Interacting with Digital Memorials in a Cemetery: Insights from an Immersive Practice

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Abstract — **This research intends to analyze how users that are also HCI designers relate to the interaction with digital memorials linked to graves through QRcodes. To do so, we have carried out an immersive practice in the Consolação Cemetery (São Paulo, Brazil), where that technology is used to tag the graves of famous deceased people and to guide the visitors in the site. Those QR code tags link the graves to an online application for digital memorials called MemoriAll. To address the problem, this paper analyzes the data collected from the surveys answered by the research subjects before and after the immersive practice, along with data from a semiotic inspection of MemoriAll.**

I. INTRODUCTION

IN the last years, cemeteries have undergone several changes, from the architecture of graves (which are now considerably smaller and cheaper) to the reasons why people visit those sites. Besides visitors who want to remember or pay homage to deceased relatives or friends in front of their graves, there is now a growing number of tourists going to cemeteries. They are mainly interested in funerary art or graves of famous people, which help preserving the collective memory of a social group. Some cemeteries are considered landmarks for sightseeing, such as Père-Lachaise, in Paris (France), and La Recoleta, in Buenos Aires (Argentina). Therefore, there is also a growing use of digital technologies in the visits to those places, similar to what happens in museums other cultural sites [28].

Technology-mediated visits to these spaces may permit experiences beyond the immediate interaction with physical objects. With a simple mobile device, a visitor in a cemetery can access information about the deceased or about works of funerary art by means of a QR Code[1]. According to Cann [4], "*QR codes transfer the dead from the cemetery to the realm of the living by giving the living a connection to the deceased that can be accessed anywhere.*"

In general, QR codes in cemeteries permit the access to digital memorials, where different kinds of data about the deceased (photos, videos, textual information etc.) can be found. This technology creates a connection between the physical place where the deceased's remains are buried and some virtual representations of what that person had been in life. Some digital memorials on the web permit paying homage to the dead [1] or even performing some religious rites. They comprise a very specific kind of system, which can be modeled with social network elements [9], but the solutions designers can come up with are still limited by their beliefs and taboos on death [13].

Facing this context, the following questions arise: do these systems meet users' expectations? How do HCI designers see these systems? This research intends to analyze how users that are also HCI designers relate to the interaction with digital memorials linked to graves through QR codes. To do so, we have carried out an immersive practice in the Consolação Cemetery (São Paulo, Brazil), where that technology is used to tag the graves of famous deceased people and to guide the visitors in the site. Those QR code tags link the graves to an online application for digital memorials called "Memoriall[2]". The profiles of the dead in Memoriall include different data, such as biography, family tree, photos, messages, videos, obituary etc.

The use of digital technologies like QRCodes in Brazilian cemeteries is still very recent, which reinforces the need to carry out studies about them in that country. More generally speaking, many other cultures and countries do not use automated technologies in cemeteries, so there is a gap to develop, innovate and experiment on this area.

In order to address the aforementioned problem, this paper analyzes the data collected from the surveys answered before and after the immersive practice, along with data from a general semiotic analysis of Memoriall.

II. METHODOLOGY

To carry out this exploratory field study, we opted for a participant observation [13] to collect data. Considering the characteristics of the immersive practice, its planning and preparation demanded great effort from the researchers.

The immersive practice in the Consolação Cemetery herein described was carried out during the 7th edition of the *Workshop on Human-Computer Interaction Aspects in the Social Web,* within the *Brazilian Symposium on Human Factors in Computer Systems,* in São Paulo. The workshop promoted the debate about opportunities and challenges that Social Web poses to the Brazilian community of researchers on HCI regarding digital legacy. Among other activities, the organizers of the workshop proposed the qualitative research herein reported, in order to articulate theoretical discussions and practical activities within the domain of digital legacy.

In the workshop's morning shift, participants discussed digital legacy and digital memorial issues. In the afternoon,

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[1] Quick Response Code, a machine-readable optical tag usually linked to extra information about the object to which it is attached

[2] http://Memoriall.com.br/

those who accepted to participate in the immersive practice followed the 4 researchers to the Consolação Cemetery. 21 workshop participants agreed to be research subjects. They were all informed that they should bring the conference badge and charged cell phones with QR code readers to the cemetery. As this was our first immersive practice in cemeteries, a place that can evoke memories of different kinds of intensities (including very passionate ones), we decided to recruit only HCI experts, which we believed would be more capable of separating private concerns about cemeteries and the experience of using QR code technologies in that setting.

Because the study was intrinsically complex, requiring perceptions and understanding of not only usability and accessibility issues, but also of communicability, emotion and human values, we recruited only HCI experts interested in social applications *as they tend to be sensitive to a wide range of technical and social issues*.

At the entry of the cemetery, the researchers made a brief explanation about the activity, its goals and instruments (the scenario, the survey, the QR code reader etc.). Participants were asked to sign a consent term, whereby they agreed to be research subjects and allowed researchers to publish data from this study. The consent term said that "*The field study is intended to permit that workshop participants have an immersive experience in the context of digital legacy, by carrying out stages of a qualitative research on Social Web, in order to reflect upon issues such as ethics, privacy, digital legacy and human issues*".

