

Needs and Opportunities in Ambient Assisted Living in Portugal

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Abstract. The exponential raise in the age dependency rate together with the difficulties in having conventional care solutions opens the space for the appearance and development of innovative Ambient Assisted Living (AAL) solutions. However, the development of these solutions requires a thorough understanding of user needs and wills. In this paper we present the scenarios being adopted in the context of AAL projects, as well as the products and services current available in each of the considered utilization scenarios. The needs of the Portuguese AAL users are analyzed through the discussion of some preliminary results from a survey targeted at the Portuguese population over 55 years old. These results will be used to characterize the needs and establish the readiness and willingness of elder Portuguese population in using AAL solutions.

1 Introduction

The increase of life expectancy at birth, the decrease in birth rates, and the growth of the older population (over 64) in Portugal, Europe and, more generally, in the World contributed to an increase of the age dependency rate. This effect of ageing intensifies the demands of elderly care in quality of life extension (see Figure 1). Current elderly care services are costly and will not meet the needs in the future [1].

Recent studies show that in the Portuguese population aged between 55 and 74 years old only 8% have higher education and 13% have upper secondary education [2]. Fig. 1 on the bottom right presents the evolution of the usage of Internet by users with age between 55 and 74 years in Portugal and European Union (EU27). It can be observed that Portuguese users are above the average of the EU27 and that the level of education is related with the level of Internet usage.

The new eldercare demands, together with the evolution in technology usage, created the needed conditions for the development of ICT enabled independent living for elderly. These Ambient Assisted Living (AAL) solutions intend to monitor and facilitate the health, safety and well-being of individuals, handicapped and elder people in specific scenarios such as at home, in mobility, in a care center, at work and in recreation, increasing their independency, mobility, safety and social contact

through increased communication, inclusion and participation by the use of ICT solutions [3].

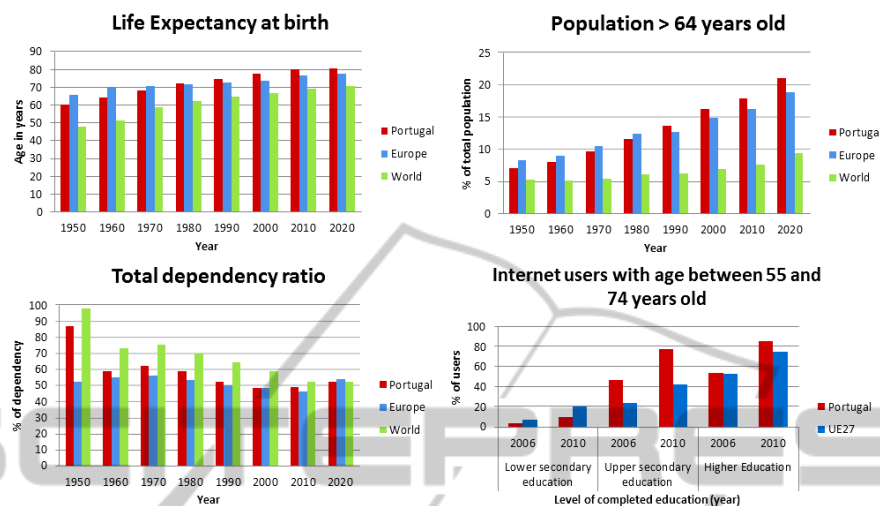


Fig. 1. Top-left: the life expectancy at birth considering both genders for Portugal, Europe and World (adapted from [4]), top-right: the total percentage of people over 64 years old of both genders for Portugal, Europe and World (adapted from [4]), bottom-left: the percentage of age dependency ratio for Portugal, Europe and World (adapted from [4]) and bottom-right: Internet users with age between 55 and 74 years years old, per age level of completed education in Portugal and in UE27 in 2006 and 2010 (adapted from [5]).

This paper analyzes current needs and opportunities of AAL solutions in development in Portugal. Section 2 presents the current AAL Solutions categorized according to different utilization scenarios and project AAL4ALL, focused on mobilizing an AAL ecosystem. Section 3 presents a questionnaire developed in the context of that project, while Section 4 discusses some of the first preliminary questionnaire results.

