PROMOTING THE SOCIAL INTEGRATION OF THE ELDERLY: HOUSING REHABILITATION AND ASSISTIVE TECHNOLOGIES

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Abstract: This paper addresses the need to respond to the new demographic reality, namely the increase of the elderly population, regarding new housing requirements. The research carried out focuses on defining housing rehabilitation strategies to fulfil the elderly needs and on how the integration of Information and Communication Technologies and Assistive Technologies (ICAT) in the dwelling space will assist this group of population and enable “ageing in place”.

1. INTRODUCTION

The goal of the presented research is the definition of strategies to enable the elderly people to live autonomously in their homes for longer before having to be institutionalized in healthcare facilities or even eliminating this need.

This paper focus on two aspects: i) the need to improve accessibility and functionality in homes by rehabilitating them; ii) the use of Information and Communication Technologies (ICT) and Assistive Technologies (AT) to promote a more independent living for the elderly and people with disabilities.

The need to carry out rehabilitation work arises out of the fact that a large amount of the housing stock in Portugal, particularly in the big cities, urgently requires intervention work of this kind. In terms of population several changes had occur in the last years. Elderly people (aged over 64) represent one quarter of the Lisbon population, and the most representative families consist of two individuals, followed by 1 individual [1]. This data has major consequences for the dynamics of neighbourhoods and their residential buildings, both now and in the future. The need to consider these domestic groups is reflected in the need to understand different ways of living and to incorporate these needs into housing. Parallel to an increase in new forms of co-residence, the emergence of ICT and their mass use has changed social relationships amongst individuals and between individuals and the surrounding space, on different levels. The use of technology has introduced numerous new possibilities in everyday life that enhance human capacities and allow for greater autonomy and comfort.

It has been calculated that by 2050 almost one third of the Portuguese population will be aged over 65 [2]. Portugal has never had such a high percentage of potentially dependent citizens and the entire care sector has to be prepared for this fact. For these groups, the use of home automation technologies, namely AT, is becoming a viable option in terms of remaining in the comfort of their own homes rather than moving to a healthcare facility.

This paper starts by approaching what are the ageing society and the right to independent living. Secondly we will focus on some strategies to rehabilitate housing, especially to address the needs of the elderly and people with disabilities. Thirdly we will show how ICAT can be useful to assist these groups of population and how it can promote social integration. At the end some conclusions will be drawn.

2. AGEING SOCIETY AND INDEPENDENT LIVING

The disabled and handicapped represent approximately 8.2% of the Portuguese population [3], with a marked increase from the very young to the elderly. At some stage, each one of us may experience permanent or temporary difficulties in our activities or mobility due to age, illness or accident. In addition, the Portuguese and European population is ageing, a factor that has drawn attention to the need to provide housing and buildings in general with features designed for universal use. According the INE (National Statistical Institute), this marked ageing of the population is one of the most striking aspects of recent demographics trends. In 2001, for the first time the proportion of elderly people – aged 65 or over – in the census (16.4%) exceeded that of young people – aged 0 to 14 – (16.0%) [1]. It has been calculated that in 2050 almost one third of the Portuguese population will be aged over 65. According to the INE [2], the Resident Population Estimates for Portugal for 2000-2050 reveal the continuing ageing of the population, as a result of the expected rise in life expectancy combined with fertility levels that remain below the threshold limit.

Factors such as smaller-sized families and higher life expectancy[i] indicate that in future many more elderly people will live alone. They will not have the traditional family support and will need to make use of external structures to obtain health care and other forms of assistance, which will have implications for the structure of the health care system. These changes are already being felt, for example in government projects to extend the social network of health care for the elderly and the appearance of new support structures for the elderly in the private sector.

Globally, a pressing need is being felt for more universal use products, environments and services. The concept of *Design for All* or *Universal Design* encompasses the idea that human beings are both similar and diverse, rather than special. There is a current concern that universal design should seek to ensure that all products and environments are designed for use by all individuals, in the broadest sense possible, regardless of age, capacity or circumstances. These products and environments should cater for all people, whether children, adults or the elderly, and whether they enjoy full or restricted mobility. Designs which are adapted to a wide variety of people take inter and intra individual differences into account and, within the design phase, increase the life of buildings and reduce the need for adaptation and modification. In future, all dwellings must be prepared for residents with all levels of mobility.