During the visit, users were photographed and recorded while interacting with memorials. They also answered two surveys: one before and the other after the visit. The pre-visit survey contained 7 questions about general data and experience in HCI, 11 questions about religion, 2 questions about representations of death, 7 questions about cemeteries and 2 questions about expectations about the immersive practice. The post-visit survey contained 2 questions about how the users felt after the practice, 10 questions about the *Memoriall* application, 1 question about their cell phones and 2 questions about the immersive practice. To guide the visit to the cemetery, the participants should follow a scenario, which is presented below.

"*You are a tourist sightseeing in São Paulo with your friends. You decided to visit the Consolação Cemetery, which is famous for works of funerary art and for the graves of famous Brazilian people, such as Tarsila do Amaral, Monteiro Lobato, Mário de Andrade and de Santos Marchise. You heard that in this cemetery visitors can use technology to access QR codes on totems and on the graves of famous people.*

When you got to the cemetery, you checked the printed map available next to the front gate and decided to take a look at the following graves: 1. de Santos Marquise's; 2. Cícero Pompeu de Toledo's; and 3. Mário de Andrade's.

Then, you chose the graves you would like to visit, copied their addresses from the map and entered the cemetery.

When you turned onto the street where 1. de Santos Marquise's grave is located, you saw a totem with a QR code tag on your right and you decided to explore it. Then, you went to de Santos Marquise's grave, accessed her memorial through the QR code and: 1.1. Observed the possibilities on the webpage of her memorial; 1.2. Read her obituary; and 1.3. Read her messages.

Then you moved to 2. Cícero Pompeu de Toledo's grave and accessed his memorial, where you looked for the following information: 2.1. Causa mortis; 2.2. Date of death; 2.3. Why he was famous; 2.4. Messages to him.

Then you crossed the cemetery to visit 3. Mário de Andrade's grave, accessed his profile and: 3.1. Read his biography; 3.2. Read the available links; and 3.3. Shared with your friends that you were there.

Finally, you walked to the exit of the cemetery, while observing other interesting things you found on the way".

The immersive practice ran as proposed in the scenario. Throughout the visit, participants exchanged impressions about the place and the experience of being there in a research activity. The visit took about 3 hours and finished when the participants answered the post-visit survey.

The data from the surveys were tabulated in an Excel spreadsheet following the numbers of the questions in the survey, and graphs were created with the aid of the software program Google Sheets[3]. As there is no information about the population size, the statistical significance of the responses could not be calculated. In this paper, all questions are referred to by using the letter Q and their respective number in the survey. Some multiple-choice questions were correlated in the analysis for promoting deeper results. In the analysis of the open questions, participants were identified by the letter U followed by a number to preserve their anonymousness and to permit the comparison of each respondent's pre-visit and post-visit surveys.

The answers from the surveys were also contrasted with a semiotic analysis of the application *Memoriall* considering the sign categories proposed by Peirce [21] and adopted to describe computer interfaces by de Souza et al. [8] and Lopes et al. [11], among other practitioners of Semiotic Engineering. However, as the main objective of the study was not the reconstruction of the designer's metamessages, we did not follow a specific semiotic method; instead, we read the screens from *Memoriall* scaffolded by the sign categories adopted in Semiotic Engineering to describe computer interfaces.

The software interfaces inspected were the same the participants dealt with when performing the activities suggested in the scenario for the immersive practice.

The qualitative analysis based on the semiotic analysis and on the answers to the surveys permit to identify relevant elements and information in this domain. It is also enriched by quantitative data regarding the impressions participants had during the immersive practice.

III. RELATED WORKS

In the last years, researches have been carried out on thanatosensitivity, an approach that actively integrates

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[3] https://www.google.com/sheets/about/

mortality, grieving and death into design and HCI research [17]. In 2011, Massimi et al. [18] defended that HCI studies must address death in a lifespan-oriented approach. According to the authors, there are four main concepts in this area: life, death, the dead and the bereaved; and there are four main research topics on the end of life: materiality, identity, temporality and methods.

Nalini [20] explains that the two main approaches to death are the scientific and the religious one. Technology itself does not promote a new approach. Instead, it is a new transversal lens through which death can be seen.

When it comes to the dead and the bereaved, different technologies have been designed and adapted to allow users to pay homage to the deceased. For instance, Oliveira *et al.* [7] pointed out four different categories of functionalities for Digital Legacy Management Platforms (1. sending previously configured messages; 2. creating online memorials; 3. storing and managing digital legacy; and 4. creating bots/avatars that simulate users' behavior.

Riechers [26], mentioned that websites for digital memorials have been there since 1996, when the platform *Virtual Memorials[4]* was created. Therefore, another relevant system design issue is the development or transformation of social network profiles into digital or online memorials. The concept of digital memorials comes from the idea of memorials in the physical world, where concrete monuments are used to honor the memory of a person or an event. According to Riechers [26], all personal memorials come from a common human need: honoring death, so as to evoke memories of happiness and pain, and to comfort the bereaved. That social practice has now been transposed to web environments, where users can pay homage to the dead by offering them virtual flowers, lighting virtual candles or sending them digital verbal messages. Some systems even allow users to make virtual prayers for the deceased. According to Carroll and Romano [5], online memorials are unique because they transcend space and time. For example, one can take part in a virtual wake or visit a virtual grave in the web, regardless of space and time constraints.

