ImmersiveMind: Providing Reminiscence Therapy to Dementia Patients through 360° videos

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Abstract
In recent years, the number of people with dementia has been increasing where one of the symptoms is the inability to communicate, leading to forgetfulness of significant events. Despite the frequent use of medications, there are non-pharmacological alternatives, such as reminiscence therapy, which seeks to use personal objects to recall past memories. In the context of technologies in reminiscence therapy, there is a lack of research that explores the potential of immersive environments, where people with dementia have the feeling of being present in a virtual world without compromising their privacy.

As such, ImmersiveMind was created to offer a low-cost tool, Google Cardboard, which takes advantage of immersive environments through a public library that provides 360-degree video, YouTube, controlled by the caregiver, avoiding the handling of this technology by the patient. After understanding the role of the caregiver and the people with dementia, it was investigated which type of glasses are most suitable for people with dementia, where it was concluded that comfort and ease of use are determinants. Finally, a platform was implemented for the caregiver, and evaluations were carried out where it was concluded that the possibility of managing patients and sessions are an important factor since it provides a proper monitoring of the elderly. Regarding the impact on reminiscence therapy, it was found that people with dementia were able to identify the objects showed in the 360 videos, which triggered memories of past moments, along with the responsible caregivers.

Keywords: Dementia, Caregivers, Reminiscence therapy, immersion, 360-degree videos

1. Introduction
The number of people with dementia has been increasing where, by 2016, worldwide, it has been found that there were about 47 million people with the disease and it is predicted that this number will grow to 131 million by 2050 [23]. One of the main early symptoms of dementia is the struggle in communicating, which leads to the forgetfulness of significant events and negative changes in behavior where, as a consequence, represents a decrease in the quality of life of the person and those around him.

1.1. Problem
Since medicine use has been the most frequent method for dementia, and knowing the adverse effects that may exist [19], the search for alternatives such as reminiscence therapy has been increasing. Reminiscence therapy aims to assist in recovery of memories through conversations between the patient and the caregiver about past experiences related to the person with dementia, with the support of memorabilia [21]. Although there are several technological studies in reminiscence therapy, there are only a few that explore immersive environments that is, environment where it takes advantage of different sensations, created virtually, where it is possible to explore [7]. Multiple projects do not take into account physical problems associated with age [4] [20] and others use personal information, disregarding the privacy factor. Finally, it is also verified that several studies use technology with high cost, which makes difficult the access to them.

1.2. Hypothesis
Considering the studies that have already investigated the use of technology in reminiscence therapy, it is important to offer a tool that takes into account the physical struggles of the elderly with dementia and the low affinity they have with technologies [3]. It must be cheap in order to allow anyone to acquire it. In the context of privacy, the use of public data allows preserving personal information of the patient and family members, which provides more immediate access to different content. In this
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- Review of related work on technologies in the context of reminiscence therapy: This study reports different types of technological approaches associated with reminiscence therapy. It also describes the advantages and disadvantages of each approach, regarding the 360° immersion, data source, cost, type of experience for the patient and complexity of use.

- Analysis of the use of 360° YouTube videos with different types of viewers: Find out what kind of Google Cardboard goggles are better for people with dementia, along with their caregivers, by viewing 360° videos available by the YouTube application.

- Design and implementation of the caregivers’ platform: Implementation of the caregivers’ platform that has the possibility to manage people with dementia which they are responsible, making and scheduling sessions for the therapy and control of the visualization of 360° videos displayed in the viewers, previously placed in the patient.

- Implementation of the application that supports 360° videos: Conception of an application that allows the reproduction and visualization of 360° videos where, through a remote communication with the platform, allows the control of what is being seen in the Google Cardboard glasses.

- Evaluations and results of the implemented systems: It was made a set of evaluations for the usability of the platform and the use of this type of approach in reminiscence therapy. These assessments allow to identify advantages and disadvantages of this approach. These results have proven which features are most relevant to the viewers, as well as the platform usage and inherent benefits for this therapy.

