Ambient Assisted Living and Digital Inclusion: Overview of Projects, Services and Interfaces

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Abstract. The last decades have been characterized by great advances in the field of information and communication technologies and innovative applications and services have been developed in all sectors. People who are more familiar with Internet technologies can take full advantage of the benefits brought by the new systems to everyday life, but, at the same time, if services are not carefully designed, they contribute to augment the digital gap between "info-skilled" users and people who are not acquainted with the new technologies. This paper provides an overview of interesting projects developed with the aim to favor social inclusion and to tear down barriers posed by digital technology, by supporting people with special needs (e.g., elderly and people with different impairments) in the fruition of e-services through easy forms of interactions. The study is restricted to solutions that envisage the TV device as the main user interface for supporting Ambient Assisted Living. From the survey, a basic set of services and interfaces, here described, appear to be fundamental for improving digital and social inclusion, but the design methodology for developing TV-based interfaces and services must be carefully chosen to reduce social marginalization.

Keywords: Ambient assisted living · TV interface · Inclusion

1 Introduction

In these last years, ageing of population and the percentage of elderly people with respect to the entire population are constantly growing, as well as the digital gap between them and *Information and Communication Technology* (ICT) society; this fact is leading to a new type of social marginalization in the era of digital communications.

The concept of social inclusion is strictly correlated with digital inclusion notion, intended as the way to overcome the digital gap between people who are familiar with the fruition of Internet technologies ("info-skilled") and people who are not ("info-marginalized"). Such technologies can provide a huge support to social inclusion, helping elderly or people with special needs to live like others. Although the implementation of ICT services could solve some social marginalization issues for impaired people, the introduction of several services with low usability could limit the number of people accessing them.

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A key issue to favor social inclusion is the provision of e-services through easy forms of interaction, so as to allow elderly or disable people with different impairments (i.e. vision, hearing, mobility, dexterity) to access ICT services without being marginalized by information society. To achieve this goal, specific services and interfaces should be designed and implemented by starting from user perspective and understanding their needs and criticalities.

In this work, we provide an overview of e-service provisioning models, aimed at enhancing digital and social inclusion through the implementation of accessible and usable television-oriented interaction interfaces. Such interfaces are aimed to involve elderly, disabled and their caregivers and other info-marginalized people into the benefits of the ICT society. Specifically, human-machine interfaces towards an easier and more familiar user interaction are described, focusing on their adoption by info-marginalized people.

The paper is organized as follows. Section 2 provides an overview of several projects adopting the TV in *Ambient Assisted Living* (AAL) scenarios. The main concepts of these framework are introduced and discussed, in order to highlight their differences and characteristics. Starting from the outcomes of such projects, Sect. 3 describes platforms, interfaces and services designed to ease the access of info-marginalized users to the ICT society. Available services and user interfaces are introduced, focusing on innovation provided on the digital and social inclusion field. Finally, Sect. 4 presents the concluding remarks.

2 Overview of TV-Centric Projects

Several projects are intended to face critical issues such as to increase independent living or to implement a comprehensive assisted living scenario. This section provides a brief overview of interesting solutions introduced by some projects adopting the TV interface to interact with users.

2.1 T-Seniority

The T-Seniority EU project [1] focuses on the prevention and early action on care for elders, by improving quality of life and social independence through innovative ICT services, delivered on different digital TV technologies. It enabled a replicable solution across Europe within digital services area for the improvement of the quality of life and social care of ageing population.

The system offers a set of integrated care e-services delivered throughout TV and it is basically composed as explained in the following (see Fig. 1).

From the T-Seniority server side, all the information technology infrastructure and support tools necessary to deliver the service reside in a central server hosting a data center. Services are then delivered through the Internet, according to a *Software as a Service* (SaaS) model. All the back-office functionality is included as well.

