User Centered Design of an Augmented Reality Gaming Platform for Active Aging in Elderly Institutions

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Abstract: In this article, we describe the design and development of a gaming platform with augmented reality components whose purpose is to fight sedentary lifestyle by promoting active aging in elderly institutions. The augmented reality components project games on the floor where the users can interact by moving sideways or sitting and playing with the arms.. In this work, we target the design of a complete platform that can be easily transported, configured and deployed in elderly institutions to promote exercise. The concepts were developed using a user-centered methodology. End-users were motivated to participate in a study where social, economic and pathological conditions were analysed. The acceptance of the concept, the expectations generated, and the concerns raised, were assessed through questionnaires formulated both to the elderly users and to the professionals of the care institutions. Our results show that the elderly can be stimulated to practice physical exercise with the addition of fun and social interaction.

1 INTRODUCTION

Modern societies have a growing elderly population due to the medical advances that increase the life expectancy of the human being. In developed countries, there is also social pressure to maintain the quality of life and optimize the institutions that care for the elderly. This growing number of people can benefit from digital technology innovation tailored to different needs. The aging population represents one of the major societal problems today with a rising trend (Nations, 2015). All people born in the Babyboom era will belong to the elderly population (Allianz, 2014) in less than a decade and a half, representing 1.4 billion people by 2030 (Nations, 2015). The fight against sedentarism and the promotion of active aging are a necessity to provide a better quality of life and to combat the problems of the geriatric population (Udayshankar & Parameaswari, 2014). This aging population will require infrastructures, professionals and tools adapted and optimized to respond to the challenges associated to the elderly age. The existing infrastructures are insufficient to provide services to all elderly (Bloom, Jimenez, & Rosenberg, 2011). Traditional services are sometimes less agile and less versatile in the response provided. For example, activities carried out by occupational therapists are run using mainly paper and pencil, often in group activities. However, new technologies provide a much wider range of possibilities to promote active lifestyles that urge to be exploited by the society and professionals. Furthermore, many of the institutions targeted in this work have a short number of professionals that is clearly insufficient to provide adequate support in periodic examinations and revaluations of the physical and cognitive conditions for all. These facts portray the need to use technological approaches that allow an optimization of resources.

In this study, we describe the initial work in designing and testing a digital interactive platform that promotes physical exercise in the geriatric sector. We used an iterative design process to build and user test the platform to meet the needs, concerns, and expectations listed by the professionals and elderly of the institutions. Also, we want to understand how we can create approaches focused on physical activity to improve wellbeing in late life. In this way, for the platform development, we use a process based on user-centered-design (Abras, Maloney-Krichmar, &

Preece, 2004).The design process is composed of three stages. The first stage only takes into account the technological and logistic requisites of the system: it must include the necessary hardware and software for operating a pre-defined set of games for exercise and it must be easily transported between and within the care institutions. A prototype was developed for early testing. In the second stage the developed prototype was presented at three care institutions and a series of interviews allowed the collection of feedback both from professionals and elderly users. The interview generated a set of guidelines to improve the design. In particular the need for suitable covers and interfaces was pointed out by the interviewees.
In the third stage, we designed alternative concepts for the cover and interfaces that were again presented to the institutions. A final design was selected for production.

This paper starts with an overview of related work in Section 2, where the main approaches for technological devices for the promotion of exercise among the elderly are outlined. In section 3, 4 and 5 we describe the three aforementioned stages of design. In Section 6 we discuss the main concerns and expectations that we could infer from the interviews with the professionals and users. Finally, in Section 7 we draw the main conclusions of the study and perspectives for future developments.

