

# Digital memorials: classifications and design recommendations

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## Abstract

Digital memorials are currently addressed in several studies on the design this type of system requires. However, as different types of memorials have different needs, this research analyzes characteristics of this type of software in terms of design, structural elements, cultural relevance etc. This paper presents an overview of recommendations for digital memories from several published articles and sums them up.

**Keywords:** *Digital Memorial, Multicultural Systems, Recommendations, Culture*

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## 1 Introduction

Memorials are spaces designed for displaying testimonial memories and they can play a significant role in the grieving process. In the physical realm, they can be individual or collective monuments in public places, or even tombstones in graveyards. Castro et al. (2008) report that cemeteries have changed over the years, as they moved from places of worship to outdoor environments. They are increasingly hidden from urban landscapes in park graveyards, vertical cemeteries, and crematoriums, and are now additionally beginning to populate the Internet. As part of this process, memorials were incorporated into digital media by digital memorial services.

According to Ariès (2003), “death is familiar and close to us, on the one hand, and diminished and desensitized, on the other; it is markedly opposed to our own death, which frightens us to the point that we no longer dare to invoke its name”. By that, he means that fear renders death a taboo. Therefore, as death-related services, digital memorials are surrounded by sensitive cultural aspects and are still beginning to be explored.

In light of these issues, many studies on digital memorials were produced by different researchers, at different times, managing different contexts and proposing different solutions. Because memorials abide to their cultural contexts, in which matters of user’s nationality, religion, preferences etc. are involved, they may differ a lot from context to context. For example, in Brazil, where we operate, digital memorials are relatively new, e.g. on Facebook, they were only available in 2015.

A study by She (2018) reinforces that a digital memorial is currently a space meant for those dealing with grief. To do so, the platform must allow users to act accordingly to their beliefs and to their social context. There are different ways to build a memorial, whether linked to a tombstone in a cemetery, or on a social network profile transformed into a memorial. Thus, how can designers be guided based

on good practices and studies to create designing alternatives in such a sensitive and interdisciplinary area?

When performing a search for studies in this field, published in Portuguese and/or English in the Brazilian context, one comes across a collection of relevant research with diverging contributions, which need to be systematized.

This research aims to systematize and analyze researches for the design of digital memories in works that consider the Brazilian context and culture. Our research is part of the *DAVI*<sup>1</sup> Project, whose studies investigate issues postmortem digital legacy issues. The analysis of the recommendations can result on important discussions for the design and maintenance of digital memorial systems. They are useful to designers, guiding them in their decision-making while providing a structured set of information stemming from research in this field.

To do so, we searched for articles on digital memorials published in the area of Human-Computer Interaction. Thus, we classified digital memorials into four big groups, the memorials analyzed in the articles were classified into dedicated digital memorials, memorials in social networks, collective digital memorials and memorial systems associated with tourism. After extracting the recommendations from the papers, an interpretative and associative analysis of them was carried out. It resulted in one hundred and forty-six recommendations that were classified into six macro themes and eleven micro themes. Furthermore, it was possible to notice recurrent elements in the systems analyzed by the authors and the recommendations extracted from the papers.

In this article, after this introduction, the theoretical contribution is presented, followed by the methodology, the related works (from which the recommendations were extracted), the types of digital memorials, the analysis of macro and microthemes, the analysis of the recommendations, the final remarks and, lastly, references. It should be noted that this article is an

<sup>1</sup> <https://lavi.ic.ufmt.br/davi/en/>

extended and revised version of the article written by Ueda and Maciel (2021).

## 2 Theoretical Contributions

To compose these theoretical contributions, we considered works on digital legacy services, especially digital memorial services. Therefore, we herein initially present studies on the classification of digital legacy services, followed by a classification of digital legacy management services. We then move to discourse on digital memorial services, and finally to a few examples of digital memorials emerging from the Covid-19 pandemic.

Oliveira et al. (2016) and Öhman and Florid (2017) establish similar classifications for digital legacy services according to their functionalities. They generally group the tools into four large groups with similar names and functions, as follows: digital legacy management services, posthumous messaging services, digital memorial services, and immortalization services. Öhman and Florid (2017) call the market that caters for the afterlife needs in digital systems as “DAI - Digital Afterlife Industry”.

Addressing digital legacy management systems (DLMS), Yamauchi et al. (2021) suggest classifying them into two types: DDLMS – Dedicated Digital Legacy Management Systems – and IDLMS – Integrated Digital Legacy Management Systems. The difference between them is that the latter comprises systems that incorporate legacy management elements in addition to the other functionalities of the system. Thus, if these specific features were removed, these systems would continue to exist. The primary goal of DDLMS, on the other hand, is to manage the user’s digital legacy, so, if the legacy management functionalities were to be removed, the system would be completely stripped of characterization. Digital memories can be integrated into systems, as is the case of social network systems that permit transforming a profile into a digital memorial, as is done on Facebook for example. But they can also be dedicated, as in the case of websites created specifically for this purpose, such as the “Inumeráveis” (2020).

The concept of digital memorials derives from memorials in the physical environment, where these monuments are used to honor, symbolize and remember a deceased person and are part of the mourning process for those who remain. Still, Fanous (2016), when discussing the art of epitaphs, highlights other functions resulting from the epitaphs present in these memorials, such as remembering the deeds of the deceased person, displaying messages of personal faith, and even allowing comments on the honored person’s death. Thus, they also play the role of historical records and, consequently, become important objects for touristic purposes.

In their analysis of the Super Lachaise application, a digital memorial system associated with the Père-Lachaise cemetery, Leitão et al. (2017) use the concept of MCP – Cultural Viewpoint Metaphors, where each MPC represents a level of mediation in the interaction of the user (metaphorically described as the traveler in MPCs) with another culture. The ‘Domestic Traveler’ metaphor is based on the idea of a traveler interacting within their native

culture; at the other extreme, the ‘foreigner without a translator’ metaphor represents contact by immersion in a foreign culture without the support of a translator or guide. In both cases, the mediation of the interface in the intercultural encounter is almost zero. The three intermediary metaphors refer to different levels of mediation in the cross-cultural encounter. The ‘Distant Observer’ MPC represents a gentle and distant exposure to cultural diversity, with high interface mediation through informative content about foreign culture. The ‘Foreigner on a Guided Tour,’ on the other hand, is based on the interaction of the protected traveler in foreign cultural practices, with relative mediation of the interface, as if they benefitted from the assistance of a tourist guide. The ‘Foreigner with Translator’ MPC has a low level of mediation and proposes an intercultural meeting by immersion, with the support of linguistic translation.