It is a fact that the majority of people do not have a pressing need for home automation systems, since they can carry out tasks without difficulty. Some even prefer to use traditional systems, ranging from switches to more advanced systems such as remote controls. However, new ICT have enabled people to overcome disabilities, isolated individuals to find friends, those with speech impairments to talk, etc. Appropriate use of technology can ensure that quality of life is improved for everyone by enabling those with functional or cognitive impairment to integrate into society as much as possible.

Several authors [4] [5] [6] consider that adding solutions and technical services to housing will facilitate the removal of obstacles and increase independence, decision-making powers and the autonomy of residents. The creation of dwellings which include universal design, the removal of obstacles, adaptability and assistive technology, will enable residents to remain longer in their homes and contribute towards greater stability in neighbourhoods and society in general.

The possibilities for communications and access to information have improved exponentially in recent years. Countless products and systems adapted for the disabled are now available to enable them to use distance communication. Examples include videoconferencing systems or telephones with images for individuals with hearing difficulties, telehealth, entertainment systems, orientation and navigation systems for wheelchair users, etc., which enable disabled people to enjoy very high levels of autonomy.

The installation of digital controls and communications systems represents the next step in terms of alterations to the domestic environment. The proposal to provide dwellings with Electronic Assistive Technology (EAT)[ii] will provide support for individuals when carrying out daily tasks, supplemented by personal health care, thus adapting dwellings to the needs expressed by the concept of universal design. Technology should become part of universal design and should be integrated into it from the outset rather than in its later stages. Dewsburry and Sommerville [7] warns that the introduction of the great potential offered by technology must be carefully considered and assessed because "*in the home of a disabled person, the failure of assistive technology devices could be critical to the occupants".*

According to Gann, Barlow and Venables [8] and Dewsburry and Sommerville [7], appropriate assistive technology solutions should contemplate the following factors: fitness for purpose (the system must meet the needs of the user); affordability; ease of use; flexibility, adaptability and upgreadeability (the system has to be able to evolve to reflect the changing needs to users); acceptability (the system has to fit in with the ways in which users live their lives and what is important to them); reliability (the system must be trusted by its users); interactivity; maintainability; ease of installation.

For Dewsburry, Taylor and Edge [9], inclusive, empowering and augmentative assistive technologies can be divided into two groups: "*active mechanisms"* such as control panels and switches which residents interact with, and "*passive mechanisms"* such as sensors and receptors, which residents do not interact with and which allow various features of the dwelling to be altered imperceptibly. Suitable technologies from within these two groups should be chosen, according to the level of dependency of the user.

Various experiments involving the application of assistive technologies in housing for the elderly and the disabled demonstrate the effectiveness of using intelligent houses for this group of people (the Custodian project[iii], Aware Home Research Initiative[iv], NJORD – TIDE[v], Gloucester Smart House Project[vi], SmartBo project[vii], Smart Home Project of the Joseph Rowntree Foundation[viii], Smart thinking projects[ix]). During the development of these projects it was frequently affirmed that it is still difficult to customise technology for specific cases due to numerous problems such as the lack of common protocols and qualified professionals and the high price of equipment.

3. HOUSING REHABILITATION AND UNIVERSAL DESIGN

Approximately 64% of the housing stock in Lisbon is over 50 years old [10] and therefore presents various constructional and functional problems which are the cause of its immediate unsuitability in terms of comfort. In addition to constructional rehabilitation, buildings also need functional rehabilitation, which is more difficult to quantify in statistical terms. In fact, most of the existing housing stock does not meet current habitability requirements, either in terms of comfort or functionality. The city of Lisbon has been subjected to processes of occupation and urban growth that have led to a high level of depopulation in its central area. In addition to the fall in the number of residents, this is also reflected in the ageing of the resident population, the existence of vacant or underused housing stock and its deterioration (due to abandonment or lack of financial resources on the part of its owners).

In building rehabilitation process there is no obligation in carry out barrier-free upgrades provided that this does not lead to or increase non-compliance with standards (DL 163/2006 [11]). However, it is advisable to examine all the design components to see whether an alternative could be designed to provide barrier-free access, thus offering additional convenience to all users. In this context it is necessary to ensure that rehabilitation work does not compromise emergency access, normal access (allowing access for individuals with restricted mobility) and service access (the storage and collection of rubbish, transport of goods and packages, domestic deliveries by services such as the post office or supermarkets, meter reading, and maintenance work on building).

