A Mobile Augmented Reality Assistive Technology for the Elderly

Tecnología asistencial móvil, con realidad aumentada, para las personas mayores

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ABSTRACT

Modern technology offers many facilities, but elderly people are often unable to enjoy them fully because they feel discouraged or intimidated by modern devices, and thus become progressively isolated in a society where Internet communication and ICT knowledge are essential. In this paper we present a study performed during the Nacodeal Project, which aims to offer a technological solution that may improve elderly people's every day autonomy and life quality through the integration of ICTs. In order to achieve this goal, state-of-art Augmented Reality technology was developed along with carefully designed Internet services and interfaces for mobile devices. Such technology only requires the infrastructure which already exists in most residences and health-care centres. We present the design of a prototypical system consisting of a tablet and a wearable AR system, and the evaluation of its impact on the social interaction of its users as well its acceptance and usability. This evaluation was performed, through focus groups and individual pilot tests, on 48 participants that included elderly people, caregivers and experts. Their feedback leads us to the conclusion that there are significant benefits to be gained and much interest among the elderly in assistive AR-based ICTs, particularly in relation to the communication and autonomy that they may provide.

RESUMEN

Las posibilidades que ofrecen las tecnologías son muchas, sin embargo, las personas mayores son a menudo incapaces de disfrutar de ellas plenamente, sintiéndose desanimadas o intimidadas por estos nuevos dispositivos. Esto les lleva a un progresivo aislamiento en una sociedad donde es esencial conocer las distintas formas de comunicación a través de Internet y las TIC. En este trabajo presentamos un estudio realizado durante el proyecto Nacodeal, cuyo objetivo es ofrecer una solución tecnológica para proporcionar autonomía y una mejor calidad de vida para las personas mayores durante sus actividades diarias mediante la integración de las TIC. Para lograr este objetivo se ha desarrollado tecnología puntera en realidad aumentada (RA), así como servicios de Internet e interfaces para dispositivos móviles especialmente diseñados para personas mayores. Estas tecnologías emplean la infraestructura presente en la mayoría de casas y centros de cuidados de mayores. Presentamos un prototipo de sistema compuesto por una tableta y un dispositivo de RA portátil, así como el análisis del impacto social en la interacción con usuarios y la valoración de la aceptación y usabilidad. Esta evaluación se llevó a cabo a través de grupos focales y pruebas piloto individuales con 48 participantes: ancianos, cuidadores y expertos. Sus comentarios concluyen que existen fuertes beneficios e intereses por parte de las personas mayores en las TIC asistenciales basadas en RA, especialmente en los aspectos relacionados con la comunicación y autonomía.

1. Introduction

Today, everybody agrees that we live in a society which is constantly evolving and which has become increasingly dependent on the use of new technologies to fuel this change. Such constant changes affect the members of society since there is an implied cost of adapting to all new habits and practices (time, effort etc.). In many ways, both the growing pace and the amplitude of this change has led to a widening of the gap between members of society who adapt and those who have difficulties adapting. Citizens aged 65 or over - the elderly - suffer from the added limitations that come with the aging process. Moreover, the stereotypical view relating age to resistance to change and inability to learn new approaches is detrimental to their integration and living quality in an increasingly digital society. This poses a serious social problem, pronounced by a marketing tendency towards a young audience or a focus on users with technical expertise (Prensky, 2001), and is further aggravated by the increased degree of social isolation that comes with age.

According to the Eurostat report of 2014 (European Commision, 2014), the number of elderly citizens in the European Union already constitutes 18.2% of the population, and is expected to increase to 31.3% within 20 years. Italy, in particular, is the European country most affected by these issues: approximately 250,000 Italians are affected by Alzheimer´s disease and a comparable amount with dementia (Chiatti, 2013), underlining the need for continuous assistance by carers and ICT devices.

Contrary to some common beliefs, elderly people are aware of the importance and benefits of ICTs, regardless of gender or degree of studies, as evidenced by studies by Agudo, Fombona and Pascual (2013: 131-142). It was observed that ICTs are mostly used for social and entertainment purposes such as contacting friends and family members, or creating-media content (Agudo, Fombona & Pascual, 2012). Moreover, elders show a good acceptance of multimedia applications such as videoconference/calls and online video to complement their daily activities.