The development of platforms for both the living and the dead leads Brubaker et al. [2] to consider dead users not as a special subgroup of users, but as a case of extreme users, whose particular technological needs require special attention from software. In a research on digital memorials, Lopes, Maciel and Pereira [10] analyzed the systems iHeaven[5] and *Saudade Eterna[6]* in the light of social network characteristics and experiments with users. The authors created some practical recommendations for the design of digital memorial systems [9]. The recommendations and the prototypes are aimed at designers working on solutions in that area, so they can meet users' expectations, protect dead users' reputation, and project multicultural applications.

Funeral companies have also entered the market for memorial services. For example, the *Memorial Necrópole Ecumênica* (Ecumenical Necropolis Memorial, in a free translation), in São Paulo, Brazil, offers not only the physical cemeterial structure, but also virtual and online services[7], which offer profiles of deceased people, allow mourners to interact among themselves, post sympathetic messages or participate in funereal rites online.

Digital Memorial[8] is described by its owners as an application that "*create[s] and implement[s] Digital Memorial solutions to improve family and friends' bereavement processes*". Its services include QR code products and solutions, NFC (*Near Field Communication*) software and tags, the "Keeping their memory alive" campaign, GPS solutions and gitfboxes to express sympathy.

Facebook gives the option to transform a common profile into a digital memorial after a form proving the user's death is filled in. According to Facebook, "*Memorialized accounts are a place for friends and family to gather and share memories after a person has passed away. Memorializing an account also helps keep it secure by preventing anyone from logging into it. If Facebook is made aware that a person has passed away, it's our policy to memorialize the account*". In Facebook, it is also possible to name a legacy contact for the account[9], somehow similar to an heir with enough privileges to share a final message on the person's behalf, respond to new friend requests, update your profile picture and cover photo, download everything that was shared on Facebook and so on. Changing dead users' profiles into memorials is innovative, but it considers neither multicultural approaches to death and legacy nor other functionalities a digital memorial can have.

Pereira, Maciel and Leitão [24] have carried out studies on the design of real-world artifacts such as graves, tombstones and physical memorials in order to analyze the diverse messages these objects convey through different semiotic systems. They identified design elements and built speculative and theoretical knowledge on that domain, offering: i) a description of the design space of digital memorials in terms of agents involved and their objectives for interacting with the application; and b) scaffolds for reflecting about the process of designing them.

When it comes to the impact of digital technologies in the experience of visiting physical cemeteries, QR codes on tombstones and smartphone technology have a great impact on the funeral industry in Asia, the UK and the USA [4]. For the author, QR codes are effective in presenting supplementary information within a limited space (which is the case of physical memorials in cemeteries, where QR codes expand not only geographical space, but also life itself). QR codes were created in Asia, where they have been most largely and diversely used in industry and marketing. In Japan, QR codes are used in tombstones to allow the family and friends of the deceased to see photos, videos and information about the dead. It also permits that users click on buttons to offer Buddhist chants or prayers, as well as gifts, such as incenses or food. That shows the service is not anymore restricted to marketing: it entered the realm of

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[4] http://www.virtual-memorials.com
[5] http://www.iheaven.me/ (Last access:May2014; not available in Jan 2017)
[6] http://www.saudadeeterna.com.br/ (Last access: May 2014; not available in Janu 2017)

[7] http://www.vidaperpetua.com.br/Defaultvida.aspx
[8] http://www.digital-memorial.com/ (Last access: Oct 2016)
[9] https://www.facebook.com/help/1568013990080948? helpref=search&sr=21&query=memorial (Last access: Oct 2016)

religion. Besides, the Japanese government has put QR codes in the first 500 tombstones of people killed by the Tsunami in March, 2011, so visitors can access governmental messages about what to do in case a tsunami happens. In turn, the Chinese government is stimulating the use of QR codes in deathscapes, as it reduces the huge foot traffic to clean the gravesite and to make offerings to the dead in special dates and religious festivals. Besides, due to the land shortage for the burial of the deceased, Chinese government now buries the dead in individual graves for 7 years, and then moves the remains to mass graves. Internet memorials allow the living to make offerings and honor the dead even after they are no longer in individual graves.

Cann [4] also shows that, whereas in Asian countries the government stimulates the use of QR codes in tombstones and cemeteries for practical reasons, in the UK and in USA that remains mostly a personal choice. Part of that is driven by the fact that, different from China or Japan, most cemeteries in the West are privately run. In the UK and the USA, QR codes have been little used in cemeteries, due to: (i) a lack of awareness of how to use QR codes; (ii) a lack of accessibility, because QR code technology in these countries tends to require multi-step processes; (iii) a more timid use of QR codes in marketing in these countries. However, cemeteries are employing this technology to spur funeral tourism in an inexpensive manner. The author also says that in the UK and the US QR codes are used to give more information about the deceased, through texts, photos or videos, but they are very little employed to allow religious interactions, such as praying or making offerings. In Brazil, this market is even more under-explored.

Also regarding the impact of technology in visiting cemeteries, Van der Linden et al. [27] carried out a research that consisted on having 2 groups of users visiting an old Victorian cemetery in the UK with the mediation of interactive displays and mobile devices (including smartphones, tablets, video links and a shared multi-touch surface). These were placed indoors and outdoors for users to interact with them. The results showed that visitors went beyond reading inscriptions and looking at graves, delving deeper and making connections among data about the dead, but also relating to their own personal histories. They had pleasure in seeing the photos they took integrated into the digital map, in serendipitously discovering new information about famous people buried in the cemetery and also in relating their own family histories to that of people whose tombstone inscriptions they read. One of the main questions raised by the paper is how memories created through the evocative computing approach differ from those arising from visiting a cemetery without technological mediations.