As regards the channel used by T-Seniority platform to reach end-users, it is convenient to make a distinction among the following television technologies:

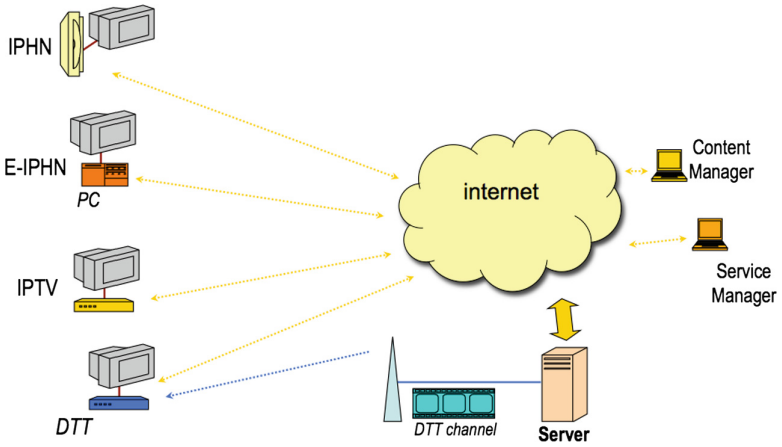

Fig. 1. T-Seniority architecture

- *Digital Terrestrial TV* (DTT), with a basic interaction due to very simple set-top-boxes;
- *Internet Protocol TV* (IPTV), delivered through the Internet as for multimedia content;
- *Internet Protocol Home Networking* (IPHN) with media consoles as interaction devices, such as Nintendo Wii;
- *Enhanced-IPHN* (E-IPHN), added in a second phase, providing a hidden pc as a central device for enhancing usability and accessibility.

The care e-services delivered by the system are composed of several functionalities (i.e. video conferencing, forms, picture books, etc.) that will be available on a specific TV technology, depending on the level of interactivity of the selected TV delivery mechanism. However, a basic set of e-care services are available on all TV technologies on T-Seniority platform, adopting the same user-friendly interfaces which take into account the impairments in vision, hearing, mobility or dexterity.

Concerning tests, several pilots have been arranged in different geographical sites, in order to prove concepts, applications, services, devices and technologies, as well as to gather continuous feedback from users. In particular, seven test sites have been established at partners locations in Spain, Italy, Greece, UK, Finland, France and Cyprus.

2.2 Oldes

OLDES (*Older People's e-services at home*) [2] is an EU co-funded project under the IST Programme that offers new technological solutions to improve quality of life of older people, through the development of very low cost and easy-to-access thematic channels and forums supported by animators.

The system includes wireless environment and medical sensors, linked via a contact center to social services and health care providers for remote monitoring.

The system (see Fig. 2) is composed of a computer installed at user's home and connected to a TV set displaying info provided by the platform via a simplified graphical user interface; access contents are selected by means of a simple remote control.

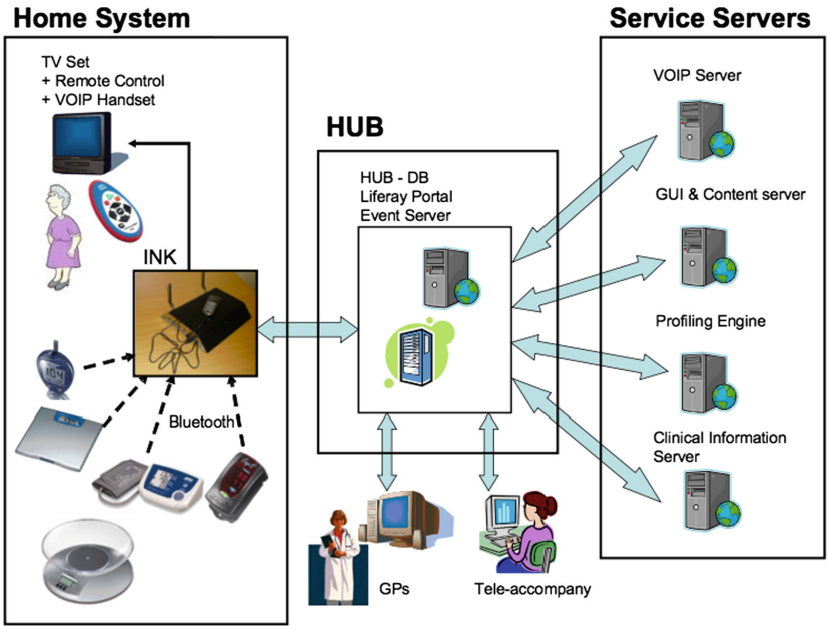

Fig. 2. OLDES architecture (Source: [2])

The system allows users to access audio and video contents and, through an adapted handset connected to the computer, they can actively participate in discussion groups with an animator or call their relatives and friends through VoIP calls.