Pereira et al. (2016) present the interlocutors involved in direct cultural encounters in digital memorial systems. They are described as follows: the Designer, the one who chooses what to encode into signs in the system and makes up the memorial; the User-creator, the one who has the initiative and responsibility to create the memorial for themselves or someone else; the User-visitor, the one who visits a digital memorial and interacts with it.

Also, Bruno and Silva (2021) present possible associations between typical goals of people in coping with grief and information found in online memorials. The authors conducted a content analysis of the interface of 20 online memorial systems. The survey included the detailing of functionalities for online memorials to honor people or animals.

During the Covid-19 pandemic, a few digital memorials emerged to honor victims: the *Memorial das vítimas de Coronavírus no Brasil*<sup>2</sup> [Memorial for the Coronavirus Victims in Brazil], a Facebook community; the initiative *Inumeráveis*<sup>3</sup> [The Uncountable], a digital memorial site framed in an artistic format by Edson Pavoni; *reliquia.rum*<sup>4</sup>, an artistic memorial of reliquaries on Instagram by Debora Diniz; digital memorials created by players in games such as *Animal Crossing*, as a setting with two rocking chairs on the beach to honor a user’s mother and grandmother who had passed away, or as more explicit mourning settings with tombstones, flowers and photos.

The previously mentioned memorials allow us to infer important aspects related to the theme. Furthermore, it is worth noting that section 4 of the related works – which are the direct object of study in this article – complements these basic theoretical contributions.

## 3 Methodology

This research is a non-systematic literature review with a qualitative approach. Initially, we searched Google Scholar for works on digital memorials in the area of HCI in Brazil in Portuguese and English. We restricted our corpus to papers from Brazilian authors due to the cultural aspects intrinsic to addressing death. Works prior to 2014 were discarded, given advances in death-related digital applications.

<sup>2</sup> <https://www.facebook.com/memorialcoronabrasil/>

<sup>3</sup> <https://inumeraveis.com.br>

<sup>4</sup> <https://www.instagram.com/reliquia.rum/>

Using “recommendations” as a search string produced meager results, so we opted for a more exploratory approach instead of a systematic review. We looked at the research cited by the authors we read, especially monographs. A few studies were found that brought superficially mentioned recommendations in data analysis. Thus, eight papers from the initial pool were selected for this study. They are presented in section 4.

Next, each text was identified with a Roman numeral: I – Lopes et al. (2014); II – Maciel et al. (2019), an extended version of the previous article that featured new contributions; III – Verhalen (2020); IV – Toledo (2018); V - Leitão et al. (2017); VI - Maciel et al. (2017); VII - Pereira et al. (2016); VIII – Ueda et al. (2019) Such studies were carried out with different objectives and contexts, therefore, they brought to the field of digital memorial services different types of contributions: recommendations, functional and non-functional requirements, or interaction design issues that did not make up recommendations.

In order to analyze these contributions together, it was necessary to group and organize them. Then, an interpretative analysis of the texts was carried out to extract their contributions, which we compiled as recommendations. We chose to treat the data as recommendations because this format is malleable and simple enough to allow all the data to be “leveled”. When the original papers were written in Portuguese, we translated the recommendations into English so as to standardize this text. In every case, we were careful not to make any change in the way the authors phrased their recommendations. Each recommendation was then identified by a Roman numeral, corresponding to the original work it was extracted from, in addition to an Arabic numeral, which identified it among the other recommendations from the same work.

From the extraction and manipulation of the recommendations, six macro themes emerged to aggregate the recommendations according to important issues in the design of digital memorials. Also, when necessary, some micro themes were created to allow for the discussion of issues that emerged from the grouping. For example, when analyzing “elements of a memorial”, some recommendations refer to topics in a memorial, others to leitmotifs associated with data in a memorial; in view of this, we created the micro themes “memorial themes” and “memorial data”.

The macro and micro themes are described as follows:

a) Elements of a Memorial: these are recommendations related to the elements of a digital memorial, comprising the micro-themes “Memorial Themes” (which addresses matters related to the topics of a memorial) and “Memorial Data” (which deals with the data or information in the topics) of each posthumous profile.

b) Design Considerations: these refer to concepts to be considered at different stages of the application design, comprising the micro-theme “reuse”, which discusses issues related to the reuse of information or services already on the market.

c) Culture: these are recommendations on cultural aspects that influence design elements and decisions in digital memorial systems.

d) Semiotics: these recommendations deal with signs in the design of digital memorials.

e) Social Web: these are recommendations related to social elements on the web in digital memorial systems, comprising micro themes related to social web elements.

f) System Actions and Decisions: these are recommendations on actions, routines and decisions that the system must carry out.

The recommendations were arranged in tables for each macro theme, which contained, in the first column, the identification of the recommendation and, in the second, the recommendation itself. Some recommendations could be included in more than one classification. For example, some social web/identity recommendations could also be classified as a memorial element/memorial data recommendation. Moreover, some social web/conversation recommendations could be framed as a memorial element/memorial topic recommendation. However, our objective was to classify each recommendation into a single theme, according to the best fit.

In addition to that, during the analysis of the texts, a few peculiarities were noticed concerning the digital memorial systems those authors had written about, especially regarding the main objectives of the systems, as well as their contexts and needs. Then, we classified digital memorial systems into four groups, which are described in Section 5.1. Therefore, a new column was added to our tables to identify to which types of memorials a certain recommendation would be applicable. Finally, Section 5.2 analyzes and discusses the themes and their recommendations.

## 4 Papers Analyzed

The eight articles analyzed in this document are presented below. Their contributions consist in recommendations, requirements, and prototypes for digital memorials. They analyze memorial systems and/or physical memorials and/or the offline afterlife industry.

Considering technical and cultural aspects, Lopes et al. (2014) present recommendations for specific (dedicated) digital memorial systems. They performed interaction tests on the iHeaven platform to understand how users felt when interacting with this type of application. Among the recommendations, they created guidelines considering social web elements to adapt these systems. In the end, they present prototypes for these recommendations.

De Toledo (2018) also considered social web elements to investigate digital memorials, but in the context of profiles on “traditional” social networks (in this case, Facebook). These memorials differ from the systems analyzed by Lopes et al. (2014) because they are not specific software for digital memorials; instead, they are

integrated with social networks. The author found that the existing digital memorial solution on Facebook did not fully meet social web requirements. Thus, through a focus group, the author collected the perception of specialists and non-specialists on the subject. Together, the research participants prospected solutions and prototypes for Facebook memorials based on social web elements.

Considering the aspects of identity, volition, and privacy, Verhalen (2020) questioned whether another social network, Instagram, provided a suitable environment for digital memorials. To do so, she analyzed how the social network handles its digital memorials and how that process could be improved, from a user's perspective. Two focus groups were held, and they generated recommendations, low-fidelity prototypes and suggestions for terms of use for Instagram digital memorials. Finally, the prototypes were studied and medium-fidelity prototypes were created from them.