Another perspective for the study of post-mortem digital legacy consists on posthumous interaction, which includes writing messages of mourning, creating profiles or communities about a deceased person, or visiting digital memorials. The concept of posthumous interaction was coined by Maciel and Pereira [15] to refer to "*system interactions with dead users' data, or to interactions between living users and dead users' data through digital systems*". Such interactive patterns must be considered in the design of digital memorials, so as to allow diverse rapports to death, the dead and their legacy. The domain has also been analyzed under different theoretical and methodological semiotic lenses, such as in [22], [12] and [8].

IV. DATA ANALYSIS

In this section, data from our immersive study are analyzed and dis-cussed. First, we present the results from the semiotic analysis of the interfaces from Memoriall. Next, we analyze the data from the pre-visit and post-visit surveys. In the analysis of the data from the surveys, the answers to multiple choice questions where respondents could choose a single option are expressed in percentage values, whereas, when more than one option could be chosen, answers are expressed in absolute values.

A. Semiotic analysis

As reported in the methodology section, the semiotic analysis of the application interface followed the same navigation path proposed in the scenario. The three memorials (de Santos Marquise's, Cícero Pompeu de Toledo's and Mário de Andrade's) participants were supposed to visit have the same general structure, as described in this section. They are also mostly composed of static signs, that is, signs that depict the state of the system through non-causal and non-temporal relations [8].

In all profiles, at the top center of the interface, there is the icon for the Memoriall enterprise, which is a stylized tree whose leaves are different shades of grey and have the shape of squares, possibly alluding to QR code tags. The name "Memoriall" is an explicit pun between the noun "memory" and the pronoun "all", suggesting all people can have digital memorials when they pass away.

As can be seen in Figure 1, there is a box where the deceased's full name, birth date and death date can be found. Interestingly, in de Santos Marquise's and Mário de Andrade's profiles, this box shows both their full civil names (Maria Domitila de Castro e Melo and Mario Raul de Moraes Andrade, respectively) and the names under which they became famous in Brazilian history. The display of pseudonyms or artistic names together with civil names is common in famous people's tombstones, as reported by Pereira, Maciel and Leitão [23]. However, maybe because of the non-official status of a digital memorial, in de Santos Marquise's and Mário de Andrade's profiles their artistic names come first, highlighted by quotation marks.

As to the birth date and the death date, they are both accompanied by metalinguistic signs, which point to other signs in the interface in order to explain or clarify their meanings [8]. In this case, the metalinguistic signs are a five-pointed star and a cross, which are placed at the left of the birth date and the death date, respectively. As discussed by Pereira, Maciel and Leitao [23], the cross is a highly-conventionalized symbol for death in Brazilian culture, where Christianity is by far the predominant religion. On the other hand, stars are not necessarily associated to birth out of the funerary domain, but they are frequently placed beside birth dates in tombstones in Brazil. By scrolling down the interface, one sees another important static sign for digital

memorials: the photo (or portrait) of the dead.

Figure 2 shows six iconic buttons that lead to different areas in the profile: biography, genealogic tree, photos, links, messages, obituary and videos. Some of those icons convey important aspects of the designer's assumptions regarding death. For example, the illustration for the link to the biography section shows a pair of glasses and an open book, which suggests an understanding of someone's biography as something bookish or merely documental, rather than human or living.

Fig. 1 MemoriALL's profile   Fig. 2 MemoriALL's buttons

The illustration for the link to the messages section is also worthy of attention, as it shows a bottled message on a desert beach. Bottled messages are usually associated to communication in situations of despair and loneliness. Besides, bottled messages are unlikely to be answered, like those sent to the dead in a digital memorial.

By scrolling down the interface a bit more, one sees an advertisement for the "Memory and Life" program of the Consolação Cemetery (a social program to attract visitors to cemeteries), a link for the admin area and, at the bottom, a button with the sentence "Send a message to the family".

Throughout the whole navigation path, three buttons are constantly present in the interface. They connect the user to his/her profile in social networks (Facebook, Twitter and Google+) so he/she can share with others where he/she is. By clicking the "obituary" button in de Santos Marquise's memorial, the user is taken to a new page, where, once again, static signs are dominant.

In the top left corner, a "home" button takes the user back to the main page of the memorial. Below, the user reads data divided into the following fields: name, address, neighborhood, zip code, city, state, block and causa mortis. But for the causa mortis, all the other fields are not related to the person honored by that digital memorial. Instead, they simply define the location where her remains are buried (for example, in the "name" field, the information presented is "Consolação Cemetery", not de Santos Marquise's civil name). Evidently, in *Memoriall* the obituary does not play the same role as in real-world institutions, where an obituary is a notice of a person's death usually including a short biographical account. Obituaries in the application mainly serve the purpose of locating the remains of the deceased in the physical world. Therefore, they can be considered deictic signs [11], similarly to the link to the Google Maps image of the location of the grave (at the bottom of the interface).

By returning to the main page of de Santos Marquise's memorial profile and clicking on the "messages" button, the user is led to a page where there are six messages — four of which were written by the participants of this research during the immersive practice. The date of the sending and the author's name are informed before each message. Interestingly, none of those six messages was addressed to de Santos Marquise. Three of them praise her (as a third person, like in "she was a great woman"), two express sympathy through phrases in Portuguese typically addressed to the deceased's family, and one just says "like it", possibly referring to the application.