2 RELATED WORK

The work on this article tries to address the lack of technological tools in geriatric institutions in Portuguese context, to promote active aging. It's specifically focused on the physical exercise component allied to cognitive stimulation. Active aging is seen as a primordial thing in society that encourages an improvement in the general quality of life (Mendoza-Ruvalcaba & Arias-Merino, 2015), specifically in our study, the part of mobility (Rantanen, 2013). However, sometimes the difficulty is in eliciting users to opt for a more dynamic and less sedentary lifestyle. The reasons depart from society (Rantanen, 2013), motivation issues in older people (Francis, 2014) and some health professionals may involuntary discourage older people from exercising (Hirvensalo, Heikkinen, Lintunen, & Rantanen, 2005).

It has been observed in the literature that traditional methods of activities, if recreated in a different and stimulating way, guarantee higher levels of interest and participation when compared to conventional methods (Cohen, 2006). In particular, exergames are video games that rely on technology to promote an active lifestyle (Sinclair, Hingston, & Masek, 2007) and represent a good alternative to traditional methods, for potentiating physical exercise, simultaneously promoting cognitive stimulation and dialogue (Pasqualotti, Barone, & Doll, 2012), (Gerling, et. al., 2014), (Mandryk & Gerling, 2015). Exergames can also be a good strategy for rehabilitation therapies, as expressed by some authors (Alankus, et. al., 2014) (Gerling, et. al., 2015). Additionally, using wearable technologies allows monitoring of vital signs and efficient continuous monitoring (Fletcher, Poh, & Eydgahi, 2010), although a search for less intrusive solutions is currently searched (El-Bendary, Tan, Pivot, & Lam, 2013). Approaches such as those taken by (Maczka, Parry, & Curry, 2015) measure the effects potentiated by technology in responding to the needs of institutions, which increase the effectiveness and efficiency of professionals. These current approaches use games as a resource, based on physical exercise combined with cognitive stimulation, which can bring health benefits to the elderly (Gonzalez et al., 2008), (Omholt & Wærstad, 2013). There are also studies that list some advantages of approaches based on virtual reality (Ribeiro-Papa, Masseti, Crocetta, Menezes, & Antunes, 2016), (García-Betances, Jiminéz-Mixco, Arredondo, & Cabrera-Umpiérrez, 2014), and trough exergaming (Rice et al., 2011) resulting in a reduction of disability and depression (Skelton & Dinan-Young, 2008). Also, the game consoles industry has been developing augmented reality games for the past 15 years that complement the virtual gameplay with physical interaction. This field of entertainment stimulates group activities and family interaction, while promoting physical exercise (Nintendo, 2009), (Playstation, 2009). One limitation of this kind of technology is that it mainly targets children and young adults and in general, they were designed for groups of people with full motion capacity. There are also intergenerational approaches in this sense as the Age Invaders (Khoo & Cheok, 2006) which has the added value of minimizing the generational gap through games.

However, the aging population is is prone to to have a sedentary lifestyle and the one that requires more external help for encouragement for the practice of physical exercise (Harvey, Chastin, & Skelton, 2013). In addition, because game consoles do not spontaneously motivate the beneficiary to the action, they rely on the user's proactive behaviour, which is more likely to happen in the young population. Another problem worth of attention in

the use of games for elderly people is that they are often too complex for this population (Mader, Dupire, Natkin, & Guardiola, 2012). The problems highlighted are related to game speed, too many visual elements and lack of feedback (Omholt & Wærstad, 2013).

The importance of user-centered design has been stressed in the literature by Omholt, Gulliksen and Rice (Omholt & Wærstad, 2013), (Gulliksen, Lantz, & Boivie, 1999), (Rice et al., 2011). The primary objective of the user-centered design is to involve the public for whom it is developing, generating customized solutions adapted to them, in an iterative process with periodic contact points (Baek, Cagiltay, Boling, & Frick, 2008).

Following similar principles, in this project, we developed a system that would stimulate a more active response of the geriatric segment, in which we included aspects suggested by the professionals and elderly users in the design, but with added attention to the requirements on miniaturization and portability.