Concerning health monitoring, a local hub communicates with wireless connection to several medical devices for the telemedicine aspects involving diabetic and cardiopathic patients: an adapted version of sphygmomanometer for obtaining elderly blood pressure, a fingertip pulse oximeter for monitoring SpO2, ECG for measuring heart rate and R-R, a glucose meter for blood glucose level, together with scales for weight check and daily diet. Moreover, some ambient monitoring systems (for patient's home temperature and humidity) have been tested, in order to check patients' living conditions, mainly in summer periods, when raising temperatures may cause serious rebounds to elderly health.

Health services and physicians are therefore able to receive, store and compare medical data and, in case of need, they can promptly respond to raising alarms.

2.3 Soprano

SOPRANO (*Service Oriented PRogrammable smArt enviroNments for Older Europeans*) [3] is an European project aimed to design a system able to assist older people with comfort and safety during everyday life, through integrated delivery of high quality support and care. SOPRANO develops and adapts to normal home environments a sophisticated range of suitably unobtrusive components, seamlessly linked to external service provision, thus enabling elderly users to live independently in society.

A major objective of SOPRANO is to take a leap forward in the way users can interact with and take charge of their living environment, as well as to develop the way professional care personnel can support the SOPRANO users when called on to do so.

Three main focuses of research and development are involved:

- Stand-alone assistive technology: products designed to compensate for motor, sensory and cognitive difficulties, frequently affecting older adults;
- Smart home technology: ICT networking in the home environment, with the integration of appliances and devices to provide control of the entire living space;
- Tele-care services: applications addressing care-related needs prevalent among older people, with ICT used to enable support from professionals and informal carers.

SOPRANO technical architecture enables pro-active assistance, by interpreting information gathered by the system about a user's situation. Responses must follow agreed rules and seamless access provided to external professionals. Safety and security is strongly enhanced with adherence to stringent reliability standards.

To ensure that services fully meet user needs, developers worked with users of SOPRANO system throughout the project lifecycle, from user requirements, through iterative prototyping, validation of concepts and functionality and usability tests involving users in their own homes.

2.4 MonAMI

The objective of the MonAMI (*Mainstreaming on Ambient Intelligence*) [4] project is to demonstrate that accessible, useful services for elderly and disabled persons living at home can be delivered in mainstream systems and platforms, by cooperating with those users and by involving key mainstream actors in the whole process.

MonAMI focuses on an open services architecture, where both services and applications are developed with a Design for All approach involving potential users.

Services are implemented in five thematic sets:

- comfort applications: home control, personalized communication interface, activity planning;
- health: monitoring, medication;
- safety and security: safety at home, visitor validation;
- activity detection;
- communication and information (Fig. 3).

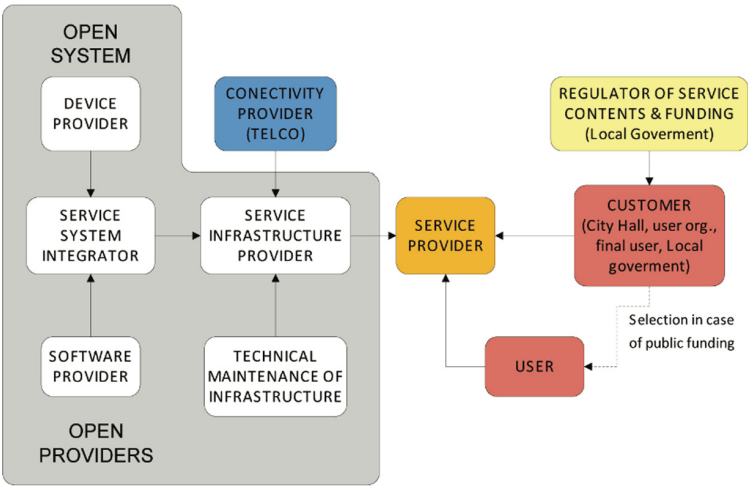

Fig. 3. MonAMI Architecture for open AAL service value chain (Source: [4])