A novel form of delivery of media content and interaction towards assistive technologies is Augmented Reality (AR). This approach consists of the superimposition of some animation or image in a realistic way, over an image captured by a digital camera. This technology has been recognized by educational researchers as a powerful interactive tool (Wu, Lee, Chang & Liang, 2013) for tasks such as visualization of complex structures (Arvanitis & al., 2009), educational

games (Rosenbaum, Klopfer & Perry, 2007), and design-based learning (Bower, Howe, McCredie, Robinson & Grover, 2014), resulting in increased student motivation. Usually, this content is delivered through computers, tablets or mobile phones, and such functionality has been incorporated into some assisted living systems (Avilés, Villanueva, Garcia-Macias & Palafox, 2009). Still, the acceptance of such technology, as pointed out by Hernández-Encuentra, Pousada and Gómez-Zuñiga (2009: 226-245), is not a mere matter of usability or design: the technology shouldn't only be a tool to replace what had been lost, but rather a tool for personal development.

One important observation of their work is: «It can be concluded that the adaptation of ICTs to elderly users is necessary, but that in itself does not mean that they will use the technology. The device must be customized, modulated and scaled specifically for an older population in which the inter-individual variability is increasing». This flexibility towards the individual necessities of the elderly is an essential part of the design of new technologies.

Computers and tablets require constant interaction and manipulation, which can make them unsuitable as a medium of content delivery for the elderly (Kurz, Fedosov & al., 2014; Almeida, Orduña, Castillejo, López-de-Ipiña & Sacristán, 2011; López-de-Ipiña, Klein & Perez-Velasco, 2013). The Sixty Sense project (Mistry & Maes, 2009) showed that realistic visual cues can be added into a user's surroundings by using AR together with a portable camera and a pico projector, and this can provide a promising approximation towards interaction with the user. Progress in AR and Simultaneous Localisation and Mapping (SLAM) methods (Henry, Krainin, Herbst, Ren & Fox, 2012; Engel, Schöps & Cremers, 2014) has removed the need for the introduction of AR markers and the adaptation of the environment for their usage.

The rationale behind the Nacodeal (Natural Communication Device for Assisted Living) project is the development of a new type of Assisted Living system for elderly people with an aim to increasing their social integration through ICTs. A guidance and communication service is provided by using two devices. The first is a tablet incorporating software developed for the end user's needs and requirements, customizable and accessible to different user categories. The second is a new kind of Augmented Reality technology (Saracchini & Ortega, 2014): a wearable device with an embedded pico projector and camera which locate the user position and orientation by using a 3D map of the environment, projecting information realistically (figure 1).

Using this technology, it is possible to create friendly guides so that its users will be capable of performing their daily activities and accessing online services which are relevant to them. In order to satisfy these conditions, the following requirements were established:

Figure 1. Conventional AR (left) , information is exhibited on a display. On-site AR (right), information is projected and observed in the environment.

• The system has to determine the user location and the AR device orientation in real-time, exhibiting content autonomously.

• It must be viable for health-care centres or residences without relying on a complex infrastructure or expensive equipment.

• The end user should interact with the system through a mobile interface (tablet), tailored to his/her cognitive levels.

• It must act as a bridging tool between ICTs, the end user and his/her family, and caregivers without changing the user's routine or reducing mobility.

• It should produce minimal changes in the environment, and not require elements such as AR markers.

These requirements should not be attained by Wi-Fi or RFID triangulation, since they do not provide precise positioning and orientation of a portable device, and also tend to require a complex and expensive infrastructure.

• Visual SLAM/AR approaches can fulfil these requirements using off-the-shelf components such as Webcams and computers.

In order to assess the efficacy of the proposed system, a study was made with elderly volunteers, caregivers and specialists from Italian health-care centres, aiming to determine the benefits in their social interactions, as well any desirable characteristics regarding content, functionality and usability. The next section will offer an overview of the Assisted Living system and details of the validation process.

2. Design and validation methodology
2.1. The assisted living system

The assisted living system was designed to use a resource available in most residences and public spaces: a wireless Internet access point. Its components are separated in two main groups: the remote infrastructure, a Web-based service that manages the content to be exhibited by the system and the local infrastructure, which is the hardware installed in the health-care centre or residence, and the interfacing devices which interact with the end-user (figure 2).