2 AAL Solutions

In order to fulfill the goals of a complete AAL system, several international projects [6]; [7] have analyzed the different ageing scenarios from the perspective of the target users. The Bridging Research in Ageing and ICT Development (BRAID) is an international project which aims at approaching the ageing phenomenon and many of its arisen challenges through the development of a comprehensive roadmap for “ageing well”. Based on the work from the feeder projects, and in particular impressed by the categorization made within the AALIANCE project [7], four different scenarios have been identified within BRAID: Independent Living, Health and Care in Life, Occupation in Life, and Recreation in Life.

2.1 Products and Services per AAL Scenarios

According to the identified scenarios several AAL products and services have been already developed and categorized [6]; [7]; [8]. Table 1 presents an exhaustive list of the existing AAL products and services grouped for each of the identified scenarios. These solutions are being developed with the help of several technologies, as medical technology, microsystems technology, information and communications technology (ICT) and innovative services. They include all daily activities such as shopping, preparation of meals, communicating with friends, washing the dishes and others that enable elders to stay in touch with the world beyond their domestic environments [9].

Table 1. AAL products and services for the AAL scenarios (based on [6]; [7]; [8]).

| | |
|--|--|
| <p style="text-align: center;">Independent living</p> <ul style="list-style-type: none"> • Biometrical sensory data monitoring system • Intelligent abnormal biometric value alarm system • Activities monitoring system • Fall detection system • Localization/Positioning system • Memory aid System • Activity management system • Impaired patient movement aid system • Meal and dietary monitoring/assistance system • Fire/electric shock detection system • Open door/window detection system • Open tap/gas/oven on detection system • Shopping assistance system • Driving assistance/monitoring system • Public transport assistance/monitoring system • Mobility obstacles detection system • Cooking assistance system • Dishes/Clothes washing assistance system • Clothes ironing assistance system • Medication assistance system • Stairs assistance system • Electro-domestic assistance system • Bureaucratic information assistance system • Context-aware system • Personal hygiene assistance system | <p style="text-align: center;">Health care in life</p> <ul style="list-style-type: none"> • Biometrical sensory data monitoring system • Intelligent abnormal biometric alarm system • Wearable monitoring devices • Chronic diseases intelligent monitoring systems • Medication alarm/dispenser system • Diet assistance system • Physical exercise assistance/monitoring system • Clinical history data repository system • Therapeutic plan assistance/monitoring system • Tele-consultation system • Sensorial disabilities compensation system • Motor disabilities assistance system • Mental disabilities compensation system • Rehabilitation assistance/monitoring system • Risk patient localization/monitoring system • Multi environment support decision system • Simple emergency alarm system • Clinical community information system |
| <p style="text-align: center;">Occupation in life</p> <ul style="list-style-type: none"> • Adapted working environment • Ergonomic system • Robotic helper • Inter-generational interaction system • Formal employers network • Professional community network • Freelancing/Entrepreneur information system • Task management assistant system | <p style="text-align: center;">Recreation in life</p> <ul style="list-style-type: none"> • Real world communities network • Virtual communities • Brain stimulation games • Online entertainment games • Remote cooperative games • Online reading and storytelling • Remote attendance to social events • Specialized, interactive and remote gymnasium • Remote interactive religious events • Remote and interactive library access • Remote painting • Remote teaching/consulting • Remote interaction with family and friends • Remote learning systems • Learning and activity recognition system • Interactive ICT learning systems • Intergenerational relation systems • Skill sharing system |

2.2 Project AAL4ALL

Although technologies for AAL are already available and often in use for different purposes, these ‘first offers’ for primary and secondary end-users are monolithic, incompatible and thus expensive and potentially not sustainable.

AAL4ALL is a project currently being developed in cooperation with 34 Portuguese interdisciplinary partners, ranging from areas as industry to academic, R&D and social disciplines. The goal of the project is the mobilization of an industrial ecosystem of products and services in the scope of Ambient Assisted Living (AAL), and focused on the definition of specific standards.

The AAL4ALL project brings together all relevant stakeholders, as Public Institutions, Industry, User Organizations, R&D Institutions in the discussion and definition of the basic AAL services of general interest [10]. Analyze what standards and other international activities already exist are the key concepts of the project which wants to avoid reinventing wheels and bring the focus only to the missing pieces.

The main objective of the AAL4ALL project is the development of an ecosystem of products and services for Ambient Assisted Living (AAL) associated to a business model and validated through large scale trial.