Moving on, to find the pieces of information about Cícero Pompeu de Toledo required in the scenario (causa mortis, date of death and why he was famous), a natural choice for the user would be to access the "obituary" and "biography" sections. However, in the "obituary" section, the user only finds the fields name, address, neighborhood, zip code, city, state and block, as well as the link to the Google Maps image of the location of the grave. There is no field for the causa mortis in this obituary, which reinforces the suggestion that in this application the role of an obituary is mainly deictic, defining the location of the deceased's remains in the physical world.

In turn, the "biography section" repeats some of the static signs from the main page of the memorial. But there, below Cícero Pompeu de Toledo's name and photo, the user finds a paragraph (extracted from the Wikipedia) about his achievements as the president of a Brazilian soccer team.

In the "messages" section, the user finds three messages: the first one, with no name or text (just a blank space preceded by the date of the sending); the second one with the chant of the soccer team of which Cícero Pompeu de Toledo was a president; the third one addressing him, with the sentence "rest in peace".

Following the scenario, the user finally gets to Mário de Andrade's memorial. In the "biography" section, the user finds a text extracted from a biographies website, followed by a list of the main books written by him. The fact that exhaustive lists of literary works are not common in biographies suggests that users might interpret the "biography" section in *Memoriall* as an "about the deceased" section, where all sorts of information would fit.

By clicking the "Links" button, the user is led to a page where he/she finds links to external sites with school projects, news and events about Mário de Andrade. Finally, if the user decided to share with his friends in Twitter that he was by Mário de Andrade's grave, he would click the respective button in the interface. That would lead him/her to his/her profile on Twitter, where the following post would be automatically written: "*Memoriall 0074A – "Mario de Andrade" Mário Raul de Moraes Andrade* http://Memoriall.com.br/0074A". That message indicates the number of the *Memoriall* tag, the deceased's artistic name, his civil name, and the URL for his digital memorial. However, the meaning of those pieces of information is very

unlikely to be understood by friends in the social network who had never used the application. The automatic message is the same in case the user decides to share his/her status with his/her friends in Facebook or Google+.

B. Immersive practice

This section analyzes data from the surveys answered by 21 respondents before and after the immersive practice. The data are analyzed in the following order: demographic data, data about habitual practices in cemeteries, and data about the interaction with the *Memoriall*.

Demographic data

In Q1, 52.4% of the participants in the immersive practice answered they are between 20 and 29 years old; 28.6% are between 30 and 39 years old; 9.5% are between 40 and 49 years old; and 9.5% are older than 50. According to their answers to Q2, 71.4% are men and 28.6% are women.

According to the answers to Q3, our sample was composed of people from all Brazilian regions: 42.9% from the South East (5 participants from the state of São Paulo, 3 from Rio de Janeiro, 1 from Minas Gerais); 28.6% from the South (3 participants from Paraná, 2 from Rio Grande do Sul, 1 from Santa Catarina); 9.5% from the North (2 participants from Amazonas); 14.3% from the North East (1 participant from Bahia, 1 from Rio Grande do Norte, 1 from Maranhão); and 4.8% from the Middle West (1 from the state of Mato Grosso).

In relation to their academic/professional profile (question Q4), 3 participants answered they are undergraduate students, 10 are graduate students, 10 are professors and 12 are researchers. It is important to notice that, in this question, respondents were allowed to choose one or more options. None of them claimed to be an industry professional.

The participants have a significant experience in HCI, as shown in their answers to Q5. 33.3% have been in the field for 5 or more years; 4.9%, for about 4 years; 19%, for about 3 years; 23.8%, for about 2 years; and 19%, for 1 year or less. As to the experience in interface evaluation (question p6), 58.2% claim to have carried out evaluations in the past; 31.8% answered they often evaluate interfaces; and only 9.1% had never done it. Such experienced profile is due to the fact that all participants were recruited from an academic conference on HCI.

Q9 asked about participants' religion, an important cultural element in the context of death, cemeteries and memorials. 32.75% answered they are Catholics; 23.8%, Protestants; and 12.5%, Spiritualists. 25% claimed to have no religion, and 4.2% did not answer Q9. In Q8, 57.14% answered they believed in God; 30.10% are atheists and 4.76% are agnostics.

However, in Q10, when asked whether they often attend rituals of their religions, 66.7% answered that they rarely do it; 23.3% never do it; and 9.5% often do it. As to life after death (P11), 57.1% believe it, whereas 42.9% don't.

Q13 asked if the respondents used social networks. The consensual answer was "yes". The most popular social networks among them are Facebook, WhatsApp and Instagram. In Q40, respondents had to answer what

operational systems they had used in their cellphone when visiting the cemetery. 66.67% used Android; 28.57%, iOS; and 4.76%, Windows.

Data about habitual practices in cemeteries

Q21 asked how often and why respondents went to cemeteries. Allowed to choose more than one option, participants answered that they go to cemeteries (Table 1):

TABLE I: HOW OFTEN RESPONDENTS WENT TO CEMETERIES

Frequently, to pay homage to deceased people	4.8%
Sometimes, to pay homage to deceased people	19.0%
To attend funerals of closely related people	47.6%
To attend funerals of not closely related people	38.1%
In touristic activities	9.5%
Never	9.5%

U16 chose the option "other", and wrote that he goes in "All Souls' Day and death anniversaries". His answer, along with the two most frequently chosen options in Q21 ("to attend funerals of closely related people" and "to attend funerals of not closely related people"), shows that respondents had somehow a relationship to cemeteries ruled by social norms, thus visiting them only in dates when they were expected to according to Brazilian etiquette rules.