The system has been designed taking into account two main factors: the content creator and the end user. The content creator is responsible for creating and programming the multimedia content to be displayed by the assisted living system. This person (or group
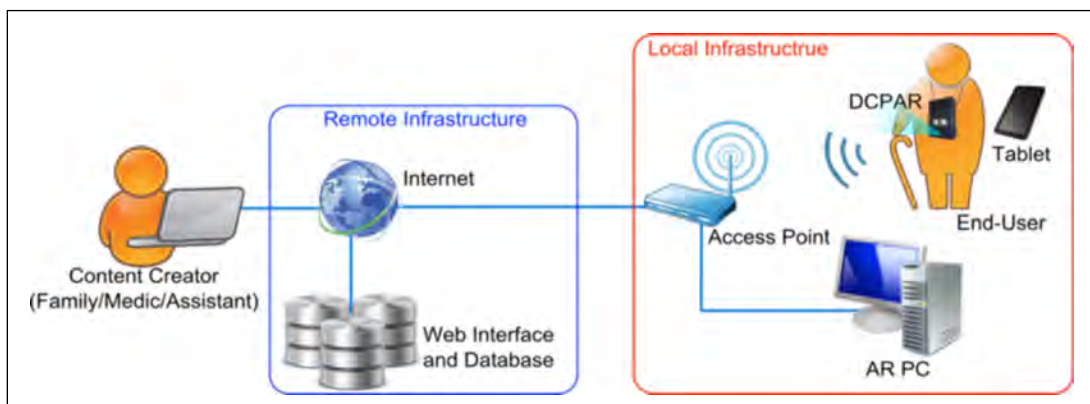

Figure 2. Design of the experimental Assisted Living system.

of people) can be a caregiver, doctor, relative or behavioural specialist, interacting with the system through a Web-interface accessible through a computer or smart-phone. The end user is the elderly person, to whom this content will be delivered through the tablet and the wearable AR device, denominated DCPAR (Device with Pico Projector for Augmented Reality) (figure 3).

A core concept of this design is that neither actor requires more than the knowledge necessary to use common house appliances. The content creator needs to know how to navigate a standard Web-page, create or edit digital pictures, presentations and movies, or at least submit already created content. The end user is required to have only basic knowledge of how to use the tablet features and no technical knowledge in order to receive AR content. Due to the wireless capabilities of the devices, the end user is not obligated to stay in a single place as he/she would if using a personal computer. This enables him/her to conduct his/her daily routine with as little interference as possible.

• Web-interface and Database. The main purpose of the Web-Interface is to enable authorized content creators to upload media content and determine where and in what context AR content should be displayed. This data will be stored in a remote database, which will be accessed by the components of the local infrastructure. Some potential services to be delivered are personal agendas and calendar, messaging, VoIP calls and online chats, newspapers, magazines, memory exercises and information about personal therapy, educational videos about subjects of interest (culinary, handcraft work, etc.), maps with advice about potential hazards, and content produced by relatives such as videos, pictures or music.

The content creators can personalise the services according to the user's needs and habits. Furthermore, each area, with the related services offered, has been designed based on user requirements collected thanks to a specific analysis of the contents (De-Beni, 2009; De-Beni & Carretti, 2010).

• AR PC. The Augmented Reality PC is a dedicated computer connected to a wireless access point. It acts as the system processing centre, not limited by the weight, energy consumption or ergonomic constraints of typical mobile devices. The AR PC automatically distributes video and audio content to be transmitted to the tablet and the DCPAR devices in real-time, monitoring the database at determined intervals in order to retrieve changes in programmed schedules. It is also responsible for the execution of algorithms for Augmented Reality, environment recognition and determination of DCPAR orientation by processing the data transmitted by its camera. Other services, such as facial recognition or behaviour analysis, can be added through software updates, avoiding hardware replacement. This component is designed to be highly automated, and initializes the entire content exhibition just after being turned on like a common house appliance. In environments with multiple end-users, such as a health-care centre, the system is managed by an operator such as a nurse or gerontologist.

• Tablet. This is a consumer tablet containing intuitive software with an orientation support system constructed according to the criteria of ROT (Reality

Figure 3. Interface devices: the tablet (left) and the DCPAR prototype (right).

Orientation Therapy), aimed at supporting people with cognitive problems. This therapy allows stimulating the users throughout the day, through continuous information relating to their personal data, space and time. It facilitates the construction of coherent cognitive representations, allowing better understanding of the context that surrounds the user and the role that he/she has. The software interface aims to simplify the user's navigation inside the services and applications and to continuously stimulate their memory. The tablet holds four main applications: Calendar, Talk, Games and Entertainment. Each field represents a dedicated service, promoting the elderly person's brain activity during its use and helping him/her to remember appointments and daily activities.