From 2016, all buildings must comply with the technical standards for access stipulated in DL 163/2006, with the exception of cases in which the building work required would be unduly difficult or involve disproportionate or inaccessible financial and economic resources. For a building to be considered accessible there must be at least one path, designated accessible, which offers safe and comfortable access for individuals with restricted mobility from the public road to the main entrance/exit and all the interior and exterior areas it contains.

Regarding dwelling rehabilitation, as for buildings, there is no obligation for projects to carry out barrier-free upgrades provided that intervention works does not create or increase non-compliance with standards (DL 163/2006). However, it is advisable to examine all the design components to determine whether an alternative design is feasible and would provide barrier-free access, thus offering additional convenience to all users.

Within dwellings, corridors, kitchens, bathrooms, stairs, ramps, fittings and doorways should conform to specific size criteria to ensure that they can be used by individuals with restricted mobility.

Any alterations carried out in a dwelling should address the need to ensure access for all. Rehabilitation work should take all the aspects of physical alterations into account that would be difficult for residents to undertake if they became necessary in the future. The dimensions of doorways and corridors, access to rooms and bathrooms should all be established during rehabilitation work, leaving the smaller-scale alterations for the time when they are actually needed.

In the aim of a recent research a specific analysis of “rabo-de-bacalhau” building type was done as well as a survey administered to the households in the studied buildings. 58% of the households that responded to the survey were sublet and contained only 1 or 2 residents. This situation mainly affected elderly people who had opted to stay in their original home and young couples without children. For those small households which are living in “rabo-de-bacalhau” buildings, some rehabilitation strategies were defined in order to fulfil their functional requirements. These strategies include e.g. dividing the dwellings into smaller autonomous units that can be used to house smaller household and enlarging the diversity of household compositions within a building (Figure 1).

With regard to making buildings and dwellings accessible to all types of users, it should be noted that within the rehabilitation goals for “rabo-de-bacalhau” buildings the intention was not to propose solutions for all identified access difficulties. The proposed interventions essentially seek to ensure that the entrance to the dwellings offers access to individuals with mobility impairments (e.g using a wheelchair) and that their movement around the interior is not worsened in comparison to the original solution. Therefore, improving accessibility was only done when the solution to the problem itself does not require constructional alterations to the dwelling.

The proposals therefore include certain size criteria, such as the use of wider doors. It should be emphasised that, in general, the proposed alterations aim to simplify the organisation of the existing space, therefore helping to create a more fluid space. The buildings studied include several examples of cases in which areas within dwellings, such as bathrooms, halls and circulation areas, do not meet present-day access criteria. Nevertheless, the proposed alterations do not includes the resolution of access issues if they are designed only with the goal of enhacing accessibility. However, when intervention work is justified in these areas, the criteria taken into consideration (e.g. regarding corridor width) are informed by current legislation on access to buildings.

Within the scope of the past research [12] no adaptations are proposed to ensure access for all residents in areas not affected by work involving the installation of ICAT or functional reorganisation. Future work will include in the transformation criteria for rabo-de-bacalhau” dwellings the need to fulfill universal access requirements when the amount of construction work to fulfill them is viable, do not represent a stability risk for the entire building or involve a disproportionate or inaccessible financial and economic resources.