These services were first tested to be feasible, usable and appropriate to user needs in feasibility and usability centres with laboratory conditions, then a living-scale field trial was carried out in Slovakia, Spain and Sweden at users' homes.

This project is an important proof of concept concerning open service provision architecture, implying in the service provision chain primary stakeholders (carers and beneficiaries) and also political institutions, raising awareness on the ambient assisted living solutions for elderly at home.

2.5 Vital

The VITAL (*Vital Assistance for the Elderly*) [5] project uses a combination of technologies and platforms for assisting remotely the elderly users in their home environment, through their most familiar devices, specifically designed for them (mainly TV, but also mobile phones for applications on the run).

The platform of ICT services offered by VITAL is focused on needs which are not limited to traditional assistance, but extend to inter-personal communication, education, personal advice, leisure, entertainment, integration into the information society and to their need of feeling safe while moving in the physical environment.

One of most interesting characteristics of the VITAL project is that it aims at tearing down the barriers which currently impede elderly users from accessing information and infrastructures; it supports elderly people to achieve an active life and to take care of themselves inside and outside their living environment.

2.6 Care@Home

Care@Home [6] project designs and develops an open platform able to provide services to elderly for fostering independent living and, at the same time, to notify caregivers about information on elder's health when needed, in order to prevent health diseases.

As for previously described projects, it encloses the social support system for the elderly, in the form of personalized communication and service channel in their home. It offers not only a two-way communication system for family, friends and caregivers, but also entertainment and additional services (i.e., enabling empowerment, wellness and social care, household, shopping and community information).

Care@home platform takes advantage of the adoption of sensors, wireless communications and multimedia. However, all such complex technologies and functionalities are combined to integrated products and services, in a personalized and easy-to-use approach. Services are delivered through interactive multimedia television, based on the 'design platform' of the Philips Smart TV, so as to be easily accessible and familiar for the user.

2.7 iTVCare

iTVCare [7] is a technological platform based on interactive television, aimed to provide seniors with support for challenging everyday activities, such as medication intake and reminders of medical appointments. It points to improve the quality of life of older adults in non-clinical settings, such as home and public nursing homes. The key challenge of this work is to determine if a television set is suitable and accepted by older people, for reminding to take their medications and doctor appointments, in order to help improving their quality of life

This project concerns the creation of an improved platform of interactive television, based on Google/Android TV technology. It envisages an open platform, built on the Android operating system including Google Chrome and applications developed with Android SDK (*Software Development Kit*).

The system architecture is shown in Fig. 4 and is composed of the following elements:

- iTVCare: a Google TV representing the home system of the user (TV, set-top-box, controller);
- Database: containing information related to medical appointments and medicine intakes;
- Android SDK: embedded in the set-top-box, enabled to execute the applications;
- Services to be consumed by iTVCare;
- Medication intakes and alert generation manager;
- Medical appointments manager;

Basically, users receive the information visually from the TV screen, by interacting through the remote control and a keyboard.

This project carried out also an evaluation of acceptance of the TV technology by the elderly, showing that users have good attitude and strong intention to use this platform, thanks to its ease of use and usefulness.