• DCPAR. The DCPAR prototype is a wearable device containing an embedded camera, a pico projector and a wireless transmitter housed in a 10x14x3 cm casing with straps which go round the neck. Although it is specialized hardware, low cost components have been used in order to achieve affordability. The device acts as an input-output video stream device, transmitting the environment visualised by the camera, which is processed by the AR PC, thus allo-

wing the generation of an image. This allows the automatic exhibition of media advice associated with each given location. For instance, when the user approaches a stove, it projects a warning about the potential hazard. More interactive content can be programmed, for example a guiding arrow adjusted in real time, depending-on user location.

• Installation. The wireless access point and AR PC use the network available at the place of installation and are positioned where there is good wireless coverage. To ensure that the Augmented Reality, recognition and localization algorithms function properly, a 3D map of the environment has to be prepared in advance. This step is done using a specialized software (Saracchini & Ortega, 2014) run through a laptop connected with a depth sensor such as the Microsoft Kinect, which scans places of interest. A 3D map is then generated and stored in the database, where the content creator can configure the AR programming according the user needs. The scanning procedure takes no longer than one or two hours, depending on the size of the scanned area. Once completed, the Assisted Living system is ready to use. Significant changes in the environment, such as if the walls are repainted, or if furniture is moved or replaced may require re-scanning, since the localization system is based on visual cues.

2.2. Validation with users

In order to effectively assess the proposed design, it is necessary to analyse its usage with elderly users, determining points of failure and inadequacies to their necessities in order to establish any concrete benefits brought to their routine. One of the key contributions to be analysed is the reduction of social isolation, and the improvement in socialisation, integration and interaction with elders affected by temporary memory loss. Taking this factor in consideration, our tests had been carried out in group sessions and individual pilots in rest homes and health-care centres located in the province of Ancona, Italy.

The user validation

phase of the system has been structured in 2 steps: a focus group that involved elderly users, caregivers and experts (test performance phase 1) and individual pilot sessions in real scenarios (test performance phase 2).

The first part of the test –the group session– was aimed at comprehending the point of view of elderly people concerning the two components of the Assisted Living system, using one focus group for each facility in order to support the subjects approximation to this new technology and make it easier for them to understand the services and applications installed. The functions and features of the devices were explained during the sessions, and some initial feedback was retrieved. A group of experts was invited to evaluate the devices and interaction with the elderly users. As a non-medical preventive tool, the system does not target patients who suffer from serious cognitive trouble, and the Clinical Dementia Rating (CDR) scale (Herndon, 2006) was used as reference base during the selection process of participants. The tests targeted people from the scale CDR 0 to CDR 1 (table 1).

In the focus groups, the experts evaluated how the devices influenced social interaction and how each individual application of the device was able to offer autonomy, well-being and happiness. They also performed an assessment of which kind of application was preferred by the end users, and to what extent the use of social media produced new interest in the elderly. Other aspects such as the usability of the tablet and desired functionalities for the DCPAR were also evaluated.

The first focus group was in Chiaravalle, in the La Ginestra rest home, with a total of 12 participants among elderly, caregivers and experts. Seven volunteers participated as pilots, and two as observers. The expert team was composed of the coordinator of the residence, an expert in Alzheimer's disease and an operator responsible for recreational activities.

Table 1. CDR scale and associated cognitive status		
CDR SCALE	**COGNITIVE STATUS**	**DEFINITION**
CDR 0	No cognitive impairment	Normal memory status, no memory loss or slight inconsistent forgetfulness. Person is fully oriented and can live autonomously. Able to maintain social relationships and intellectual interests and hobbies.
CDR 0.5	Questionable cognitive impairment	Slight forgetfulness with a partial recollection of events, but good orientation capabilities. Slight difficulty in solving problems and in social relationships. Slightly impaired autonomy and necessity of aid in home activities and in personal care.
CDR 1	Mild cognitive impairment	Moderate memory loss, more marked for recent events and interference carrying out everyday activities. Moderate difficulty with time orientation and some geographic disorientation. Incapable to carry out independently daily activities. Requires assistance in dressing, personal hygiene.

The second focus group was in Jesi, at the Victor Emanuele II residence. This group was composed of a greater number of participants, although most of them were simple observers (4 pilots and 8 observers). The devices and their usage were evaluated by the rest home coordinator, a member of Alzheimer Marche Association, a social-health operator, 2 operators responsible for recreational activities and a relative of one of the elders.

