International Support of a Common Awareness and Knowledge Platform for Studying and Enabling Independent Living

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The EU Context for Roadmapping

- **AALIANCE** is providing a framework for stakeholders, led by industry, to define research and development priorities, timeframes and action plans on strategically important issues in the field of ambient assisted living (AAL).
- **CAPSIL** is developing a roadmap and Wiki for EU research to achieve effective and sustainable solutions to independent living based on an in-depth analysis of clinical requirements and the ICT scenarios developed or under development in the EU, as well as the US and Japan.
- **SENIOR** is providing a systematic assessment of the social, ethical and privacy issues involved in ICT and Ageing, in order to plan strategies for governing technology trends according to EU legal and ethical standards.
- **ePAL** is developing a strategic research roadmap focused on inducing new ways towards a balanced active life for retiring and retired professionals while promoting a new notion of the silver economy with a wide societal impact.
The Talk

- CAPSIL and Its Goals
- Coordination between the EU, US, and Japan
- The CAPSIL Wiki
- The Development of a Roadmap and The Technology Gaps in the Road
Project Website - www.capsil.org

CAPSIL EU Support Action

CAPSIL is funded within the specific programme "Cooperation" and the research theme "ICT" of the 7th European Framework Programme.

International Support of a Common Awareness and Knowledge Platform for Studying and Enabling Independent Living

The aging of society is the single most important aspect of health care in the 21st century. Many intriguing ICT solutions are being developed within the EU, USA, and Japan for helping older people remain independent longer. However, these solutions tend to be fragmented and heterogeneous. The CAPSIL Coordinating Support Action (CSA) team is a strategic international coalition of University and Industrial partners that already have extensive teams developing hardware/software/knowledge solutions to independent living based on user requirements. All partners of CAPSIL are already members of regional and national centres on aging engaged in the process of helping to establish public policy and national standards. This support action is to launch initiatives, coordinated and disseminated by a series of workshops in the US, EU, and Japan (two per year for two years), with three fundamental goals:

to develop a detailed CAPSIL Roadmap for EU research to achieve effective and sustainable solutions to independent living based on an in-depth analysis of independent living requirements and the ICT scenarios developed or under development in the EU, as well as the US and Japan (societies where the aging of the population are currently on par or exceeding the challenges that will be found within the EU).

to support aging research by proposing procedures to incorporate all of these diverse solutions into WIKI entries (CAPSIL.WIKI). These CAPSIL.wiKs will enable researchers and the ICT industry to get the information they need to quickly and easily text solutions for prolonging independent living within the many and various...
CAPSIL’s three fundamental objectives

Activities -
Website, Workshops
Wiki Input…

To help policy makers in the US, EU, and Japan coordinate research

A Mechanism for Continual Sharing of Information
Wiki

CAPSIL Consolidated Roadmap

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Example Meeting in Washington, D.C.

Engagement with 60 individuals among program officers of US and EU agencies and researchers from the US, EU, and Japan to discuss potential synergisms among EU and US federal agencies and other US Institutions with focus on research on aging and independent living (over 20 distinct funding agencies and institutions)
Example Meeting
Washington DC

1. Delegation of the European Commission in Washington DC,
2. Head of Sector ICT & Ageing, Information Society & Media D-G,
3. Office of Science Policy, National Institutes of Health,
4. International Research Activities and Legislative Officer, National Institute on Aging/National Institutes of Health,
5. Office of Europe and Eurasia, Office of Global Health Affairs,
6. Eunice Kennedy Shriver National Institute of Child Health and Human Development, National Institutes of Health,
7. Agency for Healthcare Research and Quality, Office of the National Coordinator for HIT (ONC),
8. Department of Health and Human Services, Center for Primary Care, Prevention, and Clinical Partnerships,
9. Department of Health and Human Services, Office of the Assistant Secretary for Planning and Evaluation, Office of Disability, Aging, and Long-Term Care Policy,
10. Cerebral Palsy International Research Foundation,
11. Cerebral Palsy International Research Foundation (CPIRF) Scientific Advisory Council,
12. US Department of Veterans Affairs,
13. Center for Aging Services Technologies (CAST),
14. American Telemedicine Association,
15. President of the European Research Council,
16. Office of International Science and Engineering, National Science Foundation,
17. Biomedical Engineering Program, National Science Foundation,
18. Computer and Network Systems Division, Computer and Information Science and Engineering Directorate, National Science Foundation,
19. Integrative, Hybrid and Complex Systems Program, National Science Foundation,
AAL Technologies in the US

- **Safety Technologies**
  - Fall detection
  - Mobility aids
  - Stove use detectors
  - Smoke and temperature alarms
  - Door locks
  - Wander management tools

- **Health / Wellness Technologies**
  - Health coaching, disease management
  - Telemedicine, home monitoring
  - Medication management
  - Cognition
AAL Technologies in the US: Safety Technology Example - Currently Available Monitoring System

- **Quiet Care**

  1. Motion sensors track activities of daily living (ADLS).
  2. Base station calls QuietCare Secure Server every 2 hours.
  3. ADLs analyzed for deviations from normal behavior
  4. Alerts automatically generated and sent to caregivers.