The social nature of those visits, rather than a more personal one, is confirmed by the answers to Q22, when respondents were asked whether they visited cemeteries alone or accompanied, and by whom. Allowed to choose more than one option, 19 out of the 21 respondents said they go accompanied by family, and 10 said they go accompanied by friends. Only 4 said they go alone.

In Q23, respondents could choose more than one option regarding how they usually feel upon going to cemeteries. The options "uneasiness" (10 respondents) and "nostalgia" (7 respondents) were the most frequent ones. 3 research subjects chose the option "other" and expressed "sadness", "reflectiveness" and "introspectiveness".

On the other hand, Q30 asked them what they felt after participating in the immersive practice in the Consolação Cemetery. The two most frequent options were "indifference" and "peace". Respondents that chose the option "other" added nouns as "surprise", "experience", "wisdom", "wonder" and "curiosity".

In another research, Lopes et al. [10] carried out an empirical observation of digital memorials in Brazil by investigating if they had characteristics of the social web. Through an interaction test and a survey, they analyzed how users felt when interacting with digital memorials and how they evaluated the functionalities of those applications. By comparing the answers we got about users' feelings after interacting with digital memorials in an immersive practice and the answers [10] got regarding users' feelings after interacting with digital memorials in a controlled environment, one sees that "uneasiness" and "peace" are common answers.

Q24 asked what users normally do when going to cemeteries. The participants could to select more than one

option. Table 2 summarizes what participants answered that they go to cemeteries for.

TABLE II: WHY PARTICIPANTS GO TO CEMETERIES

To enjoy funerary art	47.6%
To pray	19.0%
To look for memories of the deceased	28.6%
To talk to the deceased	14.3%
To leave objects on graves	14.3%
To wander through graves	42.9%
To read information on tombstones	61.9%
Other	9.5%

Two respondents answered "other" and added "to keep graves tidy" and "to photograph funerals". The most common answers ("to enjoy funerary art" and "to read information on tombstones") suggest that a great share of the experience of visiting cemeteries consists of semiotic processes, where the reception and interpretation of verbal and non verbal messages play a central role. The interaction with the deceased or with the place is thus greatly mediated by linguistic artifacts, which cannot be dissociated from the role any memorial (digital or physical ones) play.

The 3 respondents who answered in Q24 that they "leave objects on graves" were asked in Q25 what kind objects they leave. Among the eight options ("flowers", "funeral wreaths", "candles", "religious symbols", "photos", "notices", "the deceased's belongings", "other"), only 4 were chosen: "flowers" (1 respondent), "funeral wreaths" (1 respondent) and "candles" (2 respondents). Those choices are possibly due to Brazilian culture, where those elements are more frequently used to pay homage to the dead. However, in other countries, as reported by Pereira et al. [23], religious symbols and personal belongings of the deceased are often left on graves. Q26 asked what resources respondents had ever used when visiting cemeteries. Allowed to choose more than one option, respondents answered what they had already used (see Table 3).

TABLE III: RESOURCES USED WHEN VISITING CEMETERIES

Item	Yes	No
Used a map	23.8%	71.4%
Followed a guide	28.6%	66.7%
Used an audioguide	9.5%	85.7%
Read print material about the deceased	4.8%	90.5%
Asked for information at the reception desk	28.6%	66.7%
Looked for information with a web browser	28.6%	66.7%
Used QR Codes	0.0%	95.2%

One of the research subjects chose not to answer that question. The answers from those who answered it show that digital resources are very infrequent in visits to cemeteries, especially QR codes, which nobody chose as an answer. Besides, the answers show that visitors rarely read print material with information about the deceased, which might result different in case the information about the dead were displayed in digital interfaces, as digital memorials do.

Data about the interaction with memoriall

In the post-visit survey, all participants answered Q35 informing they would like to use *Memoriall* in other visits to cemeteries to learn about the deceased.

Q31 asked how easy to use *Memoriall* is. 80,95% of the respondents said it is easy to use, whereas 19,04% considered it hard. However, when asked in Q32 about the design of the application, only 23,80% of the respondents said they were satisfied with it. By correlating the data from those questions with the answers to Q40 (about the operational system in the respondents' cell phones), results show that Android users were more likely to find *Memoriall* hard to use, but some iOS users reported dissatisfaction too.

When asked in Q34 about what the exploratory use of *Memoriall* promotes, participants could choose more than one option. Table 4 presents their answers:

TABLE IV: WHAT THE EXPLORARY USE OF MEMORIALL PROMOTES

Curiosity	81.0%
Exploration of the physical space	33.3%
Interaction in the cemetery	81.0%
Interaction with other people	23.8%
Access to the deceased's memories	52.4%
Other	4.8%

U8, who chose the option "other", added that the use of the system promotes "limited information", which suggests dissatisfaction with the system. The fact that the information available in the system is indeed quite limited is confirmed by the semiotic analysis of *Memoriall* we carried out. The only piece of information all memorials presented in full was the location of the grave.