Table 2. Test performance phase 1 - Focus Group sessions				
	LA GINESTRA	V. EMANUELLE	VISINTINI	TOTAL
Facility	Rest home	Rest home	Health-care centre	
Total of participants	12	18	5	35
- Elderly users involved in 2nd test session	7	4	2	13
-Observers	2	8	0	10
-Experts	3	5	2	10
-Technicians / Researchers	0	1	1	2

Table 3. Test performance phase 2. Individual pilots and CDR status				
	LA GINESTRA	V. EMANUELLE	VISINTINI	TOTAL
Elderly users involved	7	4	2	13
CDR0	2	2	0	4
CDR0.5	3	2	1	6
CDR1	2	0	1	3

The third focus group was situated at Falconara Marittima in the Visintini residence, dedicated to patients suffering from Alzheimer's and senile dementia problems. This focus group was intended to evaluate the interaction of elders with more severe cognition issues, and was significant smaller than the others. The focus group was supported by the daily centre coordinator; a psychologist specialized in cognitive impairments and one volunteer from the centre.

The second session involved 13 pilots: 10 women and 3 men with an average age of 80.3 years. Their physical and cognitive profile was also varied: six of them used wheelchairs due physical pain or infirmity, two had mild cognitive issues (CDR 0.5 and 1), and five had good physical and mental conditions. All participants resided on the tested facilities, except 3 of them: one resides in his own home and 2 others spend the day in the daily centre but return to a relative's home at night (tables 2 and 3).

3. Results
3.1. End-user feedback
Of the elderly users involved in the individual pilots, 30.8% felt completely at ease during the tests and 30.8% sufficiently at ease, thus providing 61.6% positive feedback. The remainder of the population (38.4%) felt uncomfortable, although no one rejected the devices completely. This reaction was considered quite normal with this kind of target due their unfamiliarity and certain degree of resistance towards their usage. See graph 1.

The feedback collected after the testing with the tablet was mostly positive and almost all of the elderly interviewed felt an initial embarrassment and insecurity followed by a feeling of curiosity and excitement. The elderly considered the tablet «a good tool to stay in contact with family and friends» with «easy access» and the ability to promote their «wellbeing and the sense of not feeling alone…». Many of them, after an initial resistance and fear toward the «new», learned to handle the tablet and DCPAR with familiarity. After understanding their functionality, they demonstrated enthusiasm and the will to learn much more about their functions. This progressive involvement was followed by a positive collaboration, but it also produced two critical issues: the problem of dependence on the devices and the management of the negative reactions and disappointment by the elderly at the end of the tests. The experts confirmed that the issue of «addiction» is typical in this kind of target, who are often lonely with few possibilities of social interaction or who live a monotonous life with low cognitive stimulation. Every form of involvement that enhances their memories is appreciated.

• Tablet. From the result of the survey, the elders evaluated their favourite service as the photo library (46.2%), followed by TV and video streaming (23.1%). A similar percentage (15.4%) was obtained for video calling and messaging functions and audio player. The participants showed little interest in the other applications. Their focus was in fact, directed on the content related to their relatives and friends. The agenda, especially, was considered too difficult to use by the participants with cognitive issues.

The participants desired to improve the photo album and music applications, especially regarding the
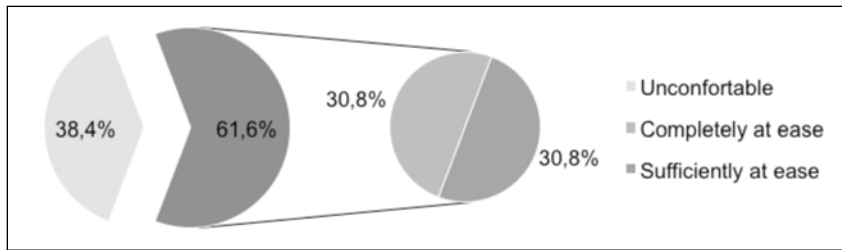
Graph 1. Degree of acceptance of the devices during the focus group.

audio volume (hearing impairment) and image size (eyesight problems). They also manifested a wish for more multimedia content from their time, as well a more intuitive interface. See graph 2.

