

An Ecosystem of Products and Systems for Ambient Intelligence – the AAL4ALL Users Perspective

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Abstract. Developed societies are currently facing severe demographic changes: the world is getting older at an unprecedented rate. In 2000, about 420 million people, or approximately 7 percent of the world population, were aged 65 or older. By 2050, that number will be nearly 1.5 billion people, about 16 percent of the world population. This demographic trend will be also followed by an increase of people with physical limitations. The traditional health care systems, not only in Portugal, but also in all other European states, will be faced with new challenges. There is an urgent need to find solutions that allow extending the time people can live in their preferred environment by increasing their autonomy, self-confidence and mobility. AAL4ALL presents an idea for an answer through 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. This paper presents the results of the first survey developed within the AAL4ALL project: the users' survey targeted at the Portuguese seniors and pre-seniors. In this way, this paper addresses the lives of the Portuguese population aged 50 and over.

Keywords. Ambient Assisted Living, technology acceptance, users surveys

Introduction

The increase of life expectancy at birth, the decrease in birth rates and the growth of the elderly population (over 64) in Portugal, Europe and, more generally, in the world contributed to an increase of the age dependency rate. These facts have motivated the

primarily aim at enabling elderly to live independently in their own homes and to assist people with special needs [1][2].

AAL4ALL is a project currently being developed in cooperation with 34 Portuguese interdisciplinary partners from different areas such as industry, academia, R&D, and social disciplines. The main goal of the project is the mobilization of an industrial ecosystem of products and services in the scope of AAL and is specially focused on the definition of specific standards. Given this goal, the project started by specifying the requirements of users by deploying dedicated surveys. These data will allow us to understand how ICT technologies are already part of the daily activities of the target users and to define new markets for care products and services. The developed survey is focused on the identification and characterization of the needs of final users in terms of AAL solutions and their technology acceptance. This procedure will allow the development of a user-centric model, capable of answering the needs of the users while ensuring an optimal integral assistance, improving the quality of life and the wellbeing of individuals and their caregivers.

The results of these dedicated surveys allowed us already to draw insights about the socio demographics of the Portuguese population over 50, their health, their families and social networks, their economic situation, their housing conditions, their autonomy in developing the basic and instrumental daily activities, their fears and insecurities, their needs and their attitudes towards technology. It shows, for instance, the variation of the social activities of the Portuguese seniors and pre-seniors and it reveals striking differences, as well as similarities, in the use of technology across Portuguese regions.

This paper starts by introducing the background knowledge that supports the AAL4ALL users' survey in Section 1. Section 2 presents the research methodology of the questionnaire: it introduces sampling methods, procedures used to conduct the survey, and the methods used to process these data. The main results achieved with this survey are presented and discussed in Section 3. This section starts by presenting the descriptive analysis of the gathered data and is followed by the correlation and variables association results. A discussion of the main conclusions supported by these results is presented in Section 4, while Section 5 concludes the paper by summarizing the results of the described analysis.

1. Background and Relevant Studies

According to the latest studies presented by the National Statistics Institute [3], Portugal is faced with a continued ageing of the population as a result of an increase in the population longevity and a decline in fertility. The proportion of older population, which represented 8.0% of the total population in 1960, more than doubled to 17.9% in 2009. In 2011, there were, approximately, 2 million older adults in Portugal, 60% of which live alone or with the company of other older adults.

When comparing the demographics of Portugal with the demographics of other EU countries, we can detect significant differences:

1. With regards to life expectancy, the Portuguese and Irish population lives

longevity against 18.7 years in Portugal) and men about 1.4 years longer (16.7 years against 15.3).

3. In 2002, Sweden and Italy held the highest proportions of individuals with 80 or more years in the total older population, respectively, 5.2 and 4.5%. The average in European Union (EU) concerning this senior population was of 3.8% in the same year. However, Portugal and Ireland stood out amongst the countries with the lowest percentages of people aged 80 or more, with a percentage of 3.5% and 2.6%, respectively.