2.1 Main Contribution

In this work, we proposed an interactive platform for games. This study is based on user centered design regarding the platform design and user test in the pre-defined context. Besides, some design guidelines were established for the development of exergames platforms. Our study provided a platform that combines augmented reality through projections and simultaneously measure vital signs and manage parameters such as balance, posture, agility, and aerobic activity.

3 DESIGN PROCESS - STAGE 1

The first stage of design relied on the technological and logistic requirements of the platform. Previous to this stage, the infrastructure necessary to experience the games that we had at university could not be transported easily because of its size.To test the system with users in real contexts in multiple institutions, there was a need to reduce the size of the structure that projects the games, so that it could be easily transported.

These logistical and size requirements dictated the birth of the platform that is being developed under the scientific project AHA (aha.isr.tecnico.ulisboa.pt). This project aims to use a social robot for the promotion of physical exercise in a geriatric context. The robot in question, Vizzy (Moreno et al., 2016), has two fundamental components: autonomy/mobility and promotion of physical exercise. Vizzy, shown in Fig. 1, will elicit people to do physical activity through verbal instructions and body language that users will have to imitate. Also, Vizzy will play the role of mediator and dynamic element of institution areas, in which he will control the same games as the platform. At the same time, Vizzy will monitor the performance of users playing these games.

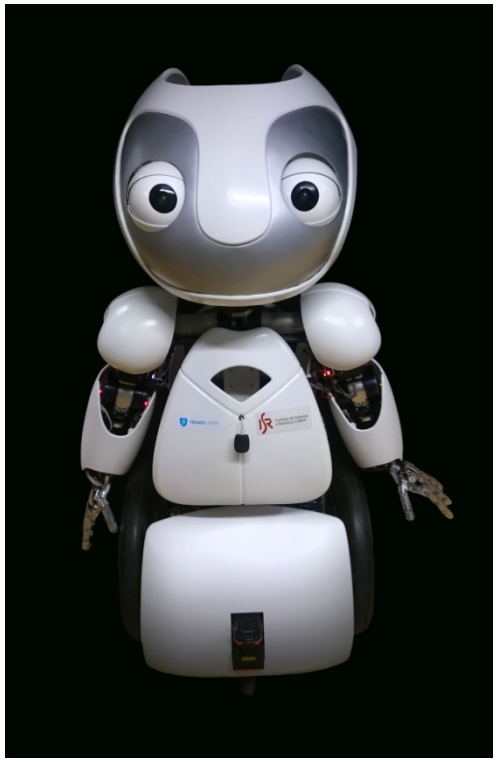

Figure 1. The social robot Vizzy to be used as the target of AHA project

In this paper, we focus on the execution of a platform without the robotic components for more easy validation of the augmented reality games, that we denote Portable Exergame Platform for Elderly (PEPE). PEPE will allow to evaluate and validate some of the components that robot Vizzy might incorporate, and be himself a provider of game exercises to the elderly population. It may also be used independently of Vizzy as a lower cost standalone product that may share with Vizzy some common aspects. In this sense, some technological components were included in the interactive gaming platform, to test its relevance and future applicability in Vizzy. In this study, we fit PEPE into a play product that simultaneously aggregates medical component, prevention and maintenance of

functionalities. PEPE also has the purpose of studying mechanisms and strategies of promotion and motivation to physical exercise. This concept is shown in Fig. 2, Fig.3 and Fig.4 The initial requisites of PEPE are to contain all the hardware required for the interaction (a computer, a 500-lumen projector, a Kinect™ v2 sensor, a keyboard and one monitor), and dimensions that allow easy transportation in a normal city car boot. This last requirement was the first verified by the researchers, due to the need to deploy the system in a short time in several nursing homes. To meet this necessity, the platform got two rotational points, to bend the structure and make it smaller, as can be seen in Figs. 5 and 6, that shows real pictures of the prototype developed for early testing.