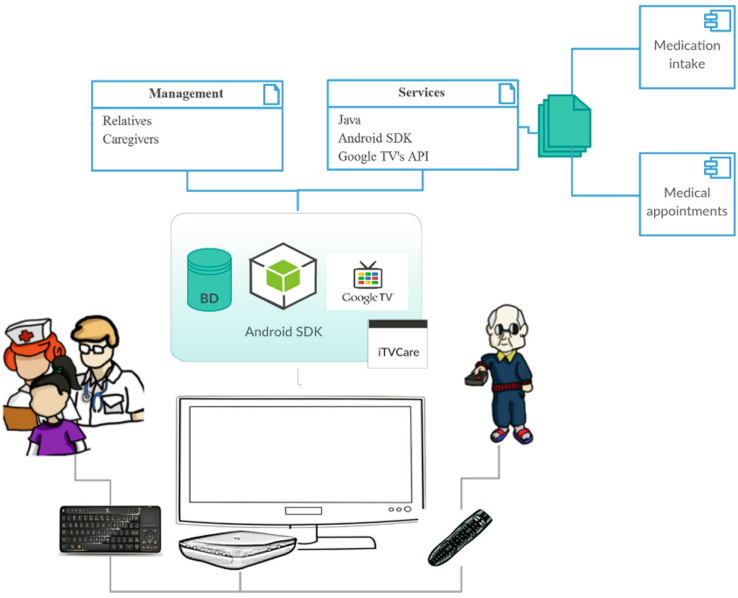

Fig. 4. iTVCare Architecture (Source: [7])

2.8 A Smart TV System for e-Health Services

Work described in [8] introduces and discusses a system for providing a set of e-health services through the smart TV interface. It implements a cloud- based service for remote access to personal medical records and it envisages a local service which allows to monitor health-related parameters, gathered through NFC-enabled medical devices, and to manage reminders for medicines

As shown in Fig. 5, a software application resident within the smart TV is the link between local and remote services. It is also responsible to provide the user's interface to the entire system.

To perform health monitoring, a microcontroller board endowed with Ethernet and NFC modules is used to collect health-related data from medical devices. The NFC reader allows to easily acquire parameters and to store the measures in a database, making them accessible in any moment through the TV application.

Usability tests were performed in laboratory settings, involving elderly people with no experience with smart TV. Results highlighted the usability of the system, showing that users could take advantage of the application and of its functionalities and they could successfully carry out the process of health parameter measurements.

2.9 Other Works

The projects described in this section refer to monitoring platform solutions, not involving TV as service delivery interface for the elderly/patient. They have been added here for providing a wider vision of Ambient Assisted Living concept.

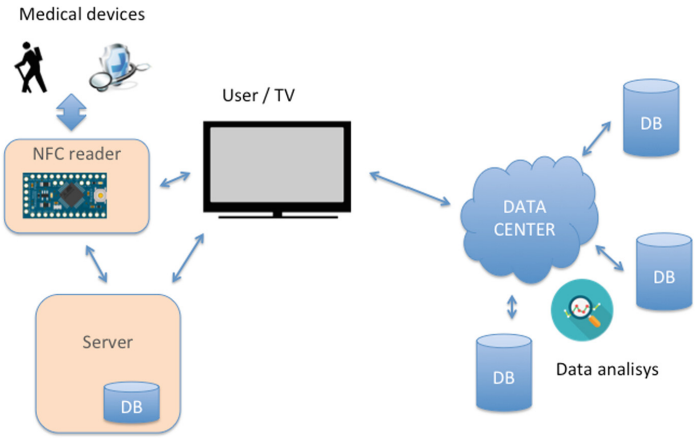

Fig. 5. Overall architecture

Reference [9] describes the design and implementation of an integrated system which collects data from different sensors, placed in a house of a person having dementia, and transmits them to a cloud system, so as to detect the daily activities of the patient and to make them available to remote caregivers.

Seven kinds of sensors are positioned in key places inside the house (i.e. flame sensor, rain sensor, temperature sensor, force sensitive, light sensitive, reed, infrared motion sensor).

Notifications from any IoT device are stored chronologically in the database, and the detection of an activity is determined by triggering a specific set of the sensors. All configurations are analyzed by the software, which enables correct interpretation of the activity in the specific context of the scenario. Consequently, it is possible to identify specific activities and their logical consequences (i.e. interrupted actions, forgotten issues, open doors) and to remind them to the patient or to his caregiver/doctor.