The two other least frequent answers to Q34 ("interaction with other people" and "exploration of the physical space") show that the experience promoted by the digital memorial was not perceived by most respondents as necessarily social or anchored in a particular physical space. The fact that interaction through a digital memorial with information about deceased people took place *in* a cemetery was considered relevant by respondents, but few felt interacting *with* the cemetery, by exploring its physical space. In our semiotic analysis of the digital memorials we found no photos of the cemetery or the grave. The only image that differs from one memorial to another is the deceased's photo (or portrait).

In Q41, participants were asked to write freely about the main problems in the system. The fact that the application did not follow responsive design principles, i.e. the fact it did not meet some design principles for mobile applications, was reported by two participants (U14 and U18). Other three participants (U2, U9, U15) said they had problems with the quality of the QR Code. In the development of applications, designers must be careful with different non-functional requirements, which impact on the user's experience.

As to the "send messages" functionality, U5 answered that "some functions are hidden", and U7 complained that "it was a messy process to send messages".

Other problems were also pointed out: unclear menu (U3),

navigation problems (U7, U10, U20), lack of consistency and patterns (U4), unreliability (U8), usability problems (U12, U17), and accessibility problems (U17).

As to visual aspects, U16 considered the interface outdated, U19 said that "some missing elements could make the system more interactive", and U20 answered that the system lacks "an interface with adequate colors and images".

The missing or incomplete information was a concern of for five other participants. U1 said there is "missing information; some deceased are not represented in the system; only the famous ones". This respondent referred to a celebrity's family's grave, where different relatives were buried, but the QR code tag on the grave led only to the famous family member's digital memorial. U17 also said "the information presented in the memorials follows no pattern". That confirms our semiotic analysis of the obituary and biography sections in de Santos Marquise's, Cícero Pompeu de Toledo's and Mário de Andrade's memorials, which showed different sorts of information.

In Q42, users were asked to write freely and give suggestions to improve the system. The main suggestions include: enhancing usability (U2, U3, U9, U10 and U14), following responsive design principles (U18), a full redesign (U4, U14, U17, U21), showing the cemetery map (U1), improving the quality of the information (U1, U3), filling in the information for all graves (U2, U8, U11 and U16), integration with Wikipedia (U1), a module for approving the messages left by visitors (U1), allowing the deceased's family to moderate the messages (U5), making it easier to send messages (U5), moving the button "write a message" to the same screen where messages are read (U15), improving the navigation (U7, U12), making the interface more visual (U7), warranting the reliability of information about the deceased (U8), allowing visitors to insert data about the deceased (U16), showing the deceased's photos (U19), adding links to the interface so as to improve the access to the system (U19), and changing *Memoriall* into a collaborative system (U7).

Q37 asked if the respondents would like to add information to the memorial profiles if *Memoriall* were a collaborative system. 61,90% answered they would add data about the deceased. Q38 asked them to justify their answers. U5 stated that he "would add information only if the deceased were a person he admired". In turn, U12 and U16 said they would add information about friends or relatives. U1 said "*that possibility* [adding information to profiles] *is interesting for historians*".

Some respondents also defined what kind of information they would like to add: "information about graves and funerary art" (U14), "related links" (U20), and "the relationship between deceased people buried in the same grave" (U3). According to U10, "the users should be allowed to edit content". For U9, a more collaborative system would "enrich the memorials with relevant information". Likewise, U15 showed concern with the quality of information; for him, "there should be an administrator to avoid defamation". On the other hand, U7 answered the system "*is somehow collaborative, as I* [she] *was able to send messages to the memorial*".

In Q39, respondents could choose more than one option to say what they found more interesting in the system. Their answers are summarized in Table 5.

TABLE V: PARTICIPANTS' PREFERRED ASPECTS OF THE APPLICATION

Finding graves in the cemetery	57.1%
Getting information about the deceased	95.2%
Getting information about the deceased's family	23.8%
Using technology in a cemetery	66.7%
Sharing experience with other people	33.3%

Their answers suggest a good reception of the use of digital technologies in cemeteries and confirm the main role of the application: presenting information about the deceased. As to the kind of information about a dead person to be presented in a cemetery, respondents have different opinions depending on the medium where the data would be available: either a tombstone or a digital memorial.

In the pre-visit survey, Q27 asked what kind of data a tombstone should contain. The five elements most frequently chosen by participants were: full name (20 respondents), birth date (17), death date (17), photo (13) and epitaph (10). Such choices are in accordance with popular tombstone formats in Brazil [23]. Interestingly, no respondent chose the option "religion", although religious symbols, such as crosses, are commonly found in Brazilian tombstones beside death dates. Our semiotic analysis showed that *Memoriall* uses a cross by default as a symbol for death, which suggests a disregard for different religions and visual representations of death.

Q36, in turn, asked what kind of data about deceased people a digital memorial should contain. The most frequent answers were almost consensual: full name (20 respondents), biographic information (20), birth date (18), death date (18), photos (19) and causa mortis (17). Possibly due to less space constraints, digital memorials are expected by users to show more information about the deceased. In the option "other", for example, users suggested adding to digital profiles information like the deceased's "favorite films", "funny facts", "likes" and "media articles". In contrast to the information available in the digital memorials we analyzed in a semiotic perspective, the respondents' answers show they what more personal information about the deceased, rather than public data like the location of the grave or the obituary. The graph (Figure 3) compares the answers to Q27 and Q36.
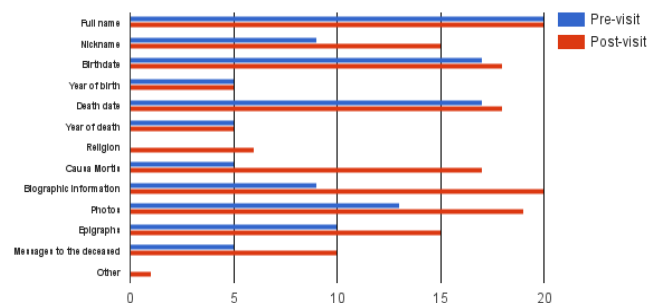

Fig. 3 Comparison between Q27 and Q36.