In turn, Leitão et al. (2017) used the semiotic inspection method to inspect the application Super Lachaise, a mobile application to support the visitation of the Père-Lachaise cemetery. The inspection focused on the communicability of cultural issues and the mediation offered by the application during users' contact with death-related cultural elements that are foreign to them. The article aimed to identify and explore the communication strategies that designers could adopt to support or mediate users' intercultural experiences in death-related systems. The authors discussed these mediation strategies based on the theory of MPCs - Cultural Viewpoint Metaphors.

Through interactive practices and a survey, Maciel et al. (2019) analyzed how users who were also HCI designers interacted with another application: Memorial. Through QR codes, this system allows visitors to Cemitério da Consolação (São Paulo/SP, Brazil) to interact with digital memorials linked to the tombstones of famous people. The authors also analyzed the application itself through semiotic analysis. Their work demonstrates some shortcomings and strengths of the application, and it also helps to elicit requirements through examples and notes.

Pereira et al. (2016) used Semiotics to analyze the offline domain in terms of physical memorials and cemeteries from different countries, in order to support the design and customization of digital memorials that respect users' multiculturalism. The authors focused on communicational aspects related to expression and content. As to results, they presented some design requirements for digital memorials and identified the actors involved in the communication mediated by this kind of system, along with their objectives. Like Leitão et al. (2017), they also addressed the level of mediation proposed by the designer for the cultural encounters in the application.

Also focusing on the physical domain, Ueda et al. (2019) investigated offline media in order to understand the contexts and needs of physical memorials that could be transposed to digital ones. The authors explored the social knowledge of people who work in the offline afterlife industry (funeral houses and tombstone plaque services) and came up with a model for a death plan, which aims to assist in planning needs and recording posthumous wills. To this end, they conducted and analyzed interviews with

these people, culminating in reflections to help the design of digital memorials.

## 5 Results and Discussions

This section describes the four types of digital memorial we coined, then the macro and micro themes with their respective recommendations, followed by the analysis of each set.

### 5.1 Types of Digital Memorials

During the reading of the eight selected works, we found out some specificities among the digital memorials that each author addressed. For example, Lopes et al. (2014) considered the existence of a type of digital memorial for groups of people, where the honored would be related for some common reason, whereas Leitão et al. (2017) investigated digital memorials that seemed to be aimed at tourism rather than posthumous tributes or acts of mourning. Understanding this difference is crucial when thinking about the design of different memorials.

Thus, we classified digital memorial into the following groups:

**a) Dedicated digital memorials - DDM:** Digital memorial systems in which at least one of the main objectives is associated with the digital memorial service, usually with its own website, not related to a social network. These memorials records facts and are meant for remembering the deceased, who do not necessarily have anything in common. As with the DDLMS, if the digital memorial functionalities were removed, the system would be totally uncharacterized by losing its primary function. As examples of this category, there are "Inumeráveis" (2020) and "InMemorium" (2021).

**b) Integrated digital memorials - IDM:** When the digital memorial service is not associated with one of the main objectives of the business, they are functionalities that supply secondary needs and are integrated into another system. Therefore, like the IDLMS, if the digital memorial functions were removed, the application would continue to exist, given that its main focus does not rely on that. They are usually integrated with social networks. One example is the social network Facebook, in which the memorialization of a profile occurs after the user's death is confirmed. It is also possible to use other features in an application that is not a social network, as in the case of the memorial in games such as *Animal Crossing*. Other examples are the *Memorial for the Coronavirus Victims in Brazil*, a community on Facebook; *reliquia.rum*, an Instagram profile; and *PetCondolências*<sup>5</sup> (2021), focused on animals.

**c) Collective Digital Memorials - CDM:** When, in a digital memorial, the honored deceased people share a common bond. They can still be either a dedicated or an integrated memorial system. For example, the *Memorial for the Coronavirus Victims in Brazil* is a collective digital memorial integrated with the social network Facebook, and *reliquia.rum* is integrated with Instagram. On the other hand, "Inumeráveis" (2020) is a dedicated collective digital memorial, as it is presented on a website dedicated to the memorial.

<sup>5</sup> <https://petcondolencias.com.br>

**d) Grief-Tourism-Oriented Digital Memorials - GTODM:** These digital memorial systems are not designed to pay tribute to the deceased or channel expressions of mourning; rather, their main goal is to provide a support system for grief tourism. Examples of this type include the *Super Lachaise* app, that guides visitors in the Père-Lachaise Cemetery, in Paris; and the *MemoriALL*<sup>6</sup>, which does the same for the Consolação Cemetery, in São Paulo. Through these applications, visitors/users can use their smartphone to interact with QR codes in the cemetery and at the tombs, which direct them to burial ground information or digital memorials belonging to the people once buried in the tombs. These interactions enrich the tourist’s experience when visiting these sites. Although these examples are systems dedicated to this purpose, it does not rule out the possibility of a GTODM integrated with another system, when assuming similar functionalities built into a general app for tourists in a city.

**5.2 Recommendations and Analysis**

The macro and micro themes, along with some samples of the recommendations extracted from the works analyzed, will be presented below (the full version can be accessed by clicking the link present in the references – Ueda, 2021). For each theme, a table is presented containing: in the first line, the macro theme and the micro theme; in the following, the recommendations associated with these themes. Each recommendation identified by: the Roman numeral associated with the study from which it was extracted (I – Lopes et al. (2014); II – Maciel et al. (2019); III – Verhalen (2020); IV - from Toledo (2018); V - Leitão et al. (2017); VI - Maciel et al. (2017); VII - Pereira et al. (2016); VIII - Ueda et al. (2019), the number of the recommendation in that work, and the macro or micro theme that is most applicable. The right column shows which types of digital memorials each recommendation is associated with. For this column, the following caption was used: I- Digital memorials integrated to social networks, D- Dedicated digital memorials, C- Collective digital memorials, T- Digital memorials to support grief tourism, and A - for all types. After each table, we present the analysis of the extracted recommendations.

The macro theme “Memorial Elements”, presented in Table 1, refers to the elements that can compose a digital memorial. This macro theme is subclassified with the micro themes of Memorial Topics, which are the topics or sections that a digital memorial can have, and Memorial data, information and data about the deceased person contained in the memorial topics.

Among the recommendations for memorial topics, the authors list spaces such as: murals, biographies, messages, family trees, media (photos, videos, audios, and the like), links related to the deceased, obituaries, spaces for fun facts (favorite movies, songs, posthumous productions, among others) and spaces for other types of tributes, such as an epitaph (space for a text that allows the bereaved to emotionally connect with the memorial, for a stranger to know a little about the deceased) and images of objects related to the deceased person’s identity, or objects present in tombs to pay a virtual a tribute (for instance by offering

the person virtual flowers and candles). Also, regarding the message space, the difference in some message functionalities present in digital memorials is notorious. There are cases where messages are addressed to the deceased, such as in a private chat, but they can also be addressed to those visiting the tourist memorial or to friends and family.