The work in [10] describes a system designed for passive care: it monitors several parameters through a personal area network, composed by a wrist-wearable wireless sensor node and a mobile platform. The system monitors vital parameters (i.e. temperature, accelerometer for falls, heart rate), in order to detect variations on user's status when they are at home. It directly communicates with the user through natural language and it currently accepts simple responses (i.e., Yes or No through voice recognition module) and a more specific limited vocabulary which is tailored to both the user and its general application for the elderly.

3 Services and Interfaces

This chapter summarizes the key elements (services and interfaces) that have been highlighted in the previous projects overview. The main lines of in-depth analysis and research in the sector of ambient assisted living are identified, and specific attention is given to the adoption of the TV terminal as the interface for the fruition of services.

3.1 Services

Starting from a user perspective, a set of key services can be identified as fundamental to prolong independent living or to ease assisted living and to enhance inclusion of info-marginalized audience:

- Voice and Video communication (i.e. calls to relatives, messaging with care organizations for assisted living, …);
- access to general interest information (i.e. weather, sport, news, …);
- public care e-services (i.e. information on pharmacies timetable and locations, hospital facilities, health good practices, …);
- appointments (i.e. meeting with other people, market timetable, …);
- task lists (to schedule tasks during the day or the week) or shopping lists;
- reservations (i.e. medical analysis reservation, movie/theater ticket reservation, …);
- reminders (i.e. for medications or doctor appointments);
- fall detection algorithms, integrated with specific devices;
- exercises at home: showing exercises, motivating users for physical and cognitive stimulation;
- tele-presence (i.e. for fighting loneliness, psychological help)
- tele-monitoring of independent living, available both to external supervision by formal carers or public administration carers, or to the elderly (e.g., firing or fall alerts, …);
- tele-monitoring of vital parameters through specific devices and sensors.

3.2 Interfaces

User interfaces are mechanisms for mediating user interaction with the system and provide different types of interaction with the user, depending on the adopted device [11]:

- *Graphical User Interface* (GUI), a visual way of interacting with computer systems, based on elements presented in a specific device [12] (i.e., desktop computers, television, mobile devices);
- *Web User Interface* (WUI), allowing interactions similarly to GUI, but focused on the Web page standards [12];
- *Tangible User Interface* (TUI), characterized by design retaining the richness of physical interaction, thus involving physical objects [13];
- *Natural User Interface* (NUI), enabling interactions with devices by using human natural resources, like gestures or voice;
- *Multimodal Interaction* (MI), combining natural input modes in a coordinated manner with multimedia systems output [14], through the integration of different categories of user interfaces.

We provide below an overview of the input and output user interfaces which can help to overtake the barriers of common hardware/software; such interfaces, available through different technological solutions, are described for both input and output modes.

Input mode:

- new devices enriching input modalities with easier forms of interaction: Wiimote-like devices [15] and 3D mouses [16] for more intuitive interactions [17];
- an on-screen *qwerty* keyboard, designed to be easily typed through the given controller (or touchscreen if provided) and introducing word prediction algorithms for minimizing typos [18];
- speech commands and tools for content reading (e.g., reading louder for hearing impairments);
- easy user identification, through several biometric techniques such as fingerprinting, hand-palm/iris/voice recognition, or specific movements [19–21], or by adopting smartcards or RFID cards, Quick Response (QR) codes [22] or barcodes.

Output mode: the special needs of older people make it necessary to comply with design guidelines created to support their specific needs.

Some of these guidelines [23–25] were used to design a low-fidelity prototype of iTVCare. The more relevant features are summarized below:

- minimize steps to reach a given screen/option/information;
- avoid scrolling;
- use of tree menus with an intuitive navigation menu;
- show same set of options in the same order, to enhance information consistency.
- reduce the information (i.e. short sentences), avoiding irrelevant content for memory impaired;
- clear indication of the current selection, in order to avoid elderly to get lost when browsing.
- use meaningful and big icons and labels for vision impairment
- prefer graphic symbols to words;
- present clear error messages, only if necessary;
- adopt large font type, high contrast and easy to read font family

Note that "elderly-centered" interface characteristics are based on the technology capabilities in relation with the end user needs. Although different media and technology adopted for service providing and/or application implementation are constantly evolving and improving, Ambient Assisted Living environments should adopt a "common interface": it should be intuitive, easily understandable and familiar for end users, in order to improve their acceptance of technology and to enhance their learning, understanding and usage of value added services [26].