1.4. Document structure

The rest of the report is organized as follows. In section 2 it is presented the background related to the basics of dementia and reminiscence therapy. Section 3 describes the state of the art regarding different types of technological approaches in reminiscence therapy. In section 4 it is shown the card sorting technique applied to the YouTube 360-degree video section and it is analyzed which Google Cardboard glasses are best suited for people with dementia. Section 5 describes the implementation of the ImmersiveMind platform and application and in section 6 and 7 are presented the usability tests results and evaluation of this approach in reminiscence therapy. Finally, in section 8 is discussed the results and the last section concludes the report.

2. Background

Before investigating the related work, it is necessary to understand some basic concepts about dementia and reminiscence therapy.

Dementia Consists of a set of different symptoms, that result in the progressive decline of cognitive abilities, such as memory loss, reasoning, physical capacity, social skills and mood swings where, one of the most common forms is Alzheimer's disease. Although dementia is difficult to identify, is usually diagnosed when the patient shows cognitive impairment and the inability to learn and recall new skills.

Reminiscence Therapy Reminiscence therapy is often described as a technique where older people with cognitive impairment are asked to recall memories of significant events and experiences from their past with memorabilia. One advantage of this method is the fact that's not necessary to use antipsychotic medicine, which is normally associated to various adverse effects. This therapy can lead to behavioral and cognitive benefits.

3. Related Work

In this section, it will be described an overview of the related work, where it’s shown the different approaches of technology in reminiscence therapy.

Multimedia

Nowadays, information provided in a multimedia format has a major impact, becoming one of the main ways of communication and data transmission, such as audio, video, images, text and graphics. Digital interactive systems gives the possibility to retrieve memories through different multimedia stimuli, where it shows quick adaptation from the caregivers and patients with dementia. Remote communication offers an opportunity for people with physical disabilities to take advantage of this type of approach. How-
ever, in order to make the most of these systems, it is necessary to collect personal data in advance, which can be a privacy issue.

**Sound Stimuli**

One of the ways to trigger memories is through sound stimuli that can help retrieve memories of the patient. An investigation shows how an immersive sound environment can prompt memories and relax the elderly [4]. Other project allows to reproduce music, known or improvised, showing positive results [6]. However, these projects are limiting because it implies that the person with dementia does not have physical impairment, since one of the problems of this type of disease is the gradual loss of movement capacities [18].

**Virtual Worlds**

The use of virtual environments creates new alternatives for patients who practice reminiscence therapy. This method creates an immersive space that induce the feeling of being present in the world created virtually. Recent studies [9] [20] have shown that the use of immersive environments in elderly people with dementia is appropriate and generates relevant stimuli, such as communication with caregivers. It has been shown that it is important to create objectives when using this type of approach, and that the reproduction of places and/or objects known to the elderly in these environments shows relevant positive results. One project showed that collaborative activities between the caregiver and the person with dementia reveals better outcomes.

**Lifelogging**

Collecting personal information for the reminiscence therapy is a method where caregivers and family gather memories of the patient, in order to process and reflect about life experiences of the patient in order to create reminiscence and trigger communication. This data gathering also involves the use of wearables/sensors in order to collect all daily activity.

These approaches [5] [15] offer techniques that do not need any effort from the patient, showing that the intervention of the elderly is not necessary to obtain positive results. However, regular use of these systems can compromise privacy, because it is inevitable to collect information daily. This type of methods are also limited to the most recent events.

**Companionship robots**

The use of robots in healthcare has been a way of providing rehabilitation and care services to the user’s daily activities. One of the best procedures to introduce robots into therapies with people with dementia is to use animal-shaped robots [8] [12] [16] [23]. It was found that, regardless of the type of robots, the results obtained from their interaction with people with dementia were similar. Although positive outcomes were observed in all the cases, in some there was a lack of connection with the robots and the cost of acquiring and maintaining them are limiting factors for a more comprehensive treatment use in diseases such as dementia.