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AAL Technologies in the US: Safety Technology Example – Research System

ORCATECH

Fusion

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AAL Technologies in the US: Serious Gaming
AAL in Japan: Changes from Japanese Health Insurance Reform

Environment
(1) Suppression of Increasing Medical Payment by Government
(2) Change of major type of disease (lifestyle related diseases)
(3) Increase awareness and risk management for companies
(4) Increase health related payment for individuals

Japanese Health related Policies
(1) Adoption of Nursing Care Insurance (2000)
(2) Plans for Prolonging Healthy Life Expectancy
(3) Change of Medical Service Payment System (2003)
(4) Change of Hospital Systems (2002～3)
(5) Medical insurance & nursing care insurance change (2006)
(6) Change of Industrial Safety and Health (2006)

Overall, the Japanese policies are shifting from “cure” to “prevention and control”. However, the government has not provided the services with ICT. Home care agencies focus on terminal care.
AAL in Japan: Business Example  ANZEN Center azbil

Steps

a) Manual or automatic alarm on a pendant or wrist band (emergency false alarm, or to chat)

b) Call the customer to confirm alarm, (or call the customer once a month)

c) Call a relative or neighbor and ask him/her to check on the customer

d) Visit the customer to check his/her condition

e) Report the condition and situation

f) Call for emergency dispatch

Medical emergency center (Fire station or hospital)

Medical care center

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AAL in Japan: Robots for welfare

- **HAL** Tsukuba Univ.
- **MY SPOON** SECOM Co.
- **WAKAMARU** Mitsubishi Co.
- **RI-MAN** Riken
- **PARO** AIST
- **PAPERO** NEC Co.
Differences between the EU, US, and Japan?

- Technological – Very Few
  - Opportunity for coordinated strategies, research and data sharing
  - Opportunity to examine best practices

- Social / Support Networks - Heterogeneous
  - Commonalities exist within certain societal structures
  - Opportunity to look at focused solutions for specific support structures

- Reimbursement – Large Differences in Care Delivery and Economic Cost Distribution
  - Opportunity to examine best practices
Roadmap and Wiki Development Methodology

- Development includes these four steps:
  - Baseline Analysis (Where are we)
  - Visioning (Where do we want to go)
  - Gap analysis (What are we missing)
  - Implementation

- Current CAPSIL consolidated roadmap, 150 pages.
CAPSIL Wiki - Currently

- 230+ main Wiki pages
- 100,000+ words
- 350 pages
Adopting a hierarchical structure to the Wiki

Describe the unique situations that older people encounter.

Describe the preventative measures and interventions that may be taken.

This naturally leads into the use of enabling technologies and research into these technologies as described in the WPs.

Scenarios based on these technologies can then be described.

Common themes can be merged and highlighted.

Leading nicely into the roadmap.

Enabling technologies and issues:
- Body Sensor Networks
- Home and Mobile Monitoring
- Transportation
- Software (Knowledge, Fusion)

Links back to wellbeing and disease and prevention and intervention.

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An Example Structure

Example Wiki Structure:
CAPSIL Wiki (a)

Main Page

This website represents a catalogue of solutions in the form of Wiki entries (CAPSILs) which describe interoperable ICT solutions to clinical requirements for Independent Living that can then be deployed throughout the EU, US, and Japan for verification of the systems and testing of clinical hypothesis of new and proposed research programmes. Each CAPSIL can act as an instructive entry point for a range of interested parties in independent living research, development and deployment.

These CAPSILs will enable clinicians and other care-givers to get the information they need to quickly and easily test solutions for prolonging independent living within the many and various heterogeneous communities throughout the EU, the US, and Japan. The CAPSIL’s will be moderated by an international collection of both ICT and clinical researchers initially composed of members of the CAPSIL team, but eventually expanding well beyond.