**Table 1. Elements of a Memorial**

Elements of a memorial-> Memorial Data / Memorial Topic	Type
I-1 Memorial Topics - Memorials should have a “wall”.	A
VI-1 Memorial Topics - Topics about the honorees: biography, family tree, photos, links, messages, obituaries, and videos.	A
VI-2 Memorial Data - The causa mortis must be mentioned of death.	A
IV-3 Memorial Data - The system must indicate who the heirs are or whether they exist.	D/I/T
VI-3 Memorial Topics – In the application, there is a part for “messages”, but they are more similar to comments or testimonials from visitors to other visitors and messages to family members. It is not meant for sending messages to the deceased person.	A
VII-2 Memorial Data - The date of death is often present, indicating that it can be understood as a mandatory field since it is part of the evidence that someone is truly dead.	A
VIII-2 Memorial Topics - Epitaph - space for a text that allows the bereaved to connect emotionally with the memorial, and for a stranger to know a little about the deceased person. This text could be a message representing the deceased or something related to the heirs; for example, a message from the person’s children.	A
VI-14 Memorial Data - Be more collaborative so that visitors can collaborate with memorial information. This would resolve issues like empty fields in certain profiles. Fans could collaborate, for example.	A
VI-4 Memorial Topics - Add a space for preferences, fun facts etc.	A
VIII-1 Memorial Topics – Have spaces to leave specific images that relate to the person, such as objects left in a tomb.	A
I, II and IV - Memorial Topics – Having a chat system	A

<sup>6</sup> <http://www.memoriall.com.br>

As for memorial data, it is noteworthy that more information is expected in digital memorials, as they have less space restriction than physical memorials, and there must be a pattern in the information presented about the deceased. However, one should be aware of the number of fields. It is important to standardize data on the deceased to be published in a digital memorial system, however this information is not always available, and it could affect the registration of new memorials. Some authors suggest informing the *causa mortis* and consider that the date of death should be a mandatory field as well, because it provides evidence that the person has really died, while the date of birth only proves that someone was born, but not that they are no longer living. However, this standard can be questioned in cases of honoring a person who has been missing for a long time and would therefore be presumed dead, but with no precise date of death.

There are different ways to obtain data for a memorial: the honoree can create their memorial before dying, or an heir or another interested party can create this memorial. Also, developers could consider collaborative ways to feed posthumous profiles. For example, other users could collaborate with information that the heir does not have. The possibility of reusing information in a GTODM for this purpose will be discussed in the section on ‘design/reuse considerations’.

Regarding the heirs, the system must inform each person who is assigned to manage the activities of a posthumous account. If there are no registered heirs, the system can use the default pre-established by the owner in the account settings, thus transforming that profile into a memorial. This occurs mainly in Integrated Digital Legacy Management Systems (IDLMS), that is, in systems that have another primary objective and the transfer of the digital legacy is an additional functionality. (Yamauchi et al., 2021)

Above all, there are issues related to the user’s life that are considered important. As presented by Maciel et al. (2017), some people may want to add personal information about the deceased, such as tastes, skills, personal and professional traits. Besides, it is also recommended to provide spaces for uploading images, which would be the digital equivalent to providing places where it would be possible to leave objects in a physical memorial.

Creating a system for conversation is a subject discussed by authors of recommendations for digital memorials. In this sense, a chat system can be created in which users can exchange messages privately and, if possible, these systems should hold several users, thus creating chat groups related to the honoree. Depending on the application, the designer should decide the scope of this conversation system. The conversational element is also discussed in the “Social Web” macro theme.

In general, regarding memorial elements, importance is placed on balancing topics and spaces in a memorial, data about the user’s life, information about death, and space for expressing words of mourning. This balance will impact user interaction, such as more intense emotional reactions when reading bereavement reports than when reading the biography of the deceased person.

The macro theme “Design Considerations”, presented in Table 2, refers to concepts that must be considered at different stages of the design of the application. Also, the micro-theme “Reuse” discusses issues related to the reuse of information and services already on the market.

**Table 2. Design Considerations.**

<b>Design Considerations -&gt; Reuse</b>	<b>Type</b>
I-11 Design Considerations - Users must be able to personalize and customize the system.	I/D/ C
III-15 Design Considerations - The application settings must be easily accessible.	I/D
III-17 Design Considerations - The application must abide by contracts signed by the account holders.	A
V-3 Design Considerations – The person who will be the creator-user of the platform must be previously defined. They can be the honoree’s friends or family , a cultural or tourist team, a fan, an external service, etc. These possibilities are defined by how the system is shaped.	A
V-4 Design Considerations – Digital memorials integrated into physical cemeteries may provide a support system for tourist visits to graveyards for burial rites, tributes, and mourning.	T/C
VI-12 Design Considerations - Consider usability and accessibility in application development.	A
VI-11 Consistence and use of application standards.	A
V-8 Reuse - Consider generating content for memorials; in the case of famous people, that should be done by reusing information from external platforms — for example, Wikipedia.	T/C
VI-18 Reuse – Present information about the location/address of the physical memorial. Also, provide a weblink to the location indicated on Google Maps.	A
V-13 Reuse – Consider, in memorial systems to support visits to physical cemeteries, the use of QR codes.	T/C

As for design considerations, it is necessary to consider that digital memorial systems are sensitive to users’ culture and identity, so they require a high degree of customization and flexibility. In this way, they can be molded to express users’ needs. The macro theme “Culture” addresses this issue in depth. The design team needs to understand the expectations and purposes of the system. For example, digital memorials that support grief tourism are primarily intended to support tourist activities rather than focusing on tributes or mourning. Also, to understand the expectations for the system, the system project should be designed with the users. Thus, more

than designing *for* users, their participation in some design processes allows the system to be more responsive and sensitive to values users yearn for.

Furthermore, it is recommended to consider usability and accessibility. The use of responsive principles, consistency, and standards in the application and its functionalities should be planned so that they are understandable and perceptible in the interface.

For systems that integrate digital memorial features as secondary functions, the memorial settings must be easy to understand and to find among the other system configurations. As it is a taboo subject, there may be the intention of not focusing on the topic or approaching it more lightly. This is valid given the product's main objectives, however it can lead to hiding the memorial settings and coming up with elusive and vague descriptions of its settings.