**Discussion**

In the context of immersion in reminiscence therapies, it is rare to find studies that investigate this concept [4] [20]. Despite the positive results, they did not take into account physical impairment associated with age and dementia. Still, there are some studies that investigate the concept of exploration in 360-degree panoramic environments through large screens yet, they lose the opportunity to create a more envolving environment for the patient [1] [2] [5] [11] [25].

One of the principles of reminiscence therapy is the stimulation of past memories through memoralia of the patient, such as photographs and personal objects. Although there are approaches with some level of personalization, it is necessary to use intimate information [14] [15] [22] which can be interpreted as invasion of privacy. Based on this concern, only two investigations [4] [21] have used public information sources, British Broadcasting Corporation (BBC) Natural History Unit (NHU) and YouTube. Both projects have shown positive results when used with people with dementia, which proves that it is not necessary to use personal information of the elderly or to make exhaustive search for data to provide adequate reminiscence therapy.

It is known that the costs associated with regular monitoring of people with dementia are very high [1] so it is not feasible to use costly alternatives. It turns out that the use of robots is a high investment and virtual worlds use equipment that is not compensatory, especially for people with physical problems. It is possible to conclude that projects that use more recurring objects, such as computers and televisions, are cheaper and often is not even required a prior investment because caregivers may already have the same equipment.

Given the cognitive difficulties in people with dementia, new barriers are created so that systems can interact with the elderly. Adapting to a new system can be time-consuming and in certain situations you may not even get used to it. During therapy it is also necessary that learning support systems be fast and effective.

The use of simple systems allied to the passivity of the technologies show the best results because they are easily adapted by the caregivers and with a simple screen the elderly can see and enjoy these sessions without requiring consider-

able movements.

4. Preliminary studies

As the disease progresses, caregivers, in particular the informal one which normally are responsible of taking care family members, are confronted with more and more difficult decisions, which, from earlier stages, means that they have to assume the responsibilities of the elder. The role of the caregiver is an important factor in the life of the person with dementia because it is the only way possible to provide a good life quality in the years to come. In this type of approach, there are few initiatives, however, the intervenients are always receptive to new technologies that can support through this demanding challenge.

4.1. Card Sorting

In order to organize and introduce the concept of 360-degree videos together with the caregivers, it was carried an open card sorting with 7 participants with a mean age of 49.143 years ($\mu = 12.941$), where 3 are specialists, 3 are informal caregivers and 1 is a specialist who also takes care of a relative.

Procedure

The chosen approach was the open card sorting technique, where participants were asked to organize 19 video titles cards from YouTube 360° section into 4 groups tops that make sense to them and then name each category freely. Here it has the advantage of understanding with what kind of organization each participant adapts best. They had 15 minutes to end, and the answers were discussed at the end of the session.

Results and conclusions

The themes that most offered a different variety of responses were those that were associated with places and nature, where a caregiver stated that because they are interconnected, so the logical for him was to merge the videos related to those categories. Another caregiver assumed another type of interpretation, calling them “cultural tours” where he gathered videos about music and locations. However, themes like “Music”, “Animals” and “Sport” were almost organized the same way across the participants. Although “Places and Events” have a considerable amount of choices, the videos in this section could be either point of interest, nature and/or music (figure 1). Thus, taking into account the opinions of the caregivers and the analysis of the obtained categories, it is believed that the 4 best sets are “Animals and Nature”, “Places/Points of Interest”, “Sports” and “Music”.

4.2. Testing different types of Google Cardboard goggles

The purpose of this study was to better show the concept of watching 360-degree videos where it was presented different types of Google Cardboard glasses in order to demonstrate the versatility of this tool and find which better suits people with dementia.

Procedure

In order to better understand how this type of tool can create some impact on the reminiscence therapy between the caregiver and the patient, the type of visualization, audio, ease of use and comfort were analyzed by the within-subjects design method where all participants experienced all three goggles. After the session ended, participants were asked what kind of emotions people with dementia might feel, what factors might better stimulate cognition and whether they felt any negative variation on a physical level.