• DCPAR. In general, they felt the DCPAR bulky and heavy, sometimes having difficulties to understand its usage properly. However, most of them managed to use the tablet and AR functionalities with a high degree of autonomy. Regarding the device's functionality, the users were very pleased with its capacity to project images and movies from relatives or subjects of interest such as sport or religion. The device responsiveness was deemed suitable, adapting the projected image to the geometry of the environment properly. The most desired functionalities of the DCPAR were the active visualisation of content produced by their relatives and its use as agenda device, contrasting with the difficulties present in the tablet (graph 3).

A significant issue appeared regarding the device ergonomics: due the user's posture and pico projector inclination, the image projection was inferior to that expected. Also, it was deemed uncomfortable since it is worn around the neck, potentially increasing issues caused by arthrosis, common in people of advanced age.

3.2. Carer feedback

The carers considered the Assisted Living system a useful tool, but overly complicated for independent use by an elderly person, especially if the user has cognitive or physical problems. This was reinforced by the testers and their families, whom suggested improvements in some details of the graphic interface, such as the «keyboard size» and a full involvement of the

caregivers, «who must play a central role during the elderly people's introduction to and training with the new technology». They also suggested adding exercises to promote the association between places and images, in order to stimulate the spatial perception within the environments –facility or private home– and introduce the possibility to make video calls with relatives and friends.
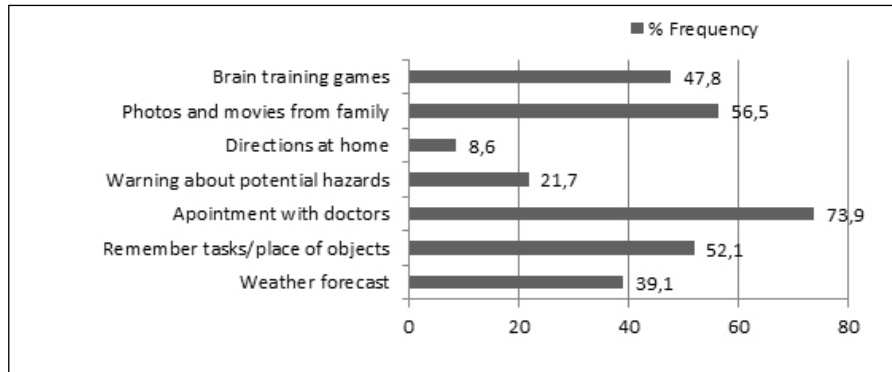
According to the carers, the use of the proposed system may change based on the environment where it is used. In an elderly person's home it is useful for the memorization of appointments and events, as an alarm system for domestic dangers and obstacles, as a reminder to take medicines properly, as a phone system to communicate with their own social network, and as a stimulus to increase short term memory and personal interests. In a nursing home the system can improve the relationships among users as an entertainment device, it can help users remember their daily activi-
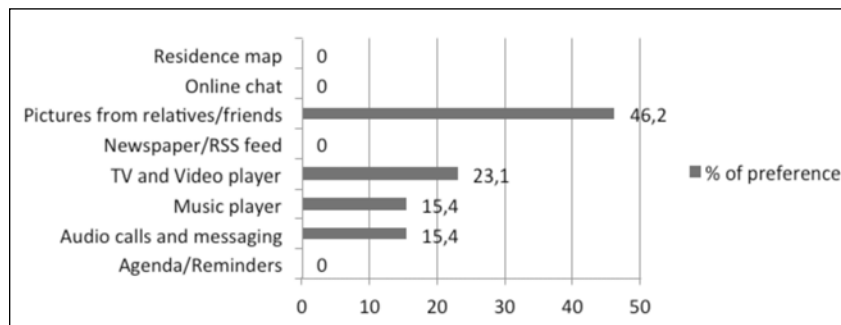
Graph 2. Favourite services provided by the tablet.

ties, and it can make it easier to identify objects present in the space through the association of the name made visible by the AR projections.

They observed how the DCPAR images were appreciated by the users wearing it and by the surrounding elders. It was also considered a stimulating tool for the mobility of the elderly. The testers felt compelled to investigate more, walking a lot during the pilots. As weak points, they identified its unsuitability for people with physical problems (e.g. elderly using wheelchairs) due to the viewing angle, and the difficulty of carrying it around for prolonged times. Furthermore they suggested the support of carers or

Graph 3. Frequency of requested DCPAR functionalities by elder users.

of the elders regarding the ICT involved. This reinforces the notion that «these generations of the elderly need and want to learn, and see this moment in their lives as the right time to approach ICT (Agudo & al., 2012).

family members in managing user appointments and user personal profiles on the on-line database.