Besides, the designer should always seek to standardize the application, no matter what it is, because standardization renders it easier for the user to have a better grasp of each interface element and configure and use them in the most satisfactory way. One should highlight the need for flexibility and customization of the system for the user-creator and visitors.

Being aware of the interlocutors in a digital memorial system helps understand the roles of each of the parties in the system interaction and creation. Possible interlocutors for these systems are listed as follows: the designer, who develops the interface and limits users' actions; the user-creator, who is responsible for authoring the information in a digital memorial; the target user or visitor, who accesses/visits digital memorials for different purposes.

Each interlocutor has their own particularities, which can influence their interactions and the design of the system. For example, a creator-user may follow a different religion from the deceased and will not always know how to represent his or her faith. To tackle that, information on the interface can help these users by providing a brief explanation about any symbols offered. Target users, on the other hand, may have different intentions depending on the type of memorial: a tourist visiting a memorial, for instance, has different intentions from those who will visit it to mourn. And designers are subject to cultural influences as well, whether conscious or not.

Still, it is important to reflect on the possible creator-users. For example, they could have been friends or relatives of the deceased honoree, or members of a cultural community, of a tourist group, or of a group of fans. Different creators can have different needs regarding the data of a profile. The way a system is designed restricts the actions of some of these creators.

The micro-theme "reuse" deals with the reuse of external information and services in the topics of the memorials. This provides an alternative for "user-creators", who can thereby generate content for the profiles through a wiki service, for example, in the case of famous people in grief-tourist-oriented or collective memorials. This type of reuse confers reliability on the information, as those data undergo some curation on the original platform, and this reliability is "inherited". However, solely using external sources makes it difficult to add or change content directly within

the system and discouraging collaboration. So, for example, if a fan wants to contribute to a memorial, they will have to change the article on the wiki site to change the information in the digital memorial system.

When using Wikipedia as a source, it is important to note that the articles on this wiki tend to have a more biographic rather than grief focus. Thus, the system that adopts Wikipedia as its main source will follow the same tendency. Also, due to the collaborative and free initiative Wikipedia, information in each article often vary considerably, which makes it difficult to standardize data in memorial profiles that feed on Wikipedia pages.

It is also possible to direct the user of a digital memorial to the wiki site to read information about the deceased honoree there. This makes it possible for Wikipedia tools to interact with the memorials. In the case of Wikipedia, the user is directed to the content on the website in its original language. Wikipedia allows the user to change the language in which the content is presented, but there is no guarantee there will be a translation of the content to the user's language. In case there is content in the user's language, it is important to notice that the cultural perspective of the text is changed to that of the visitor, which compromises immersion. More on this topic is discussed in the topic "Culture".

Also, it is possible to integrate geolocation services such as Google Maps into digital memorial topics related to locations. In grief-tourism-oriented memorials, the location of a tomb or a landmark associated with a particular person can be better indicated by these services, allowing the user to plan their visit and tourist route. Therefore, it is recommended to allow visitors to plan their visit through the digital memorial system. That can be done, for example, by allowing them to search or view the list of famous people buried in a given cemetery so they can plan their route on the day of their visit.

In addition to that, the use of QR codes is recommended in digital memorials for touristic purposes, thereby providing the opportunity to explore information about a memorial of particular touristic interest, benefiting from the fact that the data about the deceased would not have a physical limitation.

All recommendations from Culture and Semiotics (Tables 3 and 4) apply to the four types of digital memorials coined in this work. Thus, the column of memorial types was removed from section 5.1.

The macro theme "Culture", shown in Table 3, addresses recommendations on cultural aspects that influence design elements and decisions in digital memorial systems.

Digital memorials are culturally sensitive, as they are multicultural systems. Users have varied cultural profiles and, for this reason, they present different posthumous practices and different conceptions, rites and representations of the afterlife, all of which must be considered in these systems' design. Thus, designers need to reflect from the beginning and throughout the design process about the elicitation of cultural requirements. This directly relates to the macro theme of design considerations.

When the system only adopts functionalities aimed at a specific conception of what death is, ignoring other representations of this phenomenon, this impairs interaction from the perspective of cultural diversity. It is necessary to contemplate diversity when creating the design. To do so, one can, for example, implement the pre-configuration of cultural symbols and elements of group belonging (e.g. religion, traditions, clubs, Freemasonry, football teams etc.). User customization is highly recommended.

Therefore, it is necessary to explore the many possibilities of representing, expressing, and communicating cultural content about the afterlife. There are several ways to involve users in multicultural experiences on this topic. For example, one can consider whether to disclose the religion of the deceased, or the possibility for a user-visitor to honor a person by means of religious signs that could be embedded in social media tools.

However, there are limits to exploring these possibilities, and implementing many cultural factors can generate a system that fits no one. Choices of cultural aspects are crucial to ground decisions on how to meet the needs of target users.

**Table 3. Culture. (To be continued)**

Culture
II-5 - Consider cultural aspects from the beginning of the design process: as the representation of death, mourning practices, and funereal rituals vary a lot across cultures, which aspects should be considered in digital memorials, as culture-sensitive systems. Engineers must reflect on what cultural aspects they will model and how they will do so. Language is a key variable. Religious symbols, funerals, burial rituals, and protocols for communicating condolences are other relevant cultural variables in digital memorials.
I-16 - Design for Diversity: Designers should consider that the bereaved have varied profiles and different conceptions of death. This understanding should guide the modeling of the system, mainly in the judgment of what signs to explore or remove. Therefore, adding features to the system that are only aimed at a specific concept of death, ignoring other representations of this phenomenon, harms interaction from cultural diversity. Designers' beliefs and culture should not limit system design solutions. On the other hand, personalization and customization of the system by users are highly recommended.
VII-22 - Designers must be aware that they can be influenced, consciously or unconsciously, by the notion of death inherent in their own culture.
VII-25 - The development of the system should reflect on opportunities to express (or not) the religion followed by the deceased when a user-visitor honors them.

**Table 3. Culture. (Conclusion)**

Culture
VIII-9 - Cultural elements are very significant for some people, so these elements may replace epitaphs, as they are as representative as verbal messages. Thus, signs related to religion, groups of all kinds (such as Freemasonry), football teams, among others, must be included in memorials.
VIII-8 It is recommended to pre-configure religious symbols according to the user's religion and elements related to a favorite football team or any other groups the user was a member of.
VII-23 Designers should be aware of taboos and sensitive issues regarding death and grief in different societies at all stages of the process.
VII-27 The design of digital memorials should allow users to perform virtual interactions with the deceased, similar to those performed by visitors to cemeteries.