Figure 2. Front View of PEPE

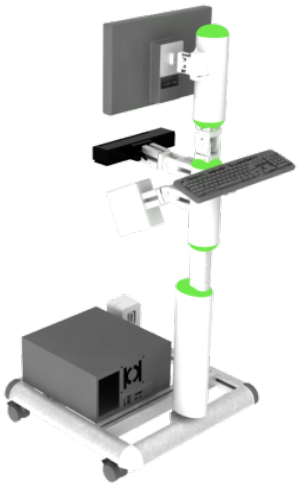

Figure. 3 Rear view of PEPE

Figure 4. Simulation of the interaction to be performed with PEPE

This prototype also served to elicit the participants to give us their feedback with a visual and functional perception.

Figure 5. Unfolded PEPE

Figure 6. Folded PEPE

4 DESIGN PROCESS - STAGE 2

In order to continue the development of PEPE, we used an exploratory study in which the elderly and professionals were consulted on the appearance and functional aspects of the platform. We took three group sessions in three institutions, in order to investigate how the elderly and the professionals perceive PEPE and the general interaction concept. The three institutions were based on the geographical area of Lisboa, Portugal. Focus groups are used for the discovery of topics related to social involvement and are a good strategy in revealing diverse opinions on a particular subject (Morgan,

Krueger, & King, 1998). The sessions were orchestrated by an investigator, who watched, took notes and recorded audio, and by a professional from the visited institution. The duration of the three sessions lasted approximately 60 minutes.
One institution is private more focused on daily occupation (Institution 1), the two others are senior residences with occupational and care services (a public centre Institution 2 and a private senior residence Institution 3). An experiment was also carried out in each institution with the real platform, together with the elderly and professionals that will be deepened at the end of the second stage (see Section 4.1)

PARTICIPANTS

To cover a large heterogeneous number of inputs, the participants are from multidisciplinary areas that work with the geriatric sector, being: 2 psychologists (P1) and (P2), 1 gerontologist (G1), 1 Occupational Therapist (OT1), 1 Physiotherapist (F1), 1 Technical Director (DT1). A total of 24 elderly people, ranging in age from 66 to 94 years, were consulted during the three sessions (5 in the first, 8 in the second and 11 in the third). Seven participants were male and 17 are female. Eleven participants had some type of motor disability.

PROCEDURE

The three sessions were held in three different institutions in order to gather different social, economic and ergonomic points of view. At the beginning of each session, the researcher presented and contextualized the purpose of his visit to the institution and the objectives of the process. Each session consisted of three steps. In the first step, the participants were questioned about the current practices of institutions in promoting physical exercise. The question asked was "How do you practice physical exercise here in the institution?" The second step tried to understand the expectations of the elderly and the professionals regarding technological approaches in the promotion of active aging. The third step was related to the presentation of the PEPE concept and structure. Interviewees were asked to comment on their adherence to the concept and guidelines for building and improving PEPE. This step also dictated the development of three different appearances to be adopted by PEPE. The last step was to use PEPE in real usage, where they experimented with the platform and some technical aspects were reviewed.

ANALYSIS

Field notes and audio files were then analyzed through thematic analysis and an inductive approach (Braun & Clarke, 2006). A number of core subjects were identified that expressed ideas of participants during the three sessions. Although some divergences of opinion have been noticed, most points are common to all three institutions. This methodology allowed us to cross different ideas and perceptions.

RESULTS

The main objectives of the sessions were to provide researchers with guidelines and considerations of the technical development and appearance of PEPE.
The first issue pointed out by the professionals, is related to the cognitive and motor limitations of the elderly, for example dementia or reduced mobility, that may represent a threat to any solution developed. One of the stated requirements is that the equipment must be used also by people in wheelchairs or people with crutches. The professionals recognise the advantages and benefits in the practice of physical exercise, as it can delay some problems of aging and allows a maintenance of physical condition. However, it is stated that encouraging some seniors to practice physical activity and balance exercises may not be easy because of the lack of motivation. The common practice for physical activity is based on rehabilitation, when the person already has some problem. Desirably, the common practice should be prevention. At present, the elderly people have activities that promote exercise, usually in the morning. These are composed of exercises of repetitive movements, with series of 10 movements for each member or worked area. Even if they are motivated to carry out the activity, it is up to them if they want to participate in the activity. These activities are practiced in a group, except in cases requiring individual monitoring by physiotherapists.