Equipment

For this study, it was used three different glasses where the price of each was, including shipping cost, less than ten euros. The first one was made from cardboard, bought on eBay, the plastic one was acquired at a hypermarket and the EVA foam was purchased on MyMemory online store and the smartphone used for this experience was Vernee Apollo Lite. Regarding the videos, they were taken from YouTube, from the 360° section, all had to have less than 5 minutes, quality had to be equal or superior to 1080s and the videos were chosen from the card sorting results.

Participants

For this study it was recruited 10 caregivers, where 3 were specialists, 6 were informal caregivers and 1 was a specialist who also takes care of a relative. Participants’ age ranged from 23 to 71 years old ($\mu = 50.2$, $\sigma = 15.47$) and only two knew about this type of technology.

Dependent measure

Participants were asked to complete a questionnaire with a scale of 1 (totally disagree) to 5 (totally
agree) in order to compare the different characteristics of the glasses through the mean of the results and thus discover possible significant differences.

Results and conclusions

In order to analyze the results, besides the mean and standard deviation calculus, it was also investigated whether there were significant differences with the non-parametric Kruskal-Wallis test. In the end, it was also interpreted the users’ comments on the impact that this type of tool can have on an emotional level, cognitive stimulus and possible physical changes. Regarding the visualization of the videos, the plastic ones ($\bar{x} = 4.7$, $\sigma = 0.483$) were the most practical because they contained eye adjusters, while the cardboard glasses ($\bar{x} = 4.0$, $\sigma = 1.054$), although they had the lowest results, were also the ones that presented greater divergence of values. The non-parametric test was applied, and no significant differences were found ($\chi^2(2) = 2.63$, $p = 0.268$). Regarding the audio, it was found that the differences between cardboard ($\bar{x} = 4.8$, $\sigma = 0.632$), plastic ($\bar{x} = 4.7$, $\sigma = 0.675$) and EVA foam ($\bar{x} = 4.7$, $\sigma = 0.675$) are minimal which shows that it is not an important factor ($\chi^2(2) = 0.157$, $p = 0.925$). It was also investigated which is the simplest to put and to use, where it was discovered that the cardboard one ($\bar{x} = 3.7$, $\sigma = 1.418$) presented the worst results because they did not have a good adjustable elastic. EVA foam ($\bar{x} = 3.9$, $\sigma = 1.1$) showed slightly higher values because they have suction cups that hold the smartphone. The plastic ones ($\bar{x} = 4.5$, $\sigma = 0.707$) had the best results, and it was possible to observe significant differences between the glasses ($\chi^2(2) = 20.802$, $p < 0.05$). Finally, in relation to comfort, as the plastic ($\bar{x} = 4.5$, $\sigma = 0.70$) ones contained cushioned edges, they were the ones that pleased more the participants, showing significant differences ($\chi^2(2) = 30.335$, $p < 0.05$). It can be concluded that the glasses that obtained the best results were the plastic goggles because they can adapt to each face and it is more comfortable compared to the others.

5. Implementation

This implementation has two components, the first one corresponds to the platform where the caregiver organizes the data and the visualization of videos inherent to the person/people who are responsible with. The second component is the mobile application running on an Android smartphone where videos are displayed, at 360-degree, which are chosen and controlled by the caregiver through the platform.

For the implementation of the platform and the application, a set of requirements were collected, regarding the opinion of the caregivers:

1. Add and manage one or more people with dementia to a caregiver;
2. Store relevant information about the patient;
3. Provide remote control of immersive videos to the caregiver, without the need to interrupt the session;
4. Plan, in advance, sessions, by picking themes and/or videos for the reminiscence therapy;
5. Register results and stimuli regarding the visualization of 360-degree videos with the patient, which encompass types of cognitive reactions and possible physical changes during therapy;
6. Review the obtained results from the activities that already happened.

5.1. ImmersiveMind platform

For the implementation of this platform, it was built based on the client-server architecture where, on the client side it was used the framework Bootstrap 4, which, besides making the development a lot faster, it adapts easily to different types of screens thanks to its responsiveness, and on the server side it was used an open-source interpreter, NodeJS, among with Representational State Transfer (REST) and MySQL modules, which were used to execute requests and establish communication with the database, respectively.