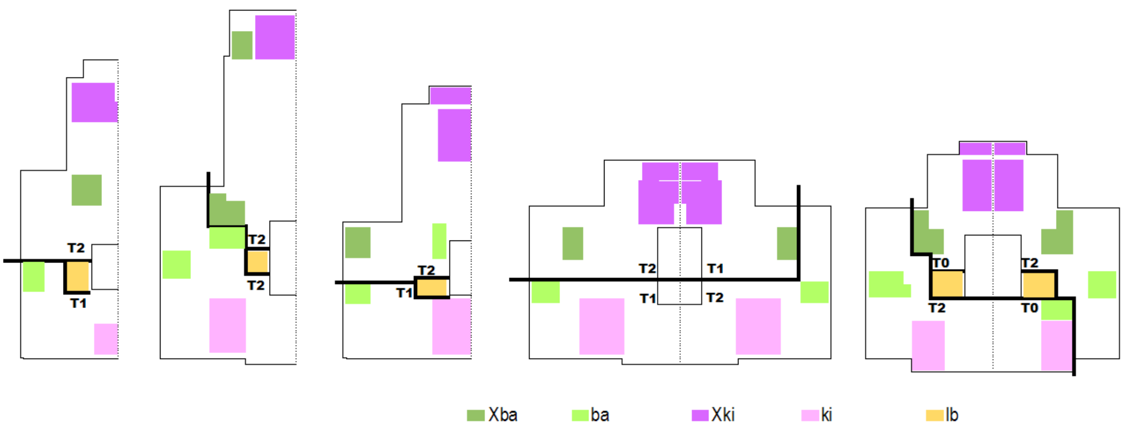

Figure 1 – Hypothesis for rehabilitating some “rabo-de-bacalhau” dwelling types by dividing a dwelling into two autonomous units (the image shows examples of locations for new bathrooms – ba – and kitchens – ki – according to different dwelling types).

4. ASSISTIVE TECHNOLOGIES AND HOUSEHOLD PROFILES

It is recognised that the elderly population in Europe has increased and there is now a growing awareness of the need to intervene and invest in improving living conditions for this social group. This has helped draw attention to the need to provide housing and other buildings with universal features. With regard to the use of AT to support individuals with special needs, various methods have been studied and solutions implemented in different countries. The installation of digital controls and communications systems represents a step towards the changes that have to be made to the domestic environment. The proposal to provide housing with AT will enable individuals to receive help in carrying out daily tasks, supplemented by personal health care. In addition, ICT provides those with restricted mobility (whether for physical, geographical or economic reasons) with the possibility of access to service centres services without the need to leave the home. In this context, we have seen a considerable improvement in communications options and access to information through countless products and systems adapted for the disabled to enable them to communicate from a distance.

In the scope of the presented research several packs of technologies were assigned to different families profiles and three levels of technology were defined which take into account the evolution of residents' requirements and hence the need to upgrade infrastructure.

4.1 Assistive technologies

Telecare

The implementation of systems of this type offers many advantages, both for the elderly who can live independently in their own homes for a longer period of time, and for the state since it avoids the high costs of health care units and also prevents overcrowding in hospitals. The elderly and those suffering from chronic illness or disability require a significant level of support from family and friends and if this is lacking they are may resort to health care units and hospitals unnecessarily.

Telecare systems are based on a series of sensors and electronic aids installed in the user's home which automatically inform the health centre when there is an alarm and initiate a response to the problem that has been detected. The sensors enable the system to function but are not an actual response and cannot function in isolation from the rest of the system. The response lies in the monitoring and response from the healthcare workers via the health centre or alongside the user, as appropriate.

Telecare systems have been widely adopted in countries such as the United Kingdom since the late 90's [13] and, according to James Barlow[x], have been helping to change the structure of health care in cities. In fact, these systems can reduce recourse to hospitals for health care and internment, thus reducing the number of beds occupied.

According to Barlow, Bayer and Curry [14], the services supplied by telecare fall into four groups: information and communications (medical advice, classification, access to self-help groups); monitoring of safety and protection (floods, gas leaks, open doors, environmental control, protection against intruders); monitoring of health and activities (control of heartbeat, respiration, blood pressure, etc; detection of falls, occupation of rooms, identification and location of individuals, occupation of beds); assistive technology (control of surrounding areas, automatic control of doors and windows, control of automatic movement of chairs and wheelchairs).

A telecare system, if properly implemented, should firstly take into account an assessment of the actual needs of residents, ensuring that they have access to services that meet their actual individual needs rather than making use of a standard "kit" that is the same for everyone. Secondly, it is vital that the installation and programming is carried out correctly. After this, it is necessary to teach the users how to operate the equipment and to ensure that the functions are demonstrated in the home with a link to the care centre that will be monitoring the dwelling. Thirdly, it is important to ensure that the telecare answering centre has the relevant information on each of the users, namely personal information on their state of health and main contacts in the event of an emergency. These centres operate 24 hours a day, 7 days a week and provide a human, rather than a technological response. Finally, it is also important to ensure that the response from the care centre is effective and immediate and conforms to what has been agreed in advance with users of the service.

Basic telecare services may be supplemented with the introduction of electronic assistive technology. As these technologies represent a considerable financial investment, they are normally only used in cases of chronic illness or when funds are available. In fact, introducing ICT into the home through telecare has countless advantages and is not expensive, in comparison with installing automated mechanisms and motors.