Finally the carers believed that the best way to encourage seniors in the use of the ICT devices was through an initial gradual approach process with the constant support of a «trainer» (e.g. a carer or relative). The approach that new technology needs involves people who have close contact with the users, since the users are much more collaborative with them than with strangers. Another interesting method to introduce seniors to the system could be through a more entertaining approach such as using educational games.

The experts who participated in the system validation consider the elderly people's involvement starting from the first phases to be fundamental in order to avoid their isolation tendency. It could also be an excellent tool for elderly with dementia diseases to support traditional non-pharmacological therapy, although in this case the users would need support from an operator.

4. Conclusions

The user-need analysis and the grade of acceptance of the proposed technology solution has highlighted how important it is for the elderly to stay constantly in contact with other people in order to positively stimulate their cognitive functions and prevent social isolation. The relational component has been carefully considered during the validation phase of the prototype in order to understand the real value of the tested technology and its ability to effectively influence the market.

The results showed that most of the elders want to be involved in the digital process, but with specific attention to their previous knowledge and experience that means a deep respect of their learning times. Most difficulties that arose were related to interface design and usability due to their specific cognitive requirements, and not to the level of interest or understanding

Augmented Reality plays an important role in the Assisted Living system, as it offers automatic context detection and the realistic introduction of information into the environment. In contrast to the tablet, the system is capable of interacting with users autonomously, adopting the role of «personal assistant», helping them achieve goals instead of deviating them from their usual routine. This improves their potential mobility, and the information provided for the elderly that suffer from temporary memory loss becomes an added –or «augmented»– value that is expressed through the most accessible channel to this target group: the association between experience and images. The matching between images and written/audio messages, according to experts in cognitive neuropsychology, promotes and stimulates the brain's activities and helps older people to maintain their memory in good health for as long as possible (Essay UK, 2006; Mazzucchi, 2008). The analysis made in this study produced valuable information towards designing a suitable AR device for elderly users. As pointed out by the users and experts involved, the prototype was too bulky and cumbersome. The device should incorporate a better ergonomic design and provide a simpler way of projecting an image in the field of view if there is to be continuous use and constant integration into the users' lives. In order to achieve this goal, further research in miniaturisation and ergonomics of portable computing devices should be carried out.

Further testing is needed on elderly people who live alone. Their necessities and points of view may differ considerably from those who have constant contact with caregivers, and our survey didn't cover this aspect. Currently, we are performing studies on volunteers under such conditions in order to measure the degree of impact that the proposed system may have on them.

It can be concluded that the proposed technologi-

cal solution presents an advance towards the introduction of ICTs to the elderly, with potential beneficial impacts on their lives. The tablet and the DCPAR have the potential to promote social interaction and virtually stimulate the cognitive process in the elderly, thus enhancing their self-sufficiency and quality of life. The system avoids being a mere tool to compensate losses or delegate functions, a factor that elderly people identified as being a negative effect of ICTs (Hernández-Encuentra & al., 2009). Instead, this technology has the potential to complement the process of personal growth at this stage of life by giving access to educational and entertainment content and by enabling seniors to overcome social isolation effects by keeping in touch with relatives, friends and society. In future research, improvements in this technology will be investigated with the following goals in mind:

• To provide the elderly who live alone the possibility to stay in contact with relatives and friends.

• To promote autonomy among the elderly through assistive and educational content.

• To increase the users' sense of safety and serenity through the possibility of implementing a call centre that can provide them with quick assistance.

By «augmenting» elderly people, there is increasing expectation that integrated AR technology in mobile devices will make their contact with ICTs and digital facilities a pleasant and natural experience. Progress in visualization and portable technology, such as the recently developed Google Glasses, and smart-watches supports the notion that ICTs have the potential to reach most members of society, regardless of age or gender.

