

PROJECT PERIODIC REPORT

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Project acronym: COMPANIONABLE

Project title: Integrated Cognitive Assistive & Domotic Companion Robotic Systems for Ability & Security

Funding Scheme: FP7 Collaborative Project

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Periodic report: 1st 2nd 3rd 4th

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1. PUBLISHABLE SUMMARY

The CompanionAble Project

There are widely acknowledged imperatives for helping the elderly live at home (semi)-independently for as long as possible. Without cognitive stimulation support the elderly dementia and depression sufferers can deteriorate rapidly and the carers ill face a more demanding task. Both groups are increasingly at the risk of social exclusion.

CompanionAble will provide the synergy of Robotics and Ambient Intelligence technologies and their semantic integration to provide for a care-giver's assistive environment. This will support the cognitive stimulation and therapy management of the care-recipient. This is mediated by a robotic companion (mobile facilitation) working collaboratively with a smart home environment (stationary facilitation).

The distinguishing advantages of the CompanionAble Framework Architecture arise from the objective of graceful, scalable and cost-effective integration. Thus CompanionAble addresses the issues of social inclusion and homecare of persons suffering from chronic cognitive disabilities prevalent among the increasing European older population. A participative and inclusive co-design and scenario validation approach will drive the RTD efforts in CompanionAble; involving care recipients and their close carers as well as the wider stakeholders. This is to ensure end-to-end systemic viability, flexibility, modularity and affordability as well as a focus on overall care support governance and integration with quality of experience issues such as dignity-privacy-security preserving responsibilities fully considered.

The collaboration of leading gerontologists, specialist elderly care institutions, industrial and academic RTD Partners, including a strong cognitive robotics and smart-house capability makes for an excellent confluence of expertise for this innovative project.

The Objectives

1. Provide a new AAL solution through the synergetic combination of the strengths of an embodied mobile robotic companion with the advantages of a stationary smart home environment.
2. Semantic – Cooperative integration at sensor level.
3. Semantic-Cooperative integration between the robot and the smart house sensor network environment.
4. Semantic-Cooperative integration of personal therapy management (possibly involving home information spaces such as the home TV screen, healthcare staff, medical professionals, gerontologists).
5. Semantic-Cooperative integration between the home environment (including smart house sensor network plus the robot) and the care system (District nurse/social services/healthcare system) ostensibly mediated by the CompanionAble and including alerts as required.
6. To create a system for health education for the patient and family, providing self-confidence and improving quality of life.
7. To create a system able to help with improvement of contacts between the person and his/her carers and the wider social setting.
8. To create a system with more efficient homecare monitoring by enhanced communication and coordination with professional helpers.



9. Social inclusion and homecare of persons suffering from chronic cognitive disabilities.
10. To achieve the continuous availability of sense-ful close support and cognitive engagement of the elderly.



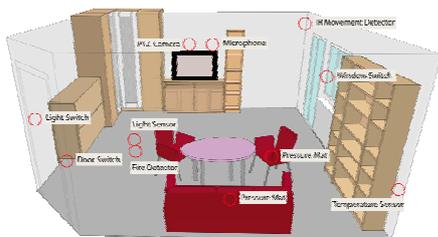
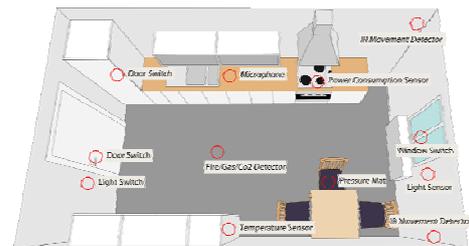
Advantages of the Mobile Robot Companion

- Real interaction Partner – an embodied, anthropomorphic system with natural interface and human-like behaviour.
- Embodiment guarantees visible intimacy and privacy (e.g. by closing the “eyes”).
- Allows a plug-and-play solution (only requires “energy” and internet access).
- Low-cost solution without the need for reconstructing the home environment.
- Allows promising marketing policy: “Rent-a-robot” or “Robots-on-demand” as a personal social assistant.
- Mobility – allows mobile video conference, alarm evaluation, remote control by relatives / social care services.

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Advantages of the Smart Home

- Numerous existing installations with a wide spectrum of functionality (incl. video-conferencing).
- High acceptance rates by the residents.
- 24 h reliability.
- Interoperability with domotics systems already successfully tested.



- Not limited to homes without stairs.
- Allows simultaneous monitoring of all rooms.
- Easy remote access to sensor systems and controllable devices.
- Low maintenance cost.

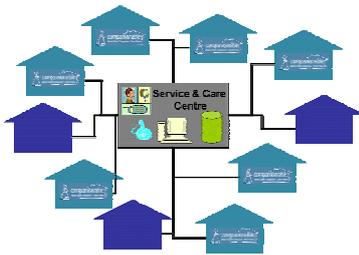
Support for the Elderly

Through the integration of the two sub-systems CompanionAble provides a care environment that supports carers, both family members and therapists, in their daily tasks. This involves

1. Realisation of an intelligent day-time-management.
2. Content generation for cognitive stimulation and training and coherent delivery through multiple channels (stationary and mobile).
3. Reminder function for medication taking and analysis of acquired data regarding the health status of the care-recipient.



4. Efficient and natural social communication and care networking by means of audio-visual communication with relatives or care-givers.



Remote Care Support

By developing the framework for central server support and integration, CompanionAble provides for the integration of Service Centres to ensure user safety and timely response to critical situations. This is supported by the ability to remotely control the robot, either by the service centre staff, therapist, or a family member.