The project started by specifying the requirements of users and informal and formal caregivers by using dedicated questionnaires. This data will be used to understand how ICT technologies are already part of the daily activities of these target users and to define new markets for care products and services. The expected results are the identification and characterization of the adopted AAL solutions and their acceptance by users and caregivers. This procedure will allow the development of a user-centric model, capable of answering their needs while ensuring an optimal integral assistance, improving the quality of life and the wellbeing of the individuals and their caregivers.

2.3 ALL Products and Services Available in Portugal

Within the work developed in AAL4ALL several products and services were already identified as being available in Portugal. Table 2 presents the products and services available in Portugal categorized according to the scenarios of Independent Living, Healthcare in Life and Recreation in Life. Note that, to the best of our knowledge, there are no products currently available in Portugal for the Occupation in Life scenario.

Table 2. Available AAL products in Portugal for the ALL scenarios.

| Scenario | AAL Product | Function | Ref. |
|--------------------|----------------------------|--|------|
| Independent living | ElderCare | Activity monitoring and fall detection system. | [11] |
| | MOVER | Activity monitoring and fall detection system. | [12] |
| | MAGTAG | Wrist compact device with localization and activity monitoring features. | [13] |
| | LUL – Living Usability Lab | Voice recording system to facilitate the development of natural user interfaces using simple touch and voice to aid patient with reduced mobility. | [14] |
| | iGenda | Memory aid and activities management system | [15] |

Table 2. Available AAL products in Portugal for the ALL scenarios. (cont.)

| Scenario | AAL Product | Function | Ref. |
|---------------------|--------------------------------|--|---------------|
| Independent living | NETCARE | Wireless vital signs monitoring system with availability of collected data through web application. | [16] |
| | ExaAllinOne | Home based portable and simple vital signs monitoring system of low cost. | [17] |
| | Smart and Interactive Textiles | Patient movement aid system for help patients with mobility problems in performing basic tasks. | [18] |
| Health care in life | Microsoft Health Vault | Cloud-based clinical data repository acquired and transmitted by monitoring devices such as: body sensors, smartphones and computes. The collected information will be available to pharmacies, laboratories, hospitals and health care centers. | [19] |
| | eCAALYX | AAL monitoring system for elder people with chronic diseases. Activities monitor and fall detection. | [21] |
| | VirtualECare | Multi environment (home, care nursery, hospital, and mobility) support decision system that interconnects the elder user and relatives to improve his quality of life based in personalized health monitoring. | [22] |
| | +APOIO | Single touch emergency alert system. It is able to contact remotely family, friends or caregivers. If the button is pressed and the word "HELP" is screamed the system automatically activate the emergency means. | [11] |
| | VitalJacket | Wearable biomedical and activity textile sensor system. | [23] |
| | PRK_TREATMENT | Therapeutic exercise and rehabilitation process support system for caregivers and Parkinson patients. | [24] |
| | ExaNoNeedle | Drug transdermal administration device at home and monitored through the health care unit. | [17] |
| | Primus Care | Integrated home support and health services system. | [25] |
| | AALPLUX | Continuous wireless biomedical monitoring system for home, hospital and other care institutions, designed for localization, fall detection, unblocking devices and cardiac frequency monitoring. | [26] |
| | ALERT PDMS | User friendly graphical interface application for centralization and storage of data obtained from different clinical monitoring devices. | [27] |
| | LOOK4MYSOUNDS | Cardiac frequency monitoring system through the implementation of a digital stethoscope with sound intelligent analysis for detecting anomalies and raise alarms. | [28] |
| | TELEMOLD | Blood oxygen level and physical activity monitoring system for pulmonology patients optimized for oxygen prescription. | [29] |
| | Unidosys | Intelligent drug dispenser system. | [30] |
| Recreation in life | ACTIVO PC SENIOR | Laptop special designed and produced for elder people use using features as keyboard lightning, higher dimension keys, ergonomic mouse and an integrated 3G modem. | [31] |
| | INICIATIVA IDADE MAIOR | Project to minimize the effect of loneliness and isolation through a pre-configured mobile phone | [32] |
| | TIO | Web portal dedicated to elder population with information and advices. | [33] |
| | LADO A LADO / ACONCHEGO | Project to integrate higher education students with socio-economic difficulties to live with and care for an elder individual reducing his loneliness and isolation feeling. | [34]; [35] |
| | Futuro Feliz em Familia | Associated project combining elder people with different levels of dependency and deficiency that need clinical care at home and volunteers (family, friends, neighbours) to facilitate the social integration and minimize the recourse to health professional reducing the health costs. | [36] |

