

Care services provision in ambient assisted living

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Abstract

Many societies are facing a big demographic shift, reflected in a fast growing generational unbalance with very high percentage of old people, which puts their social security systems in danger. In this context, a conceptual architecture for an ambient assisted living ecosystem is introduced with the objective of facilitating the development and provision of technology-supported integrated care and assistance services for senior citizens. These services are the result of collaboration among various stakeholders, enabled by the notion of collaborative ambient assisted living ecosystem. A 3-layered model is adopted for the architecture: Infrastructure layer, Care and Assistance Services layer, and Ambient Assisted Living ecosystem layer. The involved actors and their relationships are modeled as part of the architecture implementation specification. An example of service design in this context is also presented.

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1. Introduction

Current demographic trends observed in most western countries are leading to a difficult generational unbalance, which creates serious societal challenges, namely as a result of the pressure put on existing social security systems. On the other hand, the progress on the information and communication technologies (ICT), and the increasing availability of Internet, is motivating the search for technology-based delivery of care and assistance services. Complementarily, recent progress on sensors and other intelligent devices, including home automation and robotized systems, with interconnection capabilities as reflected in the notions of Internet of Thing and Cyber-Physical Systems, creates the opportunity to offer new services. This trend is reflected in a large number of research initiatives on ICT and ageing during the last decade.

While earlier initiatives were more focused on providing healthcare services to senior citizens with special needs, current developments recognize the importance of adopting a broader perspective of the ageing process. As such, the concept of “ac-

tive ageing” provides a more appropriate scope of understanding of the needs of senior citizens. Furthermore, the notion of “productive ageing” introduces a new perspective regarding the way society often perceives older people. Under this view, effective support to the ageing process should not be exclusively focused on providing healthcare, but rather on creating an environment in which elderly citizens do not feel excluded and a burden to the society. In this line, the BRAID roadmap [1] proposed a holistic research agenda for ICT and ageing along four main *life settings*:

- *Independent living* – addressing how technology can assist in normal daily life activities e.g. tasks at home, mobility, safety, agenda management (memory help), etc.;
- *Health and care in life* – focused on how technology can assist in health monitoring, disease prevention, and compensation for physical and cognitive disabilities;
- *Occupation in life* – focusing on how technology can support the continuation of professional activities along the ageing process; and
- *Recreation in life* – finding how technology can facilitate socialization and participation in leisure activities.

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Complementarily, the notion of Ambient Assisted Living (AAL) is being established as a concept focused on the use of technology to improve the independence and wellbeing of aged people in the environment where they live or work.

Although some initiatives have already addressed these areas, in this context, an integrated environment that supports the creation of an ecosystem that embraces collaboration of all related stakeholders (from elderly citizens and their relatives, to service providers, hospitals and NGOs) is still missing.

Addressing this challenge, the AAL4ALL project aims at developing an ecosystem of products and services for ambient assisted living (AAL) [2]. The underlying assumption in this project is that the creation of a sustainable support environment for the ageing citizens requires the involvement and effective coordination of multiple stakeholders, from diverse sectors and distinct backgrounds. One of the results of the project, and the main topic of this article, was the development of a conceptual architecture for an AAL care ecosystem as the base for the creation and effective delivery of care and assistance services resulting from the contribution of multiple stakeholders.

The remaining sections of this article, which extends a preliminary work presented at Healthcom2013 [3], include: trends in ICT for AAL, notion of integrated care service, a care ecosystem architecture, the corresponding AAL ecosystem layer, the ecosystem management model specification, and a service design approach to design integrated care services. The article ends with some conclusions and future work identification.

2. Some trends in ICT for AAL

Several initiatives have addressed the development of ICT applications with the aim of improving ambient assisted living environments and the related provision of care and assistance services. Among these initiatives, a great number of sensor-based applications can be found, especially for monitoring the health conditions and triggering alarms in case of need. Examples include fall detectors, body condition monitors, front door open/close detectors, pressure mats, bed/chair occupancy and electrical usage sensors [4]. On the other hand, past initiatives also resulted in the development of some services to assist in cognitive impairments, such as agenda reminders, serious games, assistance robots, etc. [5–7]. In some of these works, although not their main focus, aspects of security and privacy in communication infrastructures are considered [8]. Other examples of research projects and pilot experiments focused on ICT and ageing can, for instance, be found in [9–13]. Nevertheless, many good ideas and promising pilot cases fail to scale because wrong priorities were chosen at the wrong time or a more holistic framework was missing.

In fact, it is nowadays clear that purely technology centered approaches, without consideration of the socio-organizational aspects are likely to not prevail or even fail, once they might not be accepted by users, or not find a sustainable business approach for wider deployment. Therefore, when designing a new conceptual architecture for ICT and Ageing it is fundamental to also address the need for organizational and cultural change [14,15].

This comprehensive perspective is taken in the BRAID roadmap [1] which besides technology-oriented research actions, also proposes a number of socio-organizational research actions for each of the considered life-settings.

Reflecting the same holistic trend, the Portuguese AAL4ALL project is focused on the development of an ecosystem of products and services for AAL, complemented with an adequate business model for this ecosystem and driven by realistic business scenarios. As such, the design of a conceptual architecture in AAL4ALL adopts a socio-technical perspective [16].

3. Notion of integrated care service

The notion of integrated care has been a subject of discussions in various forums dealing with ageing. For instance, a guide for policymakers from the Alliance for Health and Future [17] identifies integrated care as a much needed core component of health and social care reforms across Europe, which aims at:

- *Addressing the changing demand for care arising from the ageing population;*
- *Offering care that is person-centered, recognizing that health and social care outcomes are interdependent;*
- *Facilitating the social integration through better access to flexible community services; and*
- *Leading to better systems efficiency through better coordination of care.*

In addition to closing the traditional division between health and social care, the notion of integrated care can also encompass any assistance to ageing individuals in their professional and leisure activities. This view is also consistent with the approaches that take a “life course perspective” on ageing [18]. As such, in this work we adopt the term **care and assistance service (CAS)** as a category of services, either of a medical or social nature, aiming at helping senior citizens in their daily lives, compensating for the natural reduction of physical and/or cognitive capabilities that comes with the ageing process. Particularly focusing the context of ambient assisted living, ICT-based technological support is explored in service delivery.

When referring to the term “service”, it is important to distinguish between CAS, a kind of business service, and software service. The ICT area tends to consider services as some form of “black boxes” that perform some action(s), being more focused on data, control flow, and interoperability aspects. On the other hand, the business or customer perspective, tends to see a service in terms of the added value that is delivered to a customer and the corresponding conditions of delivery. Under this perspective, issues such as quality of service (QoS), service level agreement (SLA), terms and conditions, period of availability, interactions with customer, etc., gain prominence [19].

In terms of delivery, CAS execution may be represented by a **business process**. In some cases, the service might be performed through alternative business processes, depending on the triggering event (Fig. 1).

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