Evaluation of the CompanionAble Solution

The CompanionAble system will find its proving ground through its performance evaluation in various test beds in France, Spain, the Netherlands and Belgium. This will provide the opportunity to demonstrate the graceful integration of Smart Home Facilities and Mobile Robot Companion to enhance the life of the Elderly living at home.

This will ensure that the system is adaptable to the specific needs of the different nationalities and cultures thus ensuring the best social inclusion possible.

Summary of the Achievements of the 1st period

Following the setting up of a strongly supportive and participative management structure appropriately empowered through the establishment of a consensus Quality Management Plan as agreed by the Consortium as an elaboration of the Partner undertakings per the Consortium Agreement, the Partners concluded their review of national and international guidelines with respect to ethics before embarking on a most thorough and systematic analysis of the AAL users' requirements in general and, in particular, those of the target beneficiaries namely the Mild Cognitively Impaired (MCI) users living at home as Care Recipients (CRs) and other implicated stakeholder groups such as the Care-Givers (CGs) and Professionals.

After a sustained period of activity comprising of two phases of domain requirements elicitation and refinement followed by a detailed analysis of the requirements generalisation ontology, hierarchy and relative priorities, the consensus requirements prioritisation for the AAL MCI domain has been achieved. In light of this, the use-cases and the test-cases were arrived at for the entire CompanionAble Requirements Spectrum and the initial Framework Architecture Specification for the graceful and seamless integration of the Service Robot Companion and the Smart Home Environment was achieved.

Accordingly the underlying sub-systems have been specified, for example person and system state semantic fusion and situation-awareness integrators, and, supporting components such as the person state tracker family of modules, the contextualised alarm and remote centre services as well as the day-time management system supported by speech-input-output interactivity as empowered by dialogue management.

This first year has also seen the Consortium making preparatory plans for the test bed trialling of the first CompanionAble prototype by completing plans for the Training as well as the Validation and Usability Evaluation processes.

As the first EU-funded Integrated Programme in its class, the CompanionAble Project is aware of its European RTDI leadership responsibilities particularly re the graceful integration of service robotics within AAL environments and as such has successfully delivered a number of publications, research workshops and awareness-raising events through its dissemination activities involving the AAL Cluster of EU-funded projects as well as the wider European ICT Community.

These contributions to the European ICT research community have established a strong paradigmatic innovation leadership in the areas of AAL ontological analysis and mapping to empower the deployment of semantic technologies, integrative requirements engineering, usability evaluation and virtual user co-design platforms to support all ambient-assistive intelligent systems but particularly to serve the AAL application domain for the elderly. These contributions have included, for example:

- i) Contributions and presentation in the area of Virtual User Systems at the AAL information Days Brussels, April 2008.
- ii) The AAL Domain EU-fund Projects, Shared Ontology, harmonised ontology partitioning and mapping for AAL sectors, established as an objective of the AAL Cluster.
- iii) The UI-REF and C-ASSURE Tutorial Presentation, Paper and contributions at the European Ambient Intelligence Conference Usability Research Workshop Nuremberg, November 2008.
- iv) The Virtual User Systems Research Networking Session at the ICT Conference Lyon, November 2008.

Notable achievements of the Consortium in its first year have included some of the most fundamentally critical deliverables of this project which have been satisfactorily concluded and which shall continue to underpin its future success; for example the requirements engineering and prioritisation management, as part of an integrated process closely coupled to validation and usability evaluation to form a tightly run usability refinement learning loop to inform the responsive framework architecture re-specification and re-design . The wider establishment of this framework (known as the UI-REF, User-Intimate Systems Requirements Engineering Reference Framework) which has already been successfully adopted by other projects heralds a new defining stage in usability co-design research which has firmly consigned to history the outdated heuristically-imposed HCI usability and evaluation approaches rooted in the old school attachments to a bygone age with little appreciation of the click-happy fickle world of WWW instantaneous usability dominance and still less understanding of the deep personalisation requirements that are imperative in provision of acceptable security-privacy-trust-integrity preserving intimate-assistive living environments. Thus by providing yet another proving ground for UI-REF the Consortium has further established the only known integrated Requirements Engineering and Usability Evaluation Framework to-date which is itself founded on the only psycho-cognitively-based and thus memory-and-affects-aware usability relationships centred framework to-date namely C-Assure (Badii 2000) which incorporates the widely-established psychological principles of Human Judgement and Decision Making (J/DM-theoretic), and, Pleasure-Pain-Recall (PPR-theoretic) basis of Dynamic Usability Modelling within a usability-relationships-centred Co-Design methodology and practically applicable framework.

Accordingly the CompanionAble Consortium has contributed to the AAL Cluster, not only a paradigm for sector-specific ontologically coherent requirements spectrum partitioning and prioritisation resolution but also its twinned evaluation methodology forming an integrative axis of iterative usability refinement learning thus enabling a full-loop cost-effective process chain with tight coupling to the requirements prioritisation as already successfully applied to the AAL domain.

The CompanionAble Consortium prides itself on the excellent synergy of expertise and capabilities of the Partners in the major fields that underpin its Research-Technology-Development and Innovation, notably its access to world-class capabilities in Smart Home test beds (SmH), Service Robotics (UIL, MLAB, IBISC), and Sensor Networks and Sensor Fusion (GET, LEG, ARC, ESIG), as well as gerontology and behavioural psychology and day-time activity management (UDC).