It is important to make users aware of which approaches are used in the system. Informing them of the approaches can provide the necessary context for their interactions. For example, a memorial could have a Buddhist cultural perspective, with cultural markers expressing how this group represents the afterlife, and limited customization options. In this case, communicating the cultural perspective adopted could help users from outside that culture understand a little of this approach, allowing them to interact with users who are culturally contemplated by the system. It should also be noted that: a) designers must be aware that they can be influenced, consciously or unconsciously, by their own cultural beliefs, which can limit system design solutions; b) taboos and sensitive issues regarding death and grief in different societies should be considered throughout all stages of the design process.

As for the users' exposure to cultural diversity (intercultural encounters), it is relevant to reflect on the level of mediation that the designer will propose in the system. This influences to what extent users feel supported or independent in interpretation, immersion, and interaction with a foreign culture. Thus, Cultural Viewpoint Metaphors (covered in section 2) can help the system design so as to clarify how the system works (or should work), and to help understanding which users receive support from the platform and which do not have their needs met. So, it is recommended to explore possibilities and make choices, for there are many ways to represent, express, and communicate cultural content about death and the afterlife. There are many ways to engage users in multicultural experiences with death and grief. However, there are limits to exploring these possibilities. Sometimes less is more: trying to implement too many cultural factors can generate a system that fits no one. Thus, choices about cultural aspects are a fundamental aspect in the design.

As discussed in the micro theme of "reuse", wikis can change a cultural perspective when the language of the service is changed. To reduce this interference, the use of

the metaphor of the foreigner with a translator allows keeping the content in the original cultural perspective, by only translating the text without presenting another article on that topic. This allows for greater immersion of the non-speaker in the culture of others.

Cultural aspects also influence the themes covered in the micro theme “memorial data”. Individuals have different facets in society, considering their public, family, religious or professional lives. For example: for some people, certain temporal milestones are important, as they are associated with their identity and should be present on their tombstones, such as the date of entry into a religious order, for example.. Also, temporal representation is subject to culture-sensitive variations, such as the order of the date elements (day, month, and year), showing the complete date or just the year. The calendar may also vary according to culture, as in Western *versus* Chinese calendars.

The design of memorials should allow users to perform virtual interactions with the deceased, such as lighting candles, leaving flowers, polishing the tombstone, leaving offerings, or even praying. Soon after the death of a given person, several tributes are deposited on tombs, such as wreaths and flowers. In the virtual space, something similar occurs, since in digital memorials many tributes can be seen in the form of posts shortly after someone's death.

The tributes written on tombstones are structured with a careful arrangement of signs. Thus, in digital memorials, corresponding care is needed to engineer the signs encoded in these systems so as to meet the communicative needs of identifying the honoree and offering a system of meaning that makes it possible to express grief issues. It is up to the designer to decide if these signs will be implemented natively or if users will be able to add their own signs to the system. The macro theme “Semiotics” in Table 4 deals with signs in the design of digital memorials.

Elements in a physical memorial also denote social status, just like the material used or ornaments. Thus, there should be opportunities to express these elements in digital memorials as well.

**Table 4. Semiotics. (To be continued)**

Semiotics
I-13 – Be cautious when using buttons: “The keyword of a button that performs some interaction with a digital memorial must be chosen carefully. Users may find it awkward to “like” a memorial (or any other frivolous expression of appreciation) and may find a button for religious expressions such as “pray” for a memorial disrespectful or irrelevant.”
II-6 - Language is a key variable; Religious symbols, funereal, and burial rituals and protocols for communicating condolences are other relevant cultural variables in digital memorials.
VII-19 - The following should be considered in the choice of signs for the representation of religion: if and how to express the religious identity of the deceased, considering that each religion relates to specific cultures and ways of dealing with and representing the afterlife.

**Table 4. Semiotics. (Conclusion)**

Semiotics
VII-21 - When choosing the signs for honoring the dead, one should consider what kind of expressions of homage are expected in different cultures. We can have homages represented by different objects, such as candles and flowers, or epitaphs, for example.
VII-28 - The tributes on tombstones are conveyed by a careful arrangement of signs, both in terms of expression and content, and digital memorial systems should allow for the same expressions.
VII-16 Offer the opportunity to express different facets of public, family, or professional life through different signs.
VI-17 There should be a message functionality, just like a bottled message.

A digital memorial must also allow a user to write public or private messages on their own profile, like Twitter, offering the possibility to write a text or message without having any recipient, as if it were a bottled message. A bottled message dropped overboard cannot be answered, and its destination is not even known for sure. In addition to that, the “keywords” of a button that performs any kind of interaction with the memorial must be carefully chosen. Some choices can generate unwanted results, such as awkwardness or disrespect: “liking” a memorial or any other frivolous expression of appreciation can feel awkward; a “pray” button may be disrespectful or irrelevant to representing the importance of this ritual.

Furthermore, special care must be taken when designing cultural signs. Each religion carries a specific culture and a way of dealing with and representing death, regardless of the question of culture commonly linked to nationality, and some design choices may limit the identification or representation of some users. For example, it is a familiar practice in Western Christianity to indicate the date of birth with a star and the date of death with a cross, however, due to the secular aspect of French society, they do not use religious symbols in public spaces, which might prevent them from using the symbol of a cross in a memorial.

One possible approach in digital memorials is to allow users to customize the interface with icons of their religion. For example, while Catholic users consider tombs highly symbolic, Protestant users tend to attribute greater significance to coffins. A Protestant might like a “pray” button for a memorial, but this form of interaction might not seem right to an atheist.

Likewise, the noun “heaven”, for example, is not recognized as a post-mortem designation in many religions.

However, it should be considered in the choice of signs for the representation of religion whether and how to express the religious identity of the deceased or the expressions of mourning of the visiting users, given that religion is often a basic part of the concept of death for many. In addition, choices must always be made in

projecting cultural elements since covering many cultural factors can generate a system that does not fit anyone. The noun “heaven”, for example, is not recognized as a post-mortem designation in many religions.

Therefore, the possibility of choosing signs for the representation of multiple public or private identities must be considered. How to express different spheres of activity of the dead in their culture, for example, family names, public names, professional activity, interests, etc.

The macro theme “social web” contains recommendations related to social web elements in digital memorial systems (Table 5). In this field, there are several existing recommendations since, in general, applications of digital memorials are constituted through social network structures.