According to Eurostat projections, there will be a significant increase in the average European dependency ratio, which should reach 31.7% by 2020 and 47.2% in 2050. This increase is expected in all European countries. Given these numbers, it is evident that we face a problem, not only socially, but also at a medical and economical level. It is essential to facilitate healthy ageing, with autonomy and independence, by allowing older people to remain active in labor market as long as possible.

Information and Communication Technologies (ICT) can play an extremely important role in achieving these goals. ICT can contribute to improve the quality of life of older people, ensuring a healthier and more independent life by helping them to overcome daily problems.

2. Methodology

The AAL4ALL users' survey was developed through an iterative process addressed by a subgroup of 10 industrial and academic partners of the AAL4ALL project. The process started by the segmentation of the survey target group and by the definition of the main research questions to be addressed by this instrument.

The final questionnaire is composed of 8 main sections, each focusing on different aspects of the 50+ population life: socio-demographics, residence characteristics and social spaces, health measures, functionality, security, social activities, services, and attitudes towards technology.

2.1. Sample Design

The collection of data used in the sample was selected from the universe of Portuguese citizens aged 50 or more, characterized at the date of the questionnaire by one of the following settings:

- 50+ citizens attending residential facilities;
- 50+ citizens attending day care centers;
- 50+ citizens living in their own home with some kind of integration in the community (e.g. senior universities, associations, citizen public services); and
- Other citizens aged 50+.

The estimation of the sampling size was conducted prior to the application of the survey. The estimation based on proportion indicates that a sample with approximately 1100 subjects would indicate a margin error of 3% at 95% confidence. However, the

2.2. Instrument Application

In order to facilitate the transmission of the main purposes of the survey and to ensure the standardization of the filling procedure, the survey was conducted in an interviewer-mediated way. The interviewer was responsible for explaining to the respondent the goals of the study, the importance of their participation and registered their answers. All data were collected simultaneously in the different regions of Portugal between July and September 2011. In each region, one or more local coordinators supervised the sample selection, the recruiting and the interviewers training. The respondents were selected mainly from residential facilities and day care centers, but also in senior universities, associations and citizen public services.

3. Results Analysis

By conducting this survey we were able to collect data on the individual life circumstances of 1174 Portuguese citizens aged 50 and over in 18 different regions of the country, ranging from the Northern region of Bragança to the Portuguese archipelago of Madeira. The following paragraphs present the main results obtained after the analysis of the gathered data.

3.1. Socio Demographics and Residence Characteristics

The sample is composed of 788 women and 370 men in the age range of 50 to 98 years. The majority of participants are married (502) and widowed (457), with a lower presence of single (116) or divorced (72) subjects. Most of the respondents have no more than four years of school education (69.1%) and the large majority (74.3%) is retired and does not live alone (53.7%). The percentage of respondents living alone was determined to be, approximately, 21%. The majority of the respondents live in the littoral and in urban regions.

Most of the subjects live in a house or an apartment (71%), while 18.1% live in a residential facility. Furthermore, 48.8% of the respondents earn less than 734 € per month.

The analysis of the survey data also allowed us to determine that half of the respondents live in an independent house, while a fifth of the subjects live in specially designed housing for older adults, with permanent care. Thus, the results indicate that most of the respondents are still living with family or in an autonomous way.

3.2. Measures of Health

The evaluation of the perceived health status indicates that the large majority of respondents consider their health as fair, good, very good or excellent. Only, a fifth of participants reported a weak health. In the evaluation of the current health condition, 39.2% of participants reported their health condition as healthy, while 37.1% self-reported a chronic disease. The remaining group reported suffering from an acute

to identify the cardiovascular diseases among the most prevalent chronic diseases in our respondents group.