Telehealth

Telehealth systems are more specialised than telecare applications and are only justified in cases of chronic illness. These systems are based on tele-monitoring, which enables the patient's state of health to be monitored within the home, thus preventing visits to hospital. This investment in technologies for the home is justified to the extent that it is an investment in preventive rather than curative medicine which ensures that the patient is more efficiently and accountably involved.

Intelligent houses and telecare and/or telehealth systems are natural companions, given that the product (the intelligent house) and the applications (telecare and telehealth) use similar technology. In fact, the sensors and other monitoring equipment used in an intelligent house are also essential in a dwelling with telecare or tele-health facilities.

Tele-alarm services and other inclusive technologies in Portugal

In Portugal the tele-alarm service was created as part of the *Programa de apoio integrado a idosos* (PAII – Integrated Support Programme for the Elderly) with the aim of ensuring urgent and permanent care, principally to maintain the autonomy of the elderly in the home and in their usual environment. The programme is supervised by the Ministry of Labour and Social Security[xi]. The users of the service are mainly the elderly, but it can be provided for anyone who needs home care, namely when they are in a situation of dependence.

The system consists of a permanent listening centre, a special telephone installed in the home and a medallion with alarm buttons. This equipment, as well as the care provided, is costly but is partly or totally paid for by the local authorities and subsidised by the PAII. It is expected that by installing this equipment many elderly people will be able to postpone the need to live in care homes or use other health care facilities.

Parallel to this service, PT Comunicações[xii] has been developing a range of products and services – Soluções Especiais PT – designed for the disabled, children with serious illnesses and elderly people who are at risk, which offer the best communications facilities. These solutions include packages for PT systems, telecommunications services and equipment with specific features and an implicit social or humanitarian character, to make communications accessible to all, without exception. Some examples include: PT Voz Activa Zoom, PT Voz Activa Mais (allowing access to the Internet for the blind); PT Minha Voz (an enhanced communications product for those who are mute or have difficulties in structuring communication); the Portugal Telecom 112 (emergency number) for the deaf; the Q90 Text Telephone (which enables those with hearing impairments to communicate); PT Emergência 2 (hands-free telephone for rapid assistance calls); PT 118 Braille (for the blind and visually impaired); TeleAula (providing access to classrooms for children who are bedridden or confined to the home or hospital).

Assistive technologies' functions and componentes

A home that is technologically prepared to accommodate elderly people and individuals with restricted mobility does not differ very greatly from a dwelling that has been domotised for other social groups. In fact, systems which provide temperature and lighting management, monitoring of the indoor home environment, management of security and other operations, are extremely important for more vulnerable groups.

An intelligent house adapted to accommodate elderly people, those with restricted mobility or the disabled may include the following key functions:

- Providing an environment that is constantly monitored, in a non intrusive way, in order to ensure the safety of residents;
- Ensuring that the tasks the individual is unable to undertake are carried out;

- Ensuring a safe, protected environment;
- Providing autonomy and empowering residents.

A basic telecare system consist of a telephone line and sensors, which are usually wireless, fitted to walls using Velcro tape or attached to the body (as a wristband) which send signals to the telephone and from there to the exterior (the health centre, family, friends, fire service, specialist support service).

If installed without construction work, the system can function without a cable infrastructure, since information is transmitted to the equipment by using radio frequency.

Interfaces also play an important role in domotics applications for the elderly and the disabled, since they represent the face of the system. Research into "universal design" products has been developing alterations to conventional interfaces in order to adapt them to restricted mobility, visual impairment or other conditions affecting this group of people. This has resulted in equipment such as telephones with large buttons for people with visual or motor difficulties, visual alarms using lights for the deaf and telephone systems with text for the speech-impaired, amongst others.

The use of the same software in the various domotics systems in housing facilitates learning and makes it easier for all residents to understand. In addition the use of a language that is closer to the everyday language of users also makes it easier to use e.g. "I'm hot /I'm cold, rather than "25º/15º".

4.2 Assistive technologies according to household profiles and levels of integration

This research aims at determine standard packs of ICAT functions according to different household profiles. The pack of ICAT functions in this case is a description of an ideal set of domotics systems and functions for the household, which is not restricted by any existing morphological or constructional structure of a dwelling.