**Table 5. Social web (To be continued)**

<b>Social web -&gt; Identity/ Group/ Sharing/</b>	<b>Relationship/ Conversation/ Recommendation/</b>	<b>Reputation/ Volition</b>	<b>Type</b>
IV-1 Identity – The system or heir must be able to add the date of death to the memorial.			I
VII-8 Identity - Users often want to add information about the deceased to introduce them to others. Therefore, digital memorials must be designed not only considering the possibility of honoring the dead but also the desire to save them from oblivion.			D/T
IV-5 Relationship - The system should allow the creation of family trees in the memorial, if it is in the interest of the members and with the heir's permission.			D/T
IV-7 Groups – If a family tree is created within the memorial, the tree member should be able to select privacy restricted to the tree.			I/D
IV-6 Relationships - On Facebook, there is the possibility of indicating the widow of the deceased in the memorial. Also, the former spouse can update their relationship status, indicating who their spouse was.			I/D
IV-8 Conversation - The system must present an explanatory note in the memorial, with the information that, although the sending of messages is active, messages will be private and no one will have access to them.			I/D
I-5 Conversation: Although conversation, in a literal sense, can only take place between the living, implementing a user chat (messaging) with memorials can have significant symbolic value.			I/D

**Table 5. Social web (Conclusion)**

<b>Social web -&gt; Identity/ Group/ Sharing/</b>	<b>Relationship/ Conversation/ Recommendation/</b>	<b>Reputation/ Volition</b>	<b>Type</b>
II-3 Reputation - Consider curating or moderating content: Although collaboration is a key factor, the deceased person’s data is sensitive. Exposure of personal information, inappropriate statements, or photos are examples of problems that can threaten their reputation. Moderation and curation can minimize the effects of this.			D/T
VII-9 - Memorials could also allow customizing the aesthetics of the memorial in the interface.			I/D
IV-12 Sharing - The system must send notifications of posts and activities in the memorial to members, if they have configured that they want to receive them.			I/D
I-8 Sharing - Some understand the tribute to be intimate, so consideration should be given to whether the memorial will have a sharing function.			A
IV-14 Recommendation - The system should let network members enable and disable notifications about existing memorials on their network. If activation is chosen, the system could send notifications about new posts or important dates for the memorial.			I
IV-15 Recommendation - The system should not allow the memorial to be recommended to other users, contrary to what happens to the profile of living users.			I/D
IV-19 Volition - The system should remind users to configure their memorial, which should be done subtly, as with privacy settings.			I
IV-20 Volition - Even if the user has configured their memorial when they were alive, the system should allow the registration of heirs (memorial managers).			I/D

In the afterlife, social web elements have a different behavior, so death must be considered as part of the social web cycle. For example, when a profile is memorialized, it must stop being recommended to others. On the other hand, information that introduces the deceased person to those who did not know them before death can be added to the memorial in order to save the deceased from oblivion.

An information that is considered of paramount importance in a digital or physical memorial is the date of death, so the heirs must be able to add such a date to the memorial. If there is no heir, members of the deceased person’s network should also be able to add this date. Another possibility is that the social network itself adds it when detecting the user’s death.

Digital memorials should not present a single way of representing the identity of a deceased person. There needs to be flexibility and more forms of customization. In order to make it easier for users to interact with a memorial, it is recommended to show the name by which the deceased became socially known before their full name, since many people are known among their loved ones by names which are different from those registered in civil records. As a result, visitors will have an easier time identifying the person who has passed away. In the case of digital memorials resulting from the transformation of a web profile into a memorial, designers could place nicknames after the deceased person's official name in parentheses or quotation marks to differentiate civil names and nicknames.

Another point to be considered in digital memorials is the "marital status" in the network. Thus, it should be possible to indicate who the widow is on a memorial, while allowing them to change their relationship status. Furthermore, the system must have a family tree, where all or most users who have some relationship with the profile owner would be found, and this tree would only be created with the heir's permission. Later, if there is a desire to add more members, such as relatives, they would have to accept being added.

If there is a family tree, any member of this tree should be able to make any posts someone the social network available only to other members of the family tree. Digital memorials themselves can be considered forms of grouping between individuals who had some relationship with the deceased. Therefore, memorials can be considered social media groups, and their modeling must be designed based on this principle of grouping and "communities of interests". In addition to that, users might be interested in creating specific groups, composed of family members, friends of a specific deceased, among others.

The message window should show a note reinforcing that all messages are private. The chat must also allow users to leave messages to the honoree like in physical memorials, where people can leave letters to the deceased without anyone else knowing what is written.

Relationships between two users, between users and memorials, and between two memorials should be possible. For example, that would allow more functionalities for the family tree based on these relationships.

It is desirable to provide means for repurposing digital memorials through messages on the profile's "wall", by adding photos and videos of the deceased or allowing users to add events to the memorial's timeline, narrating a great deed or event in the history of an honoree's life. These forms of paying tributes help preserve the afterlife identity of the deceased. At the same time, it is also recommended that, when the profile photo is not a photo of the deceased themselves (e.g., photos of flowers, animals), the system allows to add a second photo, thus respecting the deceased's choices, but still providing ways to identify them. This aspect can also be appropriate for when the deceased had used a very old photo in their profile. Consideration should also be given to ways of protecting the reputation of the deceased person's image, both by curating posts and information in a memorial, and by

allowing the appointment of heirs who must manage the profile and attend to the posthumous wishes of the honoree. There must also be a way for the heir to allow users and groups to generate content about the deceased, by collaborating with editing the profile, posting data, files, statements, editing data privacy, messages and statements etc.

It is important to point out that any physical memorial has unique characteristics and may have decorative objects, such as flowers, or even different colors, so it is expected that digital memorials have as many decoration possibilities or even more, taking into account that digital devices do not have physical space limitations. In fact, the possibility of choosing signs for the representation of socioeconomic and cultural status should also be considered.

Memorials of integrated systems resemble social networks at a smaller scale, so it is expected that they have very similar functionalities to social networks, such as sending messages to alert members about activities in the memorial (such as an image that was added or a direct quote by that user to a post within that memorial).

However, physical and digital memorials are often seen as intimate spaces for those closest to the deceased person. As a result, the sharing option can be a controversial element, which may or may not be added to the memorial. If the sharing option is added, the contents that can be shared on this type of social network are elements such as photos and videos, messages posted on the wall of an honoree, and even a digital memorial itself. Furthermore, it is desirable for users to be able to share on other social networks the interactions they perform on the memorial. Such sharing can be explicit (via "share" buttons) or implicit, by exporting all activities performed to other networks, but without overt notification that data has been exported from one system to another.

A social network of digital memorials should make recommendations to its users of digital memorials to which they might want to pay tribute, always considering that the user was friends with the honoree. It should also recommend paying a certain tribute to a digital memorial or adding another user as a friend. On the other hand, the system should not recommend the memorial to users who were not connected with the deceased.

The volition settings based on the user's wishes concerning data management and the digital memorial settings are crucial for the system after the user dies. Modeling this type of solution allows the memorial not to be restricted and prevents it from becoming posthumously unmanageable.