3.3 Design Process

To obtain better results in terms of usability, accessibility and, consequently, digital inclusion, all services and interfaces must be designed focusing on the real user needs [27].

The design phase should be based on the user perspective and should involve users in the implementation and test phase, according to a user-centered design approach [28], as detailed below:

- Specify the usage context: identify people that will use the product, what their goals are when using it, and under which circumstances they will use it.
- Specify requirements: identify all the requirements and the users' objectives that are needed to achieve success with the product.
- Produce design solutions: this part must follow an iterative process, starting from a low fidelity prototype and evolving to a high-fidelity prototype.
- Evaluation: this phase is the most important part of the process and it must be (ideally) executed through tests with real users.

4 Conclusions

In this work we provide a survey on some interesting solutions which envisage the TV terminal as the main user-interface for supporting Ambient Assisted Living.

From these works, carried out within European Community research projects, it can be pointed out how important is the adoption of the TV screen as the main interface for presenting information to info-marginated people (i.e., elderly, impaired …). In fact, many elderly and disabled users are not familiar, and hence not well disposed, with the use of computers or mobile devices, like smartphones or tablets.; on the contrary, the television terminal allows to enhance their willingness towards the fruition of applications, specifically designed for monitoring and supporting an active every-day life, thus contributing to increase digital inclusion.

This survey points out that some types of interfaces are in common to many of the analyzed works; this happens because they are endowed with an ergonomic level and an ease of use, which permit the fruition of crucial services and complex functionalities by persons not acquainted with interaction modalities and information fruition that are typical of ICT channels.

Additionally, it emerges that a set of basic services can be considered as fundamental in the sector of Ambient Assisted Living, towards the improvement of social inclusion and monitoring elderly users and people with impairments in general. Particular attention should be paid to the choice of design methodology and the development of interfaces and services. User-centered design or, in general, participatory design methodology, where users are directly involved in the design phase and provide their feedback to researchers, has been demonstrated to represent the best way to achieve intuitive, familiar and simple interactions for info-marginated people.

We hope that this paper can provide basic indications to whom is involved in the design and implementation of services for disadvantaged users; the key concepts related to interfaces and services for TV-centric systems can be adopted for delivering more accessible information contents, coming also from Internet of Things and innovative sensors scenarios.