Within the scope of a more embrancing study several types of households were considered in order to define the ideal pack of ICAT functions and, based on their characteristics and anticipated needs and activities within the home, a set of essential domotics functions were established. Assistive technologies have been considered only for households which really need or may need them at the present time – elderly couples, single elderly people and people with restricted mobility or disabilities. Integration of assistive technologies is not considered relevant for the remaining households, since it represents a very specific proposal and, due to the high cost, it is not acceptable to install the technologies before they are actually necessary. Some technologies which serve both "aging in place" and the comfort of other co-residing groups, e.g. automated control of blinds, were considered in the previous sections.

Three levels of ICAT integration were defined that would meet the real needs of residents, taking into account the evolution of residents' requirements and hence the need to upgrade infrastructure. The different levels of ICAT packs can be chosen according to the household's income. The minimum proposed level of ICAT is recommended for every new or rehabilitated house or dwelling. The medium level is an upgrade of the lower level and requires a greater financial investment. The optimum level of ICAT integrates a complete set of technologies to meet prospective family needs, without becoming unreasonable.

If they do not meet the current or future needs of residents, ICAT elements will involve substantial additional costs in the future. In practice, these costs will be approximately four times higher than they would have been if the resident's needs had been taken into account initially [15].

It is not the intention here to define assistive technologies for various disabled or dependent profiles, but to provide an overview of certain technologies, systems and functions that may be useful to these groups. In these circumstances there should be a Process Facilitator [4], as implemented in the CUSTODIAN project, to mediate ICAT integration in order to determine the real needs of the user and to "understand the richness and individuality of the domestic spaces and the meanings that they have to the occupants" [7].

Within the research goals there are various scenarios in which the the integration of assistive technologies can be done in a dwelling, ranging from full rehabilitation works to an integration without the need for any functional rehabilitation or constructional work. Within this context, assistive technologies have the role of promoting "aging in place", i.e. enabling the elderly to age in their own home supported by technology and essentially using wireless equipment.

The domotic functions regarding assistive technologies are described in Table 1 which allow the decision-making process to assign domotic functions to specific profiles of family.

		Elderly couple	Couples/single elderly person with other person	Single elderly person	People with limited mobility or disabilities
1.1	Safety / Detection of fire				
a.	Detection of smoke and temperature				
b.	Electrically operated valve to switch off power and gas				
c.	Remote alarm (interaction: if 2.1.a is activated remote alarm is sent)				
d.	Local alarm				
e.	Interactions: with 3.2 (e.g. emergency lighting switched on in the event of fire), with 3.3 (e.g. all controled blinds opened before power is cut off, in the event if fire), with 3.4 (e.g. exits opened in the event of an emergency)				
1.2	Safety / Detection of gas leaks				
a.	Detection of gas				
b.	Electrically operated valve to switch off power and gas				
c.	Interactions: with 3.4 (e.g. windows opened to provide ventilation), with 3.2 (e.g. emergency lighting switched on in the event of a gas leak)				
d.	Interaction with 3.4 (e.g. emergency exits opened)				
f.	Remote alarm (interaction: if 2.1.a is activated, remote alarm is sent)				
g.	Local alarm				
1.3	Safety / Detection of flooding				
a.	Detection of flooding				
b.	Electrically operated valve to switch off water				
c.	Power to equipment located near flooded area cut off				
d.	Remote alarm (interaction: if 2.1.a is activated, remote alarm is sent)				
e.	Local alarm				
1.4	Safety / Detection of power failure				
a.	Detection of power failure				
b.	Remote alarm (interaction: if 2.1.a is activated, remote alarm is sent)				
c.	Local alarm				
d.	Emergency socket powered by generator				
2.1	Security / Control of access				
a.	Video caretaker control of access				
b.	Video caretaker linked to various points in the home (TVs, PCs)				
3.1	Confort / Control of HVAC				
a.	On/off control for all units in various places				
b.	Individual control in each room				
c.	Control of maximum and minimum temperature required				
d.	Remote monitoring of air conditioning system				
3.2	Confort / Control of lighting				
a.	Automated lighting controlled by movement sensors in hall – safe entry to home (Interacts with 1.1 and 1.2)				
b.	Automated lighting controlled by movement /presence sensors on bedroom/bathroom route and in these rooms (Interacts with 3.6), with dimmer function				
3.3	Confort / Control of motors (blinds and screens)				
a.	Automated blinds in all rooms				
b.	General open/close control on main panel				
c.	Individual open/close control in each room				
d.	Remote control				
3.4	Confort / Control of motors (doors and windows)				
a.	Entrance door with open/close motor (Interacts with 1.1 and 1.2)				
d.	Specific opening and closing of windows linked to air conditioning/ventilation system (interacts with 2.1 and 3)				
4.1	Information and communication / Communication within the system and with the exterior				
a.	Alarms sent to the exterior via telephone				
b.	Personal alarms with two-way communication between resident and care centre				
4.2	Information and communication / Local networks and Internet				
a.	Access to broadband Internet				
b.	Telecommunications networks in compliance with ITED				
c.	Telecare				
d.	Telehealth	*	*	*	*
5.1	Assistive technologies / basic				
a.	Video monitoring of particular areas				