Prototype

It was possible to verify that the caregivers are generally senior adults, so the construction of the web pages should have few elements of large size, with simple and short text, where the content should be confined to the maximum visible page [13]. When the caregiver accesses the platform, it is asked to register and/or login and after the confirmation, the user is directed to the ImmersiveMind home page (Figure 3).

![Figure 2: Front page of the ImmersiveMind platform](image)

It is possible to add and manage patients and create new sessions where can be selected different categories and/or search YouTube 360 degree videos. At the beginning of the activity, it can be started with a planned session, or it can start without any previous planning. On the activity page, it has the option to select several videos from the chosen categories and search YouTube videos on demand (Figure 3). When the session is finished,
it is possible to register a final balance based on cognitive stimuli and physiological changes.

5.2. Mobile application ImmersiveMind

In order to transfer videos between the platform and the smartphone, it was developed a mobile application, where they can communicate with each other, while in the same network. As the platform, it was also adopted a client-server architecture where on the server side, the information associated with the videos is collected and processed and on the client side is reproduced. It was developed on the Unity platform\(^3\) with Google VR service so that it can reproduce correctly in the glasses (figure 4).

6. Usability Tests

After understanding the role of the caregiver and the patient, and analyzing the preliminary study on the use of different types of Google Cardboard to find the most suitable for people with dementia it was necessary to verify the usability of the platform and with that, it was possible to draw conclusions from this approach along with caregivers.

At the beginning of the experiment, after a brief introduction to the ImmersiveMind platform, the caregiver was given the opportunity to explore it, no more than 5 minutes, before proceeding to the proposed tasks. To evaluate the usability of the ImmersiveMind platform, it was set out 6 tasks for the caregiver to do:

1. Add a new patient to their account;
2. Create and plan a session associated to the patient;
3. Begin activity of a planned session and start playing a video;
4. While saving, register a final analysis and end the session;
5. Start a new video visualization, but without any previous planning;
6. Review the observations of pasted sessions;

To understand the usability of this platform, it was collected the following metrics: Task time, number of non-critical errors, success rate and registry of positive and negative comments.

6.1. System Usability Scale

Additionally to the metrics presented earlier in this section, it was also defined a subjective metric, namely the System Usability Scale (SUS). The SUS is a reliable tool to measure the usability of a platform. It consists of a 10 item questionnaire with five response options from strongly agree to strongly disagree.

6.2. Participants

This usability test was conducted by a set of 8 caregivers with ages between 23 and 61 years old ($\mu = 48, \sigma = 15.603$). Three of them were specialists, four were family caregivers and one of them was a specialist who takes care of a family member.

6.3. Equipment

For this evaluation, it was used a personal computer with the necessary software to run the ImmersiveMind platform.

\(^3\) https://unity3d.com/
6.4. Procedure
At the time of the execution of the tasks, it was given a quick explanation of the task they were about to do and, in the case the participant performed the test incorrectly and/or demonstrated frustration by not being able to perform it, he was asked to stop and it was described the correct steps for that given task. Finally, the participant profile was collected and asked to complete a questionnaire on the usability of the platform.

Dependent Measures
Average time of task execution, error rate and success rate were measured by analyzing the performance of the caregivers, by task.

6.5. Results and conclusions
After completion of the tasks, the data was analyzed and in this section, they will be exposed by task and later the results of the system usability scale will be presented.

Add a new patient to their account: On this task they took 73.375 seconds, about 1 minute and 13 seconds ($\sigma = 29.75$), all completed the task successfully and there was an average of 0.5 false clicks ($\sigma = 0.535$). Two participants started by writing the first and last name on the first entry but easily recovered the error. Another participant did not know the concept of breadcrumb and, by mistake, selected the home option.

Create and plan a session associated to the patient: Session planning task was completed at 100% success rate and took an average of 94.75 seconds ($\sigma = 33.251$), or in minutes, 1 minute, and 34 seconds. With regard to false clicks, it was observed on average, 0.625 errors ($\sigma = 0.744$), because they tried to write on the image display. However, few have shown difficulties in accomplishing this task.