Getting started

- Please note that this Wiki does not allow anonymous edits any longer. Please register or log in in order to create new or edit pages.
- Configuration settings list
- MediaWiki FAQ
- Aerons Sandbox
- A useful MediaWiki Cheat Sheet can be found here

CAPSILs
CAPSIL Wiki (b)

CAPSILs

Types of CAPSIL
- Descriptive Capsil
- Linking Capsil

Capsil Workpackages
These CAPSILs relate to project workpackages and as such are Linking Capsils which may be useful entry points by contrast to the many detailed Descriptive Capsils which follow.
- WP2 Body Sensor Networks
- WP3 Home and Mobile Systems
- WP4 Software and Interaction
- WP5 Clinical and Ethnographic Requirements
- WP6 Intervention Systems

Wellbeing & Disease
- Congestive Heart Failure or CHF
- Stroke
- Obesity
- Dementia
- Depression - suggestion NC

Prevention & Intervention
- Falls Prevention
- Stroke Rehab Management
- Weight Management
- Cognitive Training
- Social Connectedness
- Activity Monitoring
- Driving Assistance
- Robotics
- Continence - suggestion NC

Technologies
- Sensors
- Algorithms (Software algorithms and data-mining techniques for sensors in healthcare)
Falls Prevention

Falls is one of the three geriatric giants and is a significant causes of injury in the elderly. Approximately 28-35% of people aged 65+ fall increasing to 32-42% for those over 70 years of age experience a significant falls event. The frequency of falls increases with age and frailty level. Falls have a significant cost associated with the event. These costs can be assigned to two categories: Direct healthcare costs such as in-hospital treatments, medication, utilization of services such as rehabilitation etc. Indirect cost through societal impact e.g. loss of economic productivity by family members who must devote time caring for a faller. The WHO report on Falls reports [1] the average health system cost per single fall injury episode in the 65+ age group was $1040. Among the different costs, hospital inpatient services where the most significant costing accounting for more than 50% of the total overall costs.

The underlying risk factors in falls are varied and in many cases the these factors are inter-related.
The First Gap (and Solution)

- The Knowledge Gap (CAPSILS of knowledge)
  - Where do you get information on who is doing what, where, when, and what are the results?
The Second Gap: What is the Problem?

- **If** everyone:
  - stayed healthy
  - could perform all the activities of daily living
  - stayed employed
  - maintained their social network
    to the level that they always enjoyed until the day they died

- **Then:**
  there is no problem

Healthcare: Extends life – doesn’t save lives
What is the goal?

Quality of Life

COST [ $/Day]

- Staying at Home
- Residential Care
- Acute Care
The Real AAL Roadmap: Curvy, Bumpy, with Potholes (Gaps)
What are the Technological Gaps in the Roadmap?

• Development of Requirements
• Some of the Areas:
  • Body Sensor Networks
  • Home & Mobile Monitoring Systems
  • Software and Interfaces
  • Intervention Systems
Clinical Requirements
• lack of commonality between study reference points, definitions and data sets
• currently mostly population studies not individual studies
• need for personalisation of measures and individualised therapies

Data Quality:
• collection of data in uncontrolled (e.g. home, mobile, office) environments

Cost / Benefit Analysis
• Collection of data on cost savings vs. quality of life
Body Sensor Networks
Research and Development Gaps

Pilots
- More data is needed on home monitoring and pervasive sensing to show clinical benefits.

Power Source
- e.g. Solar, Fuel Cells, Power Scavenging

Biocompatibility
- Studies on long term effects of sensors on human cells tissue is needed

Ultra-low power radio
- To prolong the lifetime of the sensors and enable miniaturisation, an ultra-low power radio is essential for a WBSN.
Body Sensor Networks
Research and Development Gaps

Trust, Security and Policy
• With the very limited resources on the sensors, further research is required to implement the required security policies for patient data

Usability and Practicality
• Continue research on integrating sensors into garments and other everyday objects.

Autonomic Networks
• Self Organizing/healing properties. Increasing reliability through smart routing, distributed inferencing and management methods.