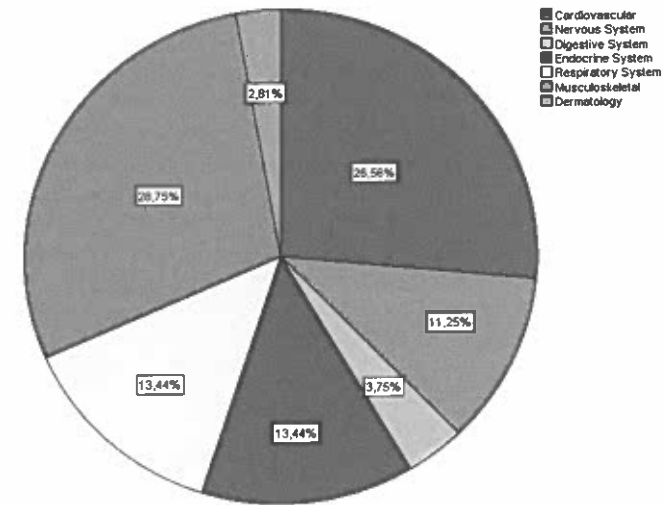


Figure 1. Prevalence of chronic diseases among those inquired.

An analysis of the difficulties with the basic activities of daily living allows identifying climbing stairs and bathing as the most frequently reported problems. However, most of the respondents classify themselves as independent persons with a high level of autonomy: housekeeping, shopping and food preparation are the activities reported with the lowest level of autonomy.

3.3. Security

In general, no difficulties are reported concerning the use domestic equipment. However, most of the respondents do recognize the importance of having a solution that could support their utilization in case of future difficulties. This result is more relevant when considering the equipment related with domestic barriers as, for instance, stairs, steps and handrails.

The main insecurities reported by the respondents are related to the fear of burglary, fire and falling, situations in which the importance of having a supporting solution becomes more relevant.

3.4. Recreational and Social activities

The analysis of the data regarding recreational and social activities indicates that most of the respondents are very or even extremely satisfied with their participation in those events. In fact, the majority of individuals report a regular participation in such type of activities, and only one fifth of the respondents report no satisfaction in this participation. Finally, more than a quarter of the participants report loneliness.

3.5. Services

The data analysis indicates that most of the respondents are satisfied with their access to the services, whether community, formal or legal services. However, the existence of a solution that could ease the access to services related with bureaucratic information, rights and duties is identified by the majority as very important.

3.6. Attitudes towards Technology

The analysis of the attitudes of the subjects towards technology is one of the most relevant components of the AAL4ALL users' survey. The results obtained indicate that the majority of the survey respondents have access to cell phones, whilst one third of the respondents do not own such a device. It is also interesting to notice that only 2 respondents use these devices for "emergency only" situations. Most of the respondents have access to Internet at home; however, approximately, two thirds of the inquired individuals have never used the Internet.

An analysis more focused on the use of AAL technologies reveals that one third of the respondents have never used this type of solution. The majority, however, report some experience with AAL technologies independently of their type. Difficulties in the use of such technologies are reported by most of the subjects and half of the sample population refers to the ability to invest in the acquisition of AAL technologies.

4. Discussion

The number of women in our sample is more than twice the number of men, reflecting the tendency previously stated by the National Statistics Institute [3] that, in Portugal, women have longer life expectancy than men. This fact is important when designing new products, because gender can determine human behavior and the management of decision-making processes [4][5]. Moreover, gender can have an influential role in determining how users respond to and use technology. Gefen and Straub [6] researched perceptual differences in the use of e-mail and found that men and women differ in their perceptions. They also concluded that men feel more comfortable using technology than women.

Regarding educational level, about two thirds are people with no more than four years of schooling. Moreover, according to data from the National Statistics Institute [3], there are still a large number of people over 65 with no school certification or with low qualification levels. According to previous analyses [7], it could be stated that this population would have more difficulties in accessing ICT.

On social services and spaces used by subjects, more than half attend some institution that supports older populations. There is still a large percentage of older population that is not included in any social support system. On those using social services, it can be observed that a large majority does so with a high frequency. By attending social activities, feelings of loneliness and sadness can be reduced and the elderly can perceive themselves in a more positive way. Even for not fully independent

older stages of life: work and family. They are the ones that organize and define human existence. Hence, given their relevance in individual life, any change that happens in these points may lead to instrumental and emotional impacts in which we could include subjective feelings of loneliness. Also, in later stages of life, people tend to notice different changes in family settings. Researchers refer to changes in married life, when sons and daughters become independent: the empty nest syndrome [9]. As years go by, spouses die and the survivors have fewer friends and are disconnected from the rest of the community. Widowers become more isolated and less support from sons and daughters is observed. Social support by the informal caregivers network (composed of relatives, neighbors, friends) become very important at this stage. The informal caregivers network is essential in order to ensure autonomy and a positive self-image to the active ageing process. Moreover, technologies can play an important role by supporting this informal caregivers network [10].