b.	Personal alarm (portable trigger) / connection to a relative				
c.	Telecare (community alarm - portable trigger / connection to a care centre)				
d.	Panic button in rooms (e.g. bathrooms)				
e.	Detection of falls				
f.	Detection of occupation of bed / prevention of falls				
g.	Night-time waking scenario – automated low-intensity lighting along the bedroom/bathroom route and in the rooms themselves (use of movement/presence sensors and pressure pad near de bed) (supplementing 3.2.b)				
h.	Telephone call scenario (lights switched on in the circulation area leading to the telephone) (Interacts with 3.2a)				
i.	Daily monitoring of consumption (to monitor activity or lack of activity)				
5.2	Assistive technologies / Specific to certain disabilities				
a.	Reminder to take regular medicine				
b.	Other memory aids (e.g. door open, oven switched on, fridge door open, tap on, appointments)				
c.	Device to fill bath to controlled water level				
d.	Temperature control for washbasins and baths to prevent burns.				
e.	Sensors to turn on taps				
f.	Height-adjustable kitchen work surfaces				
g.	Vertical push-button up or down adjustment of toilet and wash basin.				

Basic level Medium level Optimal level

Table 1 – Standard cross-referencing of households and automation assistive technologies considering safety, security, comfort and ICT (this list is restricted to the most needed and useful technologies; optimal level of integration, although defined, is not shown in this table). * In situations of chronic illness

5. CONCLUSION

The present Portuguese demographic context shows a trend towards a growing elderly population and it is therefore important to study hypotheses for improving housing conditions and integrating ICT and AT into housing as a complement and, in some cases, an alternative to assisted healthcare and residential systems. In this sense, it is important to define methodologies that enable this goal to be achieved to increase the autonomy of the elderly and enhance their independent living.

This paper addressed a methodology to define a pack of ICAT to be integrated in housing that corresponds to the household profile and enables three different levels of integration according to the available budget.

To allow "ageing in place" physical rehabilitation of the housing stock is also needed to reduce architectural obstacles and to ensure that the elderly and people with impairments can fully use their houses.

Rehabilitation strategies that take advantage of the division of large houses, that are only partially occupied, into smaller autonomous units with the incorporation of AT will enable to fulfill these goals.

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[i] The INE estimates that in 2050 the increased life expectancy be will be 79.0 for men (72.9 in 2000), and 84.7 for women (79.9 in 2000) (INE 2003)

[ii] Electronic Assistive Technology (EAT) is opposed to assistive technology solutions (AT) achieved by means of mechanical adaptations such as the removal of architectural obstacles – improvements to access, removal of steps, sizing of divisions, etc. There is a large amount of information available on this subject on Guy Dewsbury's site at URL: http://www.smartthinking.ukideas.com/

[iii] Information on the Custodian project available at WWW: <URL: http://www2.rgu.ac.uk/subj/search/research/sustainablehousing/custodian/home.html ?CFID=16502507&CFTOKEN=29780670&jsessionid=503146c3fe209e151a0543e286a755c4b1e2TR> (accessed on 2008-10-12).

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[x] James Barlow, who holded the Chair in Technology and Innovation Management at Imperial College, London and is the author of several studies on intelligent houses, was interviewed by the author as part of the "Housing for the Future" research project in 2004.

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[xii] Information on PT products available at WWW: <URL: http://loja.ptcom.pt/loja/Produtos/Casa/Necessidades_especiais/> (accessed on 2008-10-11)