Acknowledgments

References

Arvanitis, T., Petrou, A., & al. (2009). Human Factors and Qualitative pedagogical evaluation of a Mobile Augmented Reality System for Science Education Used by Learners with Physical Disabilities. *Personal and Ubiquitous Computing*, 13(3), 243-250. DOI: http://dx.doi.org/10.1007/s00779-007-0187-7

Avilés, E., Villanueva, I., García-Macías, J., & Palafox, L. (2009). Taking Care of Our Elders Through Augmented Spaces. *Proceedings of Latin American Web Congress*, 16-21. DOI: http://dx.doi.org/10.1109/LA-WEB.2009.30

Bower, M., Howe, C., McCredie, N., Robinson, A., & Grover, D. (2014). Augmented Reality in Education – Cases, Places and Potentials. *Educational Media International*, 51(1), 1-15. DOI: http://dx.doi.org/10.1080/09523987.2014.889400

Chiatti, C. (2013). The UP-TECH Project, an Intervention to Support Caregivers of Alzheimer's Disease Patients in Italy: Study Protocol for a Randomized Controlled Trial. *Trials*, 14(1), 155. DOI: http://dx.doi.org/10.1186/1745-6215-14-155

Cutler, S.J. (2007). Ageism and Technology. Generations. *Journal of the American Society on Aging*, 29(3), 67-72.

De-Beni, R. (2009). *Psicologia dell'invecchiamento*. Bologna: il Mulino.

De-Beni, R., & Carretti, B. (2010). *Come migliorare la memoria nell'invecchiamento*. Padova (Italy): Psicologia Contemporanea.

Engel, J., Schöps, T., & Cremers, D. (2014). LSD-SLAM: Large-Scale Direct Monocular SLAM. *European Conference on Computer Vision-ECCV 2014*. (pp. 834-849). Springer International Publishing. DOI: http://dx.doi.org/10.1007/978-3-319-10605-2_54

Essay UK. (2006). *The Benefits of Therapies Activies such as Reality Orientation*. Essay UK web-page. (http://goo.gl/qTH3kU) (10-09-2014).

European Commision. (2014). *Eurostat. Population Structure and Ageing*. Eurostat Web-page (http://goo.gl/4gyNuI) (10-09-2014).

Henry, P., Krainin, M., & al. (2012). Rgb-D Mapping: Using Kinect-style Depth Cameras for Denser 3D Modelling of Indoor Environments. *The International Journal of Robotics Research*, 31(5), 647-663. DOI: http://dx.doi.org/10.1177/0278364911434148

Hernández-Encuentra, E., Pousada, M., & Gómez-Zuñiga, B. (2009). ICT and Older People: Beyond Usability. *Educational Gerontology*, 35(3), 226-245. DOI: http://dx.doi.org/10.1080/036012708-02466934

Herndon, R.M. (2006). *Handbook of Neurologic Rating Scales*. New York, MA: Demos Medical Publishing.

Kurz, D., Fedosov, A., & al. (2014). [Poster] Towards Mobile Augmented Reality for the Elderly. *Proceedings of the IEEE International Symposium on Mixed and Augmented Reality*, 275-276. DOI: http://dx.doi.org/10.1109/ISMAR.2014.6948447

López-de-Ipiña, D., Klein, B., & Perez-Velasco, J. (2013). Towards Ambient Assisted Cities and Citizens. *Proceedings of 27th International Conference on Advanced Information Networking and Applications Workshops* (WAINA),1343-1348. DOI: http://dx.doi.org/10.1109/WAINA.2013.203

Mazzucchi, A. (2008). *La riabilitazione neuropsicologica. Premesse teoriche e applicazioni cliniche*. Masson (Italy): Elsevier.

Mistry, P., & Maes, P. (2009). SixthSense: A Wearable Gestural Interface. In ACM SIGGRAPH (Eds.), *Asia Sketches*. (p. 11). ACM. DOI: http://dx.doi.org/10.1145/1667146.1667160

Prensky, M. (2001). Digital Natives, Digital Immigrants part 1. *On the Horizon*, 9(5), 1-6 (http://goo.gl/0jT63R) (07-09-2014).

Rosenbaum, E., Klopfer, E., & Perry, J. (2007). On Location Learning: Authentic Applied Science with Networked Augmented Realities. *Journal of Science Education and Technology*, 16(1), 31-45. DOI: http://dx.doi.org/10.1007/s10956-006-9036-0

Saracchini, R., & Ortega, C.C. (2014). An Easy to Use Mobile Augmented Reality Platform for Assisted Living Using Pico-projectors. (S.I. Publishing, Ed.), *Computer Vision and Graphics - Lecture Notes in Computer Science*, 8671, 552-561. DOI: http://dx.doi.org/10.1007/978-3-319-11331-9_66

Wu, H., Lee, S.W., Chang, H., & Liang, J. (2013). Current Status, Opportunities and Challenges of Augmented Reality in Education. *Computers & Education*, 62(0), 41-49. DOI: http://dx.doi.org/10.1016/j.compedu.2012.10.024

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