As for health status perception, the large majority said their health was fair to excellent, with only a minority of participants reporting a weak health. Chronic diseases normally increase with ageing. The most frequent ones are high blood pressure, cancer and diabetes mellitus as well osteoporosis and depression [11]. Concerning sensorial limitations, our sample shows that vision is the most affected sense. Vision is a very important impairment when considering mobility and ability to perform different activities in everyday life, such as taking a bus or attending a course in a senior university.

Recreational activities are a very important way for older people to keep active on physical, social and cognitive aspects. AAL solutions could help with accessing these activities, especially important for more isolated groups.

It is well known that older people lose a lot of social interactions when they confront themselves with two major life events: retirement and losing a spouse. In these situations, people tend to spend more time at home, and isolate themselves for long periods of time, moving away from important primary and secondary life networks. Motivation and interest are key elements to involve older people in these activities and in meeting new people. As social networks get smaller, it is very important that they can access different activities that allow them to stay active, improving their well-being.

Considering specific data on technology devices, the vast majority of our sample owns cell phones. It is also interesting to notice that most of the respondents have a high level of frequency of use, turning the cell phone into a core piece when designing AAL solutions. A great majority of the responders reported to have a PC, even if most of them do not use the Internet on a regular basis. Almost half of the subjects report some kind of difficulty in using AAL services, but they are able to learn how to use AAL technologies, and report high confidence levels in terms of devices that they associate with AAL. In terms of products and services, and even though differences are found between different groups, data suggest that most solutions should be for the home environment. However, and according to available data, families report several difficulties when taking care of older people in their home environment. This suggests that different responses should also be considered outside the home environment. Although half the sample earns less than 734 € per month as income, responders are able to spent money on AAL technologies if this increases their Quality of Life (QoL).

social support group by bringing them closer to youngsters creating, therefore, a rich environment for sensorial stimulation. It is also believed that new technologies promote principles of solidarity between generations, increasing, for instance, volunteer actions and transmission of personal and professional experiences [13].

5. Conclusions

A succinct analysis of the presented results provides a general perspective on the stereotype of users and scenarios that should be considered in the conception of AAL solutions and equipment for the Portuguese population. The knowledge extracted from these will serve as a first hypothesis for the subsequent research focused on the creation of business models that support a realistic view of the uses of AAL solutions in Portugal. Further analyses are being performed, with a strong focus on the socio-demographic aspects in order to determine close relationships between age, income, willingness to purchase AAL equipment, and others.

The construction of AAL solutions must also take into consideration the living environments of users and their use contexts. Creating solutions intended to be used in the home environment or in an institutional context requires adaptations so that the implementation of these solutions can be facilitated. Ensuring that solutions can be usable in both contexts or easily ported from one to the other demands considerable care in the architecture and the interoperability approach. The proximity of the older population to less traditional technologies is a factor to consider, as is the lower levels of use of the internet and computers when compared to other age groups.

The demand for health care grows significantly with an ageing population. This creates the need to find new solutions and approaches to satisfy this increased demand yet maintaining control of the associated costs. These new approaches can help restructure the health care industry by enabling older people to continue their daily routines in their own environment, outside hospitals, and delay/minimize their institutionalization. To this end, ICT should support solutions to identify symptoms of illness or certain conditions at an early stage, to support older people in their daily tasks, permitting contact between them and the hospital and allow continuous monitoring by health professionals.

The study described in this paper contributes to the identification of possible products, processes or services intended to be used in the context of AAL, which will be developed during and after the AAL4ALL project. We believe that by carefully considering the users' perspectives, following a user-centered design approach, it will be possible to achieve AAL products and solutions that better match the users' real needs.

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