Utility and predisposition to acceptance of technological concepts

There is currently a technological scarcity, mainly at the level of logistical optimization and optimization of human resources. Due to shortage of staff, exercises are predominantly developed in group, resulting in lack of time for individual interactions. For example, in Inst 2, there is 1 Psychologist to around 200 older adults. These group activities are made using traditional tools, with almost no use of technology. Adaptation to each user was one of the

most critical requirements. We were also alerted to the need of monitoring in real-time the user vital signs during the activities to alert the caregiver of any abnormal event, a practice that is currently non-existing. A gerontologist mentioned that in addition to the monitor turned to the person operating the platform, it might also be interesting to have a elderly-oriented monitor to enrich the visual experience as a complement to the projection of the game. This suggested the addition of a front screen in the platform, that we decided to be touch sensitive to increase future possibilities of use with the users.

Professionals stated that the platform design should have an empathic aspect, so that the levels of acceptance and participation rates were higher. Another relevant requirement for professionals, is that the platform needs to be movable inside an institution, because many older adults have difficulty in locomotion, so the platform should be easily transported between several division in the facility. This necessity is in accordance with the logistics requirements of easy transportation, already mentioned.

Socioeconomic contextualization of the institution and of the elderly

The main reasons for the lack of technology are economic and the lack of information on the added values with respect to classical approaches. Thus, the professionals have difficulty in communicating the advantage of the new technological solutions to the administrative board, which is the decisive factor in its adoption.

Exploration of acceptance among the elderly

Elderly were questioned about the general idea of promoting physical exercise, and about their willingness to participate in the practice of physical activity. 19 seniors were receptive to the concept and willing to perform some activities.

However, 12 affirmed or questioned whether they could do the activity seated or with some physical support. The elderly pointed out pain and limitations in the joints that make it impossible for them to carry out the activities completely. The remaining nine subjects mentioned that they would not use the platform and did not intend to play. The allegations about this position are related to pain, not liking physical activity, preference to remain at rest, and the technology gap (some mentioned that technology is something not adjusted to the elderly population).

4.1 Interactive Session

PEPE was tested at the Institutions (see Fig. 7 and Fig. 8). Both elderly and the professionals tested the different interaction modalities provided by the platform (playing games while sitting or standing). This interaction served us mainly to assess the dynamics of game provided and whether the specifications of hardware corresponded to the needs of the elderly.

Figure 7. Demonstration of the platform in Institution 1

Figure 8. Demonstration of the platform in Institution 2.

5 DESIGN PROCESS - STAGE 3

5.1 Platform re-design

Based on feedback from the sessions, there were three main conclusions taken to improve the platform. First, there is the need for an empathic aesthetics of the platform. Second, the platform should have two monitors, one for the elderly and another for the professional, with adequate graphical elements and real-time monitoring. The third requirement is in relation to the games and the

capacity they have to adapt to each user. The aesthetics of PEPE was one of the most discussed points among the participants. In the perspective of private institutions, some professionals believe that PEPE has to have a more sophisticated and more sober design, “something premium” (DT1).

On the other hand, the generality of the professionals, especially in the public institution, a more emphatic formal language with brighter colours is more fitting, and several have mentioned that blue is the preferred colour among people, which is in agreement with some researchers (Wolchover, 2012)

The third concept was created based on the opinion of a psychologist and an occupational therapist, who reveal that a PEPE in white would make more sense because it does not create additional visual stimulation - the projection of games is already a very present visual stimulus. In this way, since PEPE isused jointly withVizzyin the AHA project (Fig. 1), we decided to use some aesthetic lines of the robot and adapt them to PEPE.