References

1. Moumtzi, V., Farinos, J., Wills, C.: T-Seniority: an online service platform to assist independent living of elderly population. In: Proceedings of the 2nd International Conference on Pervasive Technologies Related to Assistive Environments, PETRA 2009, 9–13 June, Corfu, Greece (2009)
2. OLDES (Older People's e-services at home). http://www.oldes.eu/home.html. Accessed 01 February 2018
3. SOPRANO - 045212 - (Service Oriented PRogrammable smArt enviroNments for Older Europeans). http://cordis.europa.eu/project/rcn/80527_en.html. Accessed 25 January 2018
4. Roy, A., Artigas, J., Lain, L., Vaquerizo, E., Falco, J., Ibarz, A.: MonAMI: mainstream on ambient intelligence. e-inclusion living scaled field trial experience in Spain. J. Res. Pract. Inform. Technol. **45**(2), 133–149 (2013)
5. VITAL (Vital Assistance for the Elderly) Contract Type: Specific Targeted Research Project. http://cordis.europa.eu/project/rcn/80735_en.html. Accessed 25 January 2018
6. Care@Home. http://www.aal-europe.eu/projects/carehome/. Accessed 25 January 2018
7. Santana-Mancilla, P., Anido-Rifón, L.: The technology acceptance of a TV platform for the elderly living alone or in public nursing homes. Int. J. Environ. Res. Public Health **14**(6), 617 (2017)
8. Raffaeli, L., Spinsante, S., Gambi, E.: Integrated smart TV-based personal e-Health system. Int. J. E-Health Med. Commun. **7**, 48–64 (2016)
9. Demir, E., Köseoğlu, E., Sokullu, R., Seker, B.: Smart home assistant for ambient assisted living of elderly people with dementia. Procedia Comput. Sci. **113**, 609–614 (2017)
10. Winkley, J., Jiang, P., Jiang, W.: Verity: an ambient assisted living platform. IEEE Trans. Consum. Electron. **58**(2), 364–373 (2012)
11. Bittencourt, I.I., Baranauskas, M.C., Pereira, R., et al.: A systematic review on multi-device inclusive environments. Univ. Access Inf. Soc. **15**, 737 (2016)
12. Newell, A.F., Gregor, P., Morgan, M., Pullin, G., Macaulay, C.: User sensitive inclusive design. Univ. Access Inf. Soc. **9**, 235–243 (2010)
13. Sommerville, I.: Software Engineering, 9th edn. Addison-Wesley, Reading (2010)
14. Pereira, R., Miranda, L.C., Baranauskas M.C.C., Piccolo, L.S.G., Almeida, L.D., Reis, J.C.: Interaction design of social software: clarifying requirements through a culturally aware artifact. In: Proceedings of the International Conference on Information Society, pp. 310–315 (2011)
15. Wii (Nintendo): http://wiiportal.nintendo-europe.com/. Accessed 25 January 2018
16. Logitech MX Air Mouse: https://support.logitech.com/it_it/product/mx-air-rechargeable-cordless-air-mouse. Accessed 25 January 2018
17. Martins, M., Cunha, A., Oliveira, I., et al.: Usability test of 3Dconnexion 3D mice versus keyboard + mouse in Second Life undertaken by people with motor disabilities due to medullary lesions. Univ. Access Inf. Soc. **14**, 5 (2015)
18. Badr, G., Raynal, M.: Optimized interaction with word prediction list. In: Proceedings of the Association for the Advancement of Assistive Technology in Europe, Florence, Italy, p. 871 (2009)
19. Shirali-Shahreza, M.: Login to internet websites by next generation game console. In: Proceedings of IEEE/IFIP International Conference in Central Asia on Internet, Tashkent, Uzbekistan, pp. 1–4 (2006)
20. Akhteruzzaman, M., Alam, M.S.: Real time fingerprint identification. In: Proceedings of IEEE National Aerospace and Electronics Conference, NAECON, Tuscaloosa, Alabama, USA, pp. 433–440 (2000)

21. Alonso, J.B., Ferrer, M.A., Rafael Diaz, M., Travieso, C.M.: Biometric system based in the feature of hand palm. In: Proceedings of the International Carnahan Conference on Security Technology (2004)
22. ZXing, Z.: Crossing: http://code.google.com/p/zxing/. Accessed 25 January 2018
23. Johnson, J., Finn, K.: Designing User Interfaces for an Aging Population: Towards Universal Design. Elsevier, Amsterdam (2017)
24. Loureiro, B., Rodrigues, R.: Design guidelines and design recommendations of multi-touch interfaces for elders. In: Proceedings of the 7th International Conference on Advances in Computer-Human Interactions, Barcelona, Spain, 23–27, pp. 41–47 (2014)
25. Nunes, F., Kerwin, M., Silva, P.A.: Design recommendations for TV user interfaces for older adults: findings from the eCAALYX project, p. 41. ACM Press, New York (2012)
26. Wills, C., Moumtzi, V., Vontas, A.: A real case study of assistive living ecosystems. In: Proceedings of 4th IEEE International Conference on Digital Ecosystems and Technologies (2010)
27. Dewsbury, G., Rouncefield, M., Sommerville, I., et al.: Designing technology with older people. Univ. Access Inf. Soc. **6**, 207 (2007)
28. Bevan, N., Bogomolni, I.: Incorporating user quality requirements in the software development process. In: Proceedings of 4th International Software & Internet Quality Week Conference (QWE2000), Brussels, Belgium (2000)