3 Population Needs: The AAL4ALL User Questionnaire

In order to understand the current level of ICT usage among the Portuguese elder population, but also to identify clearly the current needs and opportunities for AAL solution development, AAL4ALL developed a user questionnaire. It was conducted in Portugal and focused on the population over 55 years old. It had as main objectives the identification of the participants' functional limitations and level of dependency on basic and instrumental daily activities; the establishment of a relationship between the readiness to the use of AAL technology and the different levels of dependency and functionality and the establishment of a relationship between the readiness to the use of AAL technology and the specific needs of health care. Six main categories of needs [37]; [38] were explored in this questionnaire:

1. **Health:** Most of the elements of the population suffer or are in high risk of a chronic condition. In Portugal the major incidence of conditions in elder population are Cardiac diseases, Hypertension, Diabetes, Pulmonary diseases, Osteoporosis, Prostatic pathologies and Hypotension [39]. The main needs for this type of population are medical signs monitoring and health state change alarms, as well as assistance and control in medication.

2. **Safety:** Ageing affects the physical, mental and cognitive performances, what constitutes a threat to the individuals' integrity. Falls are a major risk because it has serious consequences for the subject health. There is a need for fall detection. Domestic accidents such as fires, electric shocks or flooding can severely damage its living conditions or even threaten this peoples' life. Other aspect is burglary prevention; elder or handicapped people are more vulnerable to that. Other safety risks for institutionalized people either in elder nurseries or health care institutions are abuse or negligence from the caregivers [37].

3. **Independency:** Some people due to its physical limitations are unable to perform daily tasks such as walk out of bed, personal hygiene, dressing, cooking, eating, laundry, dish washing, use the stairs and shopping. Other people have more complex limitations such as earing or sight conditions. Other important aspect is the access to information, including bureaucracy or taxes [37].

4. **Mobility:** People with physical limitation or with poor sight may require aid to walk and to use the stairs. Subjects with cognitive limitations require localization and positioning aid either when walking or using public transportation [37].

5. **Participation:** People that engage in activities such as work or study for elders tend to be less affect by ageing; it helps them conserve their health. Active life stimulation solutions such as educative programs, voluntary programs or profession skills exchange are needed to make elderly feel useful [37].

6. **Leisure:** Being isolation and abandonment the major risks of ageing for mental health; entertainment such as social activities, remote social activities as online games or events, family and friends contact are needed to avoid it. These activities can provide mental stimuli, helping them maintain their cognitive skills [38].

The questionnaire was composed of eight sections: (1) characterization of the socio-economic data of the participant; (2) characterization of its habitation situation; (3)

clinical and health data where health problems, the cognitive system status and the specific needs at health care level were reported; (4) basic and instrumental daily tasks; (5) safety characterization in terms of specific needs at domestic equipment usage and habitation condition levels, and at safety levels (fears); (6) social and recreational activities and hobbies; (7) characterization of needs in terms of services; (8) technology access and attitudes towards AAL technologies.

4 Discussion

The preliminary results of the developed questionnaire have shown that the population has the readiness to learn to use AAL solutions. From the 1220 respondents of all regions of the country, 73% were females and 27% males, 8% had completed a higher education degree and 9% completed the secondary school, numbers that are representative of the Portuguese population. The interviewed population deposits a degree of medium or high confidence on them and is willing to pay for them.

The main needs identified through the questionnaire were:

- Mobility limitations in using stairs.
- Access to information about bureaucracy, voluntary activities, and taxes.

The most significant fears reported by the inquired population were:

- Falls (in general).
- Fires.
- Burglary.

As the analysis is still ongoing, a more detailed characterization of the results of the questionnaire will be published in the future.

There are currently several AAL products and services available in Portugal; however, most of them are monolithic and developed to fulfill a specific use. In order to answer the population needs, we believe that considerable work must be done in integrating the different available products into a single and flexible solution. In fact, our previous analysis shows that most of the developed AAL solutions are concentrated on health and safety needs, and only a minority focus on independent living. There is, thus, the need for research focused on mobility, participation and leisure solutions targeted to the elder and handicapped population. There is a clear opportunity in Portugal for developing AAL solutions for occupation in elderly life.

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