear.”
1980’s

This unit could be concealed completely in the ear canal.
1990’s

Hearing aids with digital processing
The future

- Web based programming updates for digital hearing aids
- Pervasive computing for better hearing aid performance
- Integration and embedding with mobile phones and other consumer electronics
- Additional forms of hearing devices: mobile digital assistants for real-time speech to text translation
The Telephone
1877

• First commercial telephone used by Alexander Graham Bell, based on his patent of January 1877.

• This telephone consisted of a single transmitter/receiver placed within a rectangular wooden box.

• You spoke into the opening in the box and listened through the same opening.
1882

Early Bell System telephone.
1904
1927

First phone with single handset.
1964

First “touch-tone” phone
1946

First commercial mobile phone
1973 - First cell phone call in USA

• Martin Cooper, an electrical engineer and a former general manager for the systems division at Motorola, is credited with making the first cell phone call, in 1973
The Incredible Shrinking Cell Phone

<table>
<thead>
<tr>
<th>Year</th>
<th>1987</th>
<th>1989</th>
<th>1991</th>
<th>1993</th>
<th>1995</th>
</tr>
</thead>
<tbody>
<tr>
<td>System</td>
<td>Large city system (April 1989) High-capacity system</td>
<td>Digital system (800MHz)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Configuration of mobile station and antenna</td>
<td>802B:500cc 750g</td>
<td>803B:400cc 640g</td>
<td>Mova:150cc 230g</td>
<td>Digital 150cc Mova:240g</td>
<td>Ultra-compact 100cc mobile station:150g</td>
</tr>
</tbody>
</table>

Dumb Terminal               Intelligence               Smart Phone
The Wearable & Pervasive Phone
2000

Smart Phone

Wireless and Internet connectivity
Check locks on doors and windows

Automatically refill prescription

Sense and see visitors/strangers at front door

Turn on/off lights (and visually inspect) other rooms.

Check if laundry is done

Monitor of kitchen: oven and stove on/off; temp.

Order groceries with dietary restrictions

Call in for help and Assistance

Call in a nurse
Current Smart Phones: Are they Designed for older people?

- Back-lit & Contrasting colors
- Larger fonts
- Back-lit Audio-feedback
- Voice Input/Output
- Wider Screen
- Wider Vertical Key Spacing
- Wider Phone Keypad
- Full-day Back Battery
- Code reader (Smart ID, RFID,...)
Telehealth & Smart Homes
Computer-based Monitoring of Self-Care Needs of Physically Frail Elders

Randomized Controlled Trial

A comment from one participant in the intervention group:

I used to wake up in the morning, pray to God to take me, because I was ready. Now I wake up every morning and pray God will give me more time to use this computer. Thank you, thank you, thank you. When I think of all you have done to make my life easier....
VHA - VI SN-8
Community Care
Coordination
Telehealth
Service Sites
Telehomecare Technology

Results

- Improved Compliance
- Reduced resource utilization
- Improved patient education
- Improved functional Status
Hospital Admissions

N=791
The Health Buddy

Hello Mrs. Jones, how are you feeling today?

1. Great
2. Fine
3. Poor
4. Much Worse Today
Smart Homes

- Monitor the elder's health
- Monitor the elder's self-care related needs
- Monitor the house
- Monitor the elder's activities, movement, and behavior in the house
Our University of Florida Smart House Initiative
Snapshots of the Smart House
Early Prototyping
Pervasive Technology for Smart House
Technology for Pervasive Computing

Zylog EZ80

SNAP

Systronix STEP Board

RFID

iButton

Ultrasonic Pilot

Ultrasonic Beacon

iButton

TM1V

RM1V
Wireless Sensors

Fig. 35. First Mini RF Mote.

Fig. 36. weeC Mote.
Applications

• Locating elders & objects (e.g. Car in parking garage, TV remote)
• Home appliances and device control (e.g. switching functions & A/C control)
• Smart Microwave Ovens, Talking Food, etc
• Alerts and alarms (e.g., medicine reminders & postal mail notification)
• Grocery shopping assistant
• Weather Awareness
Applications

- Integrated indoor/outdoor location tracking
- Map maker and navigation
- Security Alerts (doors, windows, water leaks)
- Access Control (lock/unlock doors, windows)
- Next generation Lifeline
- Home Entertainment
- Push to Eat (and other automated services)
- Dictation
- Others…
The SmartWave Project

Diagram:
- SmartWave Project
- Cooking Database
- Internet
- Serial Connection
- PIC16F628
- TINI Microcontroller
- Keypad Interface
- Microwave Oven
- RFID Reader
Gator-Tech Smart House
June, 2004
Technology and Aging

The Importance of People

Formal Service Providers

Family – Informal Providers
International Conference on Aging, Disability, and Independence

January 2006
Florida USA

www.asa.org/icadi
THE END

http://www.rerc.ufl.edu/