The concepts A, B and C are shown in Fig. 9, Fig. 10 and Fig. 11.

Figure 9. Concept A

Figure 10. Concept B

Figure 11. Concept C

The first concept (Figure 9 - Concept A) was created to respond to a more wide target audience, mainly because of its colour and most basic formal appearance. The left side represents the front of the platform and the right side the back. The aperture on the front is used to let the projector light through. The central concept (Figure 10 – Concept B) tries to respond aesthetically to a higher economy class due to its metallic and futuristic aspect that gives it a premium appearance. This version has no front opening because its coating is unidirectional mirror film, which makes the carapace transparent and allows the passage of light from the inside to the outside. The third concept (Figure 11 – Concept C) formally derives from the Vizzy robot. In this concept, the left part corresponds to the rear view and the right part corresponds to the front view.

Regarding the information display, three images have been developed that simulate the graphical contents that could appear on the screen facing the user(see screens A, B and C in Figs. 12, 13, and 14, respectively). Screen A simulates the profile of each user in which they have access to their physical provision. Screen B shows the player's previous score, the current score during the game and the maximum record reached by any user. This screen is also based on positive reinforcement, turning green when the user scores. The last screen (C) was designed to give the user the opportunity to choose the game they want to play without a professional.

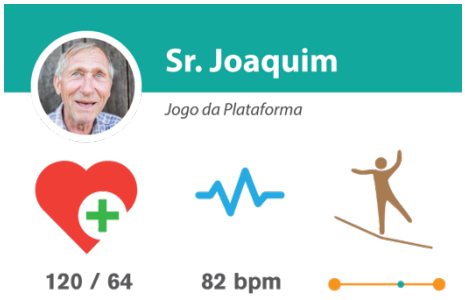

Figure 12. Screen A. Biometric data.

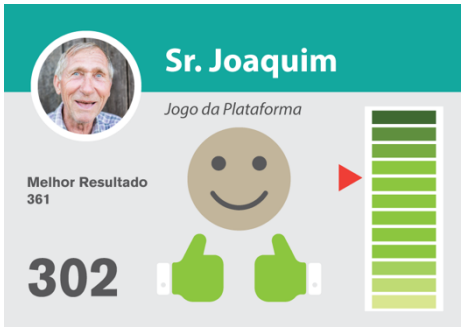

Figure 13. Screen B. Game scores.

Figure 14. Screen C. Game selection.

5.2 New Round of Interviews

After the concepts had been developed upon the results of the first phase, all institutions were visited again to carry out questionnaires that quantified the evaluations. Field notes were also noted for further analysis. These focused on the appreciation of the various concepts. Some of the questions asked are relative to stakeholder preference and what aspects are relevant to consider.

The results from the first phase (cover designs in Fig. 9, Fig. 10 and Fig. 11 and information display alternatives in Fig. 12, Fig. 13 and Fig. 14) were shown to the professionals and users. Additionally, further concerns on technical, functional and aesthetic aspects of the platform, as well as the institutions positioning in the market were made to the professional. The objectives of this iterative process were related to perceptions regarding the platform and needs from the point of view of the elderly. This option was taken so that both parties could complement with new observations and feedback the information provided in the first phase of interviews.

5.3 Evaluation

5.3.1. Cover

We have shown the professionals and the elderly the different cover designs shown in Fig. 9, 10 and 11. Each participant voted for the preferred design. Among the professionals, most votes went to design A (4 votes), then B (2 votes) and finally C (1 vote). Empirically, most professionals defended that concept A is the most empathic and what should generate greater levels of acceptance, not only due to the form factor but mainly because blue is more cheerful and inviting. However, in the opinion of other interviewees, the elderly has difficulty in focusing attention, so the platform itself must be an object that goes unnoticed and does not distract them. Thus, the white colour of concept C should be more appropriate. As for the concept B, developed for a segment of the high class, had the second highest percentage of votes, however in a chromatic level was the least empathic and cold-looking. The technical director of the day care centre (Institution 1) defends this option is not adjusted to the current older people, because they are very little technological and this concept may be too futuristic for the aging population and be less accepted.