Begin activity of a planned session and start playing a video: On average, users took 37.67 seconds ($\sigma = 16.342$) to complete the task and there was an average of 0.5 false clicks ($\sigma = 0.548$). The success rate was 75% because two participants tried to start with the “Start Activity” option, where it is not possible to choose a planned session.

While saving, register a final analysis and end the session: All caregivers were able to finish with success with an average time of 61.625 seconds ($\sigma = 24.09$), about 1 minute and 1 second with 0.125 false clicks ($\sigma = 0.354$). In this task nobody showed problems and the ones that took more time was because they wanted to read better the presented options.

Start a new video visualization, but without any previous planning: All participants completed the task and they took, on average, of 16.5 seconds ($\sigma = 8.486$). There was an average of 0.5 clicks ($\sigma = 0.535$) and no one showed difficulties and mistakes were due to missclicks.

Review the observations of pasted sessions: Caregivers took an average of 28.5 seconds ($\sigma = 5.244$) and there were no false clicks. However, the success rate was 75% so this task failed the usability tests. When questioned by the difficulty, none knew how to indicate the reason, but it was assumed that the option needed greater prominence.

System usability scale: After the calculations, taken from the score given by the caregivers, from zero to 100, the ImmersiveMind platform scored an average of 86,875 ($\sigma = 11.16$). Most values are high, which proves that the participants were interested in the kind of approach. The results by and the corresponding average are shown in figure 6.

7. Evaluation of the reminiscence therapy
After performing the tasks mentioned in the previous section, the caregiver was asked to put the Google Cardboard viewers on the patient and use the platform to control the videos displayed, where different characteristics were evaluated such as emotions, cognitive stimuli, physiological changes and adaptability to the viewers, as well as the positive and/or negative comments regarding this type of technology.

7.1. Participants
This evaluation was conducted with 9 people with dementia where ages ranged from 66 to 81 years old (XXXX). All the participants have been diagnosed with Alzheimer’s disease and in two particular cases they have severe dementia, which means that they need specialist assistance.

7.2. Equipment
To perform this test, it was used the plastic viewers chosen in the preliminary tests, a smartphone with gyroscope, and a computer with the platform ImmersiveMind.
7.3. Procedure
Caregivers were asked to select the videos that were most appropriate to show people with dementia through the platform and were asked to place the viewers on the elderly. This session had a maximum duration of 15 minutes per person and in the end, questions were made to people with dementia and their caregivers in order to ascertain an overall appreciation of the use of ImmersiveMind. In order to understand the reactions of people with dementia in greater detail, the observations were performed together with the responsible caregivers.

7.4. Results and conclusions
Given the advanced state of Alzheimer’s disease in two elderly people, they have not been able to use and enjoy the viewers as such, the descriptions of patients present in the following factors refer to people with mild dementia.

Emotions: Emotions are a representation of what we think and therefore are translated in our behavior. In 7 participants, 4 were enthusiastic and happy while viewing the videos, showing curiosity and willingness to look around. Two participants said they liked the videos, although they did not express themselves like the previous ones, and one did not show any kind of emotion, which made the analysis ambiguous.

Cognitive stimuli: One of the main objectives of the use of this approach is to create cognitive stimuli in people with dementia, in order to trigger short and long term memory. 6 were able to recognize and indicate everything they saw and when asked by the caregiver, they were able to look for the objects requested. 5 people with dementia, during and after the visualization, told past stories related to the videos they viewed. It was observed that at the end of the sessions, the elderly began to talk and share their personal experience with the Google Cardboard.

Physiological changes: When using virtual reality glasses, there is the possibility of having cybersickness, which translates into the feeling of unwillingness that the person may feel during or after the use this kind of technology, where they may feel nausea, headaches, dizziness and/or visual difficulties. In general, almost no one showed any evidence other than a woman who already had a history of health problems associated with vertigo and dizziness.