Causa mortis is a delicate subject, though: whereas it interests users, it also affects dead users' privacy requirements, so that a greater care must be taken.

Q20 asked what symbols best represent death. 36% of the respondents chose tombstones; 16% coffins; 12% light; 8% skulls; 8% sky; 8% graves; 4% crosses; 4% black ribbons; 4% the option "other", but did not add a new symbol.

Maciel and Pereira [16] posed the same question in a study with teenagers from the Z generation. The researchers report that the three most frequent answers were "cross", "coffin" and "tombstone". Our sample is too small for generalizations, but the difference between the answers in the study herein described and in that by [16] suggests that visual representations of death change not only when different nationalities are compared, but even when different ages or social classes are at stake. According to Maciel and Pereira [16], discussing symbols that can represent death might provide valuable input for the design of digital memorials, especially when it comes to warranting multicultural representations in graphic interfaces.

From the most frequent answers to Q20, *Memoriall* only presents crosses, in a very small size, beside the deceased's death date. In turn, the application has a tree as its logo, which might suggest a connotation of life and death as part of a natural cycle.

Finally, in Q43, participants were asked to give their opinions about the immersive practice. 95.24% considered it interesting, and only 1 participant (4.76%) was indifferent about it. When asked in Q44 to freely comment about the practice, U8 suggested "there should be a first moment of the experience without smartphones".

V. FINAL CONSIDERATIONS

The study presented and discussed in this paper allowed to analyze users' perception — experienced in interaction design — regarding the under-standing and use of digital memorials linked to graves via QR Code technology in a cemetery space. More than informing about the satisfaction of these users with the analyzed system and the possible improvements for its redesign, the results offer interesting insights and contributions for the research area.

Because thanatosensitivity applications are a new, different and challenging domain, a user-centered approach for requirements understanding, identification and analysis is essential. Immersive practices, such as the one reported in this paper, allow a situated identification and understanding of requirements supported by ubiquitous computing solutions. This kind of practice tends to produce rich information and allows more in-depth analysis, favoring, for instance, the consideration of cultural facets (e.g., space, arts, materials) of the usage situation as well as patterns of behavior when people use these applications in the wild. Such practices can be combined with specific requirements elicitation techniques (e.g., the Semiotic Analysis) in order to obtain better results.

From the lessons learned from this research, we highlight the need for a careful planning of the entire study. Because the practice is conducted in the external environment (i.e., in the wild), many factors can trigger interference and influence both the activities and their results, thus requiring a risk identification and management strategy. Furthermore, conducting a pilot test is fundamental to anticipate and avoid possible problems. The study and the methodology presented in this paper may serve as inspiration for other similar studies, contributing to exploratory and in-the-wild thanatosensitivity studies in HCI.

On the one hand, the analysis presented in this paper offers useful insights for digital memory application designers regarding requirements understanding and elicitation. On the other, it draws attention to the need of reflecting on the possible impact of such applications. In this sense, the study of users' perceptions, as well as their practices and customs in cemeterial spaces, favors a better understanding of this domain and a user-focused modeling for these solutions.

One of the problems evidenced by this study was the lack of information in deceased profiles. Because the information is not collaboratively inserted, depending on specific stakeholders to be available (e.g., the family, or the company that manages the software), the lack of information is commonly noticed. Additionally, the information architecture interfered negatively in the navigability and accessibility of information on mobile devices — usability and/or communicability tests could help identifying and fixing such kind of problems. Additionally, the possibility of integrating these systems with other social tools could add value to the memorials, promoting its adoption and usage.

Cemeteries can be a useful space for educational practices. Activities with young people have been held in cemeteries and the use of digital memorials can be very helpful to promote teaching-learning activities. Indeed, users in these scenarios could also collaborate inserting information into these systems, adding value to them.

Related to this research is the concern of professionals and researchers [6][19] with the preservation of cemeteries. For Araujo [6], "*tombs should be considered historical heritage, as well as a source for the past, because they make sense in our daily lives*". Indeed, in addition to the information about he deceased, as evidenced by the users in this research, the cemetery design and its exploration by people can be studied. For technology-enthusiastic researchers, an interesting market appears in the automation of these spaces, which requires attention to ethical and cultural issues, mainly related to human values. Finally, with the possibilities of cremation and / or guarding the physical body for limited time in certain cemeteries, digital memories can be a possible way of immortalizing the deceased ones.

As future research, there is the possibility of analyzing more sources of data collection, such as photos and audios captured during the practice, as well as a Semiotic Inspection of the tool used. These data can be compared with the analysis of the immersive practice presented in this paper in order to formulate a set of useful guidelines or requirements in this area. Finally, the Web interface for the system, which allows someone to hire company's services, buying a *Tag Memoriall*, and also paying tribute to a deceased (e.g.,

lighting a candle, leaving a message) is another space for future research.

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