RF Effects
• What are the effects on human exposure to RF fields over long periods (heating etc). No real data here.
Home and Mobile Systems Research and Development Gaps

**Sensing and Data Collection**
- Unobtrusiveness
- Elder involvement
- Adaptability
- Robustness, self-monitoring, self-organizing
- Synchronization
- Location and context assessment

**Clinical Evidence and Benefits**
- Algorithms for early detection and prognosis
- Understanding dynamics of diseases
- Identify target usage models e.g. CHF and Diabetes
- Efficacy, effectiveness and economics

**Data Processing and Inference**
- Privacy and security
- Standardization
- Inference algorithms and Sensor fusion
- Detection and recognition of ADLs, IADLs, and unusual events

**Integration to Workflow and Usability**
- Scalability
- Data representation, summarization and visualization
- Human Factors Considerations – Stakeholder needs and usability
- Integration with medical and clinical data (PHR and EMR)
Home and Mobile Systems
Research and Development Gaps

System Design

- Scalability
- Usability for elders and caregivers
- Access: high speed broadband
- Reliability and network performance

Engineering Research

- Unsupervised calibration and maintenance
- Integration and synchronization
- Individual identification, localization

Data Fusion Techniques

- Information fusion algorithms and statistical estimation techniques
- Statistical pattern recognition, including activities of daily living
- Early detection of slow, subtle changes
- Environmental and contextual adaptation

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Software and Interfaces
Research and Development Gaps

**Networking**
- Access to Broadband
- High-Speed 'intelligent' networks
- Context awareness e.g. Use of 'push-based' P2P
- Research into ubiquitous/pervasive computing
- Research into outdoor/mobile systems

**Data:**
**Reduction/Retrieval/Mining**
- Round-trip clinical validation of data inference
- Advanced data mining in the face of interpretation of privacy/security/national data constraints
- Standardised data production, consumption and provenance

**Interfaces**
- Alternative User Interfaces e.g. Haptic, Tangible, Ambient, Surface
- Customisation/Personalisation

**Interoperability**
- Need for International standard for FDA/CE type compliance
- Standardised service platforms
Mortality and Diseases

The World Health Organization has identified risk factors associated with the main causes of mortality in the World and set goals to address such factors with the goal of improving life expectancy and quality of life.
Intervention Systems
Research and Development Gaps

Interoperability and Standards
• No appropriate end-to-end standard
• No defined connectivity between applicable standards
• Data connectivity between the home and EHR/PHR required
• Workflow to manage multidisciplinary teams

Coordinated interventions to address multiple health issues
• Need for systems that deliver a multifocal coordinated interventions
• Need clinically valid protocols for combining and coordinating care for multiple conditions

Privacy and Security
• Common security model that is configurable for access
• Show value proposition of sacrificing some degree of privacy (education)
• Generate trust with users
• New intervention protocols for ensuring privacy and security

Usability
• Improved ease of use
• Adaptive interfaces (cognitive, vision, hearing)
• More sophisticated user models for elderly users (archetypal reference personae)
• Tailored views/interfaces for clinicians, caregivers, family, elders
### Intervention Systems

#### Research and Development Gaps

<table>
<thead>
<tr>
<th>Quality of life</th>
<th>Acceptance/Safety</th>
<th>Clinical Benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>• need to focus on QOL and physical functionality, cognitive performance and mood</td>
<td>• improved reliability of robots</td>
<td>• more large scale pilots needed</td>
</tr>
<tr>
<td>• address depression before trying to change health behaviours</td>
<td>• quality assurance, fault tolerance and failure detection and analysis</td>
<td>• identify target usage models</td>
</tr>
<tr>
<td>• more work on developing socialisation interventions: research into robot/human interactions/companions, socialisation feedback, video interventions</td>
<td>• Standards for assisted driving systems</td>
<td>• improve ease of use</td>
</tr>
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<td></td>
<td></td>
<td>• abstract technical usage detail from non-technical users e.g. clinicians</td>
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</tbody>
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Clinical Benefits:
- More large scale pilots needed
- Identify target usage models
- Improve ease of use
- Abstract technical usage detail from non-technical users e.g. clinicians
Common Themes: Toward Jumping the Gaps in the Roadmap

Common Themes

• Person-centred ergonomic design
• Privacy, security and access
• Evidence based research, large scale deployments
• Focus on QOL and mood
• Development of ontologies, knowledge models and algorithms for data reduction/retrieval/mining
• Inclusion of context awareness including location, emotion, and health
• Business models and the economics of ageing
• Evolution of standards and interoperability and lowering of trans-jurisdictional barriers
• Holistic (across all aspects of ageing), but heterogeneous (specific to regions and cultures) approach
CAPSIL Consortium Members

University College Dublin, Ireland

Harvard Medical School at Spaulding Rehabilitation

Queens University Belfast, UK

University of Genoa, Italy

Oregon Health & Science University, USA

Intel Performing Learning Solutions (Intel Digital Healthcare)

Imperial College of Science, Technology and Medicine, London UK

Waseda University, Tokyo Japan

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