Glasses adaptability: In this factor, 3 participants were able to use without any difficulty, moving their faces without needing to hold the glasses, while the remaining 4 required help to hold the viewers. Regarding comfort, everyone agreed that the glasses were comfortable and enjoyable to use, however, in some cases, it was found that the weight influenced the use of these goggles.

8. Discussion
After analyzing the obtained results, regarding the use of the platform by the caregiver, it was verified that the users expressed interest in this type of approach for the reminiscence therapy. According to the usability tests, almost all the proposed tasks were able to reach the expected metrics, however, in some cases that did not reach the expected objectives, it was possible to identify where the caregivers encountered some difficulties.

In relation to the first task, it was noticed that one of the most common errors was associated with the bar of identification of the image, which is believed to have misled the caregivers. However, given the similarity between the task of adding a new user and adding a new session, tasks execution were a lot easier to understand.

One of the tasks that the caregivers had more difficulties was the start of the planned session, where three participants had the struggle to find the “Start” button and two were not able to execute the task successfully. In this task was also asked to start a given video of the categories present, where all participants were able to use without any problem. As the categorization was already relatively familiar to most of the participants, the use of these elements became simpler to handle.

In the tasks that were asked to save and terminate the activity, and start a new activity without prior planning, no user experienced difficulties to execute it successfully, and all participants showed confidence in accomplishing these requested tasks.

Finally, in the last task where they had to review the final balance of each session, it was possible to verify that the highlight of the option was not enough, although it is already presented in the session editing header.

Regarding the evaluation of reminiscence therapy, with the support of caregivers, it was possible to verify that the elderly with dementia had a good response to this type of approach. Although it was not possible to use the glasses with the elder women with severe dementia, it served to confirm that people who are demented at an advanced stage are not able to use this kind of technology.

In the cases of people with diagnosed mild dementia, more than half were interested and, besides being able to identify the objects displayed in the video, they were able to remember past significant events, which proves that it is a useful tool for the reminiscence therapy.

The interaction between the caregiver and the patient was also important to observe. Informal
caregivers had conversations about family stories associated with the videos, which made the patient, in addition of feeling "useful" for being integrated in the experience, also felt happy to comment on these stories with the responsible relative (figure 7).

Figure 7: Interaction between the caregiver and the patient

In the end, caregivers stated that this type of approach has the potential for cognitive stimulation because it is a cheap, simple and creative tool to use where the only drawback they found was in using this type of technology in people with severe dementia.

9. Conclusions
Because there is a significant increase in people with dementia, and despite the frequent use of medication, it became essential to look for viable alternatives, such as reminiscence therapy, which is a technique that helps to recover past memories and stimulate cognition through props. Consequently, it was created a low cost technological tool that takes advantage of an immersive environment provided by a public library, in order to create a more immersive experience, with the purpose of triggering memories and encouraging communication, always with the support of the caregiver. As such, after the completion of this project, it was possible to achieve and identify different objectives.

The first objective was to investigate the state of the art, in which it was verified that the few technologies that focused on immersive environments did not take into account the motor difficulties of the elderly. Another factor was privacy, where several projects used personal data to get material for reminiscence therapy however, those who used public libraries showed positive results. In terms of cost, the focus was on the implementation of a tool that is economical, since the value associated with the medication of dementia is usually high.

The second objective was focused on understanding the role of the caregiver and the patient, which helped the implementation of the project. This leads to the third and fourth goal where the third one determined the best Google Cardboard glasses for people with dementia and the reason for that choice. The fourth objective was to provide a platform that would allow better patient and sessions management to make it simple to use during reminiscence therapy.

After completing the evaluations, it was concluded that, regarding the usability of the platform, the participants were able to accomplish most of the tasks proposed and it was understood that there is a need to create different paths for the same goal.

Regarding the evaluation of reminiscence therapy, it was found that the elderly managed to remember past moments by sharing with caregivers and also felt comfortable and receptive when using this type of tool. Overall, caregivers have stated that this is a viable approach to reminiscence therapy and leisure, recognizing that quick access and reduced cost are attractive factors for the use of this technology.

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