Among the elderly, a sample of 30 seniors with a mean age of 73.4 years was collected for feedback on the three concepts. The votes counted correspond to 15 for concept A, 11 for concept B, and 4 votes for concept C. Analogous to what was pointed out by the professionals, the elderly users mentioned the most empathic nature of solution A due to colours and rounded forms.

5.3.2. Information Display

The first screen, A, was unanimously excluded by the professionals, who said that elderly people are already alarmed by heartbeats, and because of this, this information should only be consulted by the professional. Screen B was the best accepted, by professionals and elderly, even because it was said that there is some healthy competitiveness among the elderly to play. The last screen was discouraged because the users had difficulty interpreting its meaning (selection of the games) and the professional's preference in having full control of the operation of the platform.

6 DISCUSSION

In this section, we describe the main ideas, concerns and expectations inferred from the sessions of the design phases and the observations taken during the interactive sessions. The results presented here derive from the exposure and interaction with PEPE. However, the guidelines given below are general and can be used as guiding lines for the development of augmented reality technology that promotes the practice of physical exercise and combat the sedentary lifestyle in elderly institutions.

6.1 Concerns

Cognitive Deficits

One of the major concerns regards the physical/motor disabilities that several users have. It was stated that this type of solution must be used by the maximum number of possible users. The first reason is to avoid excluding people or accentuate cognitive or motor differences. The second reason, as stated by a technical director (DT1) of an institution, "the more users can serve, the more it will offset the investment." To address this problem, some software modifications have been made that allow seniors in wheelchairs or seniors who use crutches to play as well. Also, this locomotion problem in some users is the principal factor that justifies the wheels on the platform.

In any case, the generality of the participants believes that this type of technological approach is more adjusted to the more autonomous population or with few physical and cognitive impairments. The daycare environment was the most indicated because it has more independent people who can benefit from these approaches.

Monetary Cost

One of the major concerns raised by professionals is the cost of such a device. It was declared that it might not be a democratic product due to its high cost, which will make it impossible for most institutions to acquire it. G1 reveals that it can be a costly investment for a device that brings together capabilities that will only be used to the fullest by the minority of people who have no physical or cognitive impairment. It has also been mentioned that such a product type, in addition to providing prevention, can function as rehabilitation or monitoring, thus opening its range of use and lifetime.

6.2 Expectations

Technological acceptance

All the interviewees agreed with the potentialities and optimization of processes that technology can generate. First, the professionals can save time in preparing the occupational games since the platform is very easy to setup and operate. Second, the games can stimulate simultaneously both the physical and cognitive aspects, thus reducing the need of having separate physical and cognitive rehabilitation sessions. In addition, a portable gaming platform allows for increased interaction levels and has a broad range of gaming/activities options that traditional tools cannot provide. Besides, it was mentioned that through this type of technological approach, it would be easier to encourage and motivate the elderly to participate in physical activities. In addition to technological proficiency that will become more common in the coming generations, it is a response to a societal challenge, not only in the future but today. As stated by the technical director (DT1) "it is a necessity because life expectancy is increasing and you don't watch a paradigm shift. People do not try to have a healthy and dynamic aging".

Visual elements and color

In visual terms, several professionals argue that it is important that an object for this segment of the population has few visual elements. Some professionals mentioned that usually, objects for the geriatric section are simplified because they have some degrees of technological incapacity. This argument is supported by the study (Habinteg & Pocklington Trust, 2010), which defends formal simplicity and suggests intensified contrasts in objects. The reasons go beyond the positive and cheerful load that bright colors have (Unicamp, 2008). According to the professional's experience, colorful tools can represent a strategy of attention focus and consequently, capacity to pay attention to the platform. However other professionals have a different perspective, reporting that an object with intense colors may have an overly demarcated presence and may shift user's attention to the object rather than the action it should take. These defend that the platform in white or soft colors may be a good option in this regard. They claim that although they are projecting animated content on the floor, it is already quite captivating and that an overly flashy object will divide the attention.

Infantilization

An important aspect to be considered when designing products for the geriatric segment is the need to develop objects which do not increase the social stigma surrounding the elderly. These warn of the child load that the object may possess by having oversized interfaces and buttons, but especially the games to be realized and projected.

Customization

One of the significant benefits seen in a digital device, is that it establishes itself with the formal and multimedia personalization that can be offered. Personalization creates a sense of belonging and lowers the rejection rate. Another advantage of

customization is that the platform can represent a useful personalized stimulation tool already adapted to each user. This customization is essential not only for success rates that may be higher (Harriette Halepis, 2013). It has been suggested by some professionals that approaches of this kind have to adapt to the performance and motor and cognitive capacity of each user. Also, because the geriatric segment is full of several people with multiple symptoms that differ from person to person, it was mentioned that the platform must undergo changes and mechanical adjustments to fit each case and to optimize its functionalities depending on the person.

Positive reinforcement
Some professionals were discouraged when they realized that the platform did not have any positive reinforcement that indicated the success rate of the user. They mentioned that this interaction strategy might cause users to be motivated for a longer period. This positive reinforcement can be achieved through visual or sound cues. It was suggested that part of this reinforcement could work with verbalizations indicating the performance of the game. CD1 states that part of the motivation can also come from a healthy competition that the game can elicit. It was expressed that in the ludic activities or traditional activities, there is a certain competitiveness and even a collaborative spirit that puts them to carry out the activity in a more pleasant and motivating form.

Resource optimization
One of the greatest advantages projected in this kind of assistive technology approaches is its possible optimization of data logging. This data can be accessed by professionals for further analysis. Now, during the activities, no data is collected regarding the mobility of the person or physical performance. It was stated that only rarely these are annotated, typically on paper, which can give rise to "qualitative summaries, often information is put as topics". It was also mentioned that it could be a tool for monitoring the vital signs of the users and that could contain the alarm or warning functionality in case of vital signs anomaly. This kind of process also allows the development of a history of progress of the various users, enabling professionals to measure the impact of their intervention.

Safety
It has exposed the need for security measures that provide real-time control while the user interacts with the platform. The professionals must have an interface that allows them to verify the person's performance and parameters that indicate the vital signs or issues related to balance.

Evaluation
The evaluation was considered as one of the most important issues, not only in validating the concept and its practical applicability at start, but also continually during the life of the platform. A good strategy may be small informal daily questionnaires made to the population about how they felt playing and how much they like it. It should be noted that DT1 mentioned that this type of validation among users will be the determining factor that will dictate future investment by an institution. In future tests, it will be useful to understand how PEPE has to be used regularly to effectively promote active aging and to understand the impact of this type of technology on an elderly institution. These tests have to be performed together with physiotherapists and psychologists who perform periodic tests in order to obtain the evolution of the health condition of the elderly users.

7 CONCLUSIONS

Throughout the iterative design process, we discussed the social panorama among elderly and the possible conception of a mobile interaction platform. At the moment, there is some exploitation of technology in elderly institutions, but in this research, we added miniaturization and portability in conjunction with user-centered design. The tendency with this type of devices is to increase and become more useful with a great potential to help both the seniors and the professionals. The proposed technology allows a more engaging experience in the exercise and optimization of resources for the institution. Our findings demonstrate that users can be proactive in engaging in exercise with the game platform. The envisaged benefits include captivating the seniors to physical activity through games, also increasing levels of communication and social interaction and joy. It was unanimous among professionals that this type of approach must be implemented from the perspective of promoting physical activity as a preventive measure. In any case, they recognize that there are multiple examples of people in institutions that already have some limitations and that platforms of this type could be a useful rehabilitation tool. The main gains are motivation and fun while performing rehab exercises.

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