In integrated systems (in which digital memorials are not the primary objective) such as Facebook, users may forget that they need to configure their memorial settings. (Yamauchi et al., 2021) To prevent that, the system should issue unintrusive warnings to remind the owner about this issue. The system must also allow an account owner to configure the privacy of their future memorial and choose whether people will be able to interact with it or just access it. This option can also be available to the heirs.

Heirs are extremely important in a digital memorial, and they are often the ones to make decisions about the future of the deceased person's account. For this reason, even if the user has already configured everything possible in their memorial, the possibility of adding heirs must always be available. However, both the memorial owner and the heir(s) must be able to configure in their profile the level of interaction they want to have with this memorial during their lifetime. It is important to consider that, although it is possible to design an heir in an integrated system, such as in social networks, this heir cannot add another heir, which limits manageability of the profile in the long run.

The macro theme "System Actions and Decisions" addresses recommendations on system actions, such as routines to identify if the user has passed away or adopting a default configuration for posthumous accounts of users who did not configure them before death. See Table 6.

**Table 6. System Actions and Decisions**

<b>System Actions and Decisions</b>	<b>Type</b>
IV-8 - If the owner does not configure the memorial, the page must inherit the settings of the owner's profile e.	I
III-19 - The application must send a verification message to owners of deactivated accounts.	I/D
III-22 - The application must trigger the heir, asking about the user's death, before transforming the profile into a memorial.	I
VIII-10 - The system must check the heir's interest in maintaining a memorial.	A
VIII-11 - There are cases in which there is no heir to represent the wishes of the deceased, therefore decisions on the memorial profile must be made by the system. The system can make personalized decisions for that profile or have a protocol for similar cases. However, it should always consider the user's settings configured when they were alive. This solution can be applied in cases of absent heirs too.	I/D
III-21 The application must use an algorithm to look for patterns in the comments to detect death.	I
VIII-12 As with the death plan, a digital memorial could present instructions, checklists, and guidelines for memorial planning by the one to be honored.	I/D
IV-23 The lifespan of the memorial must be informed by the owner when setting up its configurations.	I/D
III-3 The application must allow reports of and to the account heir.	I/D

Digital memorials need to be better known by users. Many users of popular social media, such as Facebook, are unaware of memorial functionalities, so many do not configure their profiles to later become memorials. In turn,

designers must develop solutions for systems to correctly handle the profile owner information and how the system should use this data. As for the actions and decisions of the system, it is expected that a digital memorial will consider the most diverse possibilities, and present a solution for any situation. Consideration should also be given to sending a notice to the owners of deactivated accounts, asking them if the reason for deactivating the account was the owner's death. If there is no response, the system must send the notice to the heirs of the account. Suppose there is an answer, and it is affirmative. In that case, the system should ask if there is no desire to turn the profile into a digital memorial to honor the deceased instead of deactivating that account. There are cases in which the heir may not be interested in managing the memorial, so the potential heir should always be asked whether they really accept to play that role. However, the kinship of the heir with the honoree must always be considered, so solutions must be designed for cases when the heir faces obstacles that prevent them from managing the memorial. For instance, consider a relative who, at some point, cannot manage the memorial after the death of a child.

Furthermore, there is a need to check with the profile heirs, if the account has one or more, in cases where users warn the system that the profile belongs to a deceased person. They may do so through comments in the profile timeline or reports to the social network. The system must check if these warnings are real, avoiding any problem or embarrassment for the owner: if the account is turned into a memorial and the owner is not dead, it can bring inconveniences to their life, as most friends and family would be misinformed of that death. That kind of situation has already happened on Facebook, where accounts were automatically transformed into memorials after people unduly reported accounts of living users as belonging to deceased people.

On the other hand, if the heirs of the account confirm that the profile owner has really died, the system must ask whether it is in the interest of the heirs to transform that profile into a digital memorial (if the user has not configured any memorial settings before dying). Designers must take into account several factors for the implementation of this addressing to the heirs, but the main factor must be the interest of the deceased, whether or not they would have liked to keep their profile active, now as a memorial. In case the deceased has not configured this option before dying, the heirs must make this decision.

Besides, the system should not allow an heir to change any settings made by the memorial's owner, unless the deceased person specifically granted them that permission before dying. In some systems, such as Facebook, upon naming an heir in the system, the user knows what they can or cannot alter in the future memorial. Prates et al. (2001) propose that the user can see in advance how those settings will be implemented in the system after death. In addition to that, it is important for the memorial owner to be able to inform what the heir's powers will be (if someone is assigned such a role) after their death. It is the system's responsibility to limit

the heir's activities based on the choices previously made by the profile owner.

Moreover, the application must allow heirs to limit the privacy of a memorial. Only users accepted or invited by the heirs should be able to view and interact with the memorial (Trevisan et al., 2021). The application must also have a reporting system, so that the heir of the account can report a member for misconduct, such as when someone adds inappropriate photos of the honoree. Other users should also be able to report misconducts to the heir. As a result, the application must warn the heir or member in case of a complaint, stating that the account may be banned. It is also recommended that the system have a maximum limit of warnings; if this limit is reached, the account must be deactivated or excluded.

As previously mentioned, one of the reasons for reaching to the account's heirs may be notices from users who report the profile as belonging to a deceased person. However, the system can automate this process using an algorithm that would report the possible death to identify comment patterns in photos, videos, and posts.

Likewise, one of the tenets when designing a memorial should be the system's accessibility and ease of understanding and configuration by the user. Instructions and guidelines should be displayed in the digital memorial to simplify the actions that the system requires on the part of the account owner. This may help the user plan the memorial the way they prefer, and it also renders it easier both for the system and the heirs to know what the account owner would like to happen to their profile. The time that a memorial will last is also an issue of concern, as it must, by definition, go beyond human existence (Trevisan et al., 2021). Thus, the system must allow the owner to set the lifespan of their memorial, or to let the heir inform the lifespan of the memorial. If the span is not defined, the memorial must remain on the network as long as the application exists.

## 6 Final remarks

Aiming to systemically organize recommendations for the design of digital memorials in the Brazilian context, the authors extracted recommendations from the eight papers on digital memorials, which were then analyzed and grouped into macro and micro themes. Thus, the contributions of these works can be compiled, even if they come from different perspectives and contexts.

It was hence possible to compile an extensive list of recommendations and elements/data that comprise digital memorials, forms of user interaction, ways of managing cultural exchange, design issues, and means of integrating other services with digital memorials. Also, based on the analysis of the eight papers, four types of digital memorial were herein categorized. These findings are useful for designers of digital memorial services and for other studies on this domain.

This study was challenged by the heterogeneous contributions of the works analyzed (recommendations, functional and non-functional requirements or contributions that addressed issues related to memorials, but without formal recommendations), which at first prevented the joint

analysis of their findings and then led to an extensive number of recommendations. To make this analysis possible, it was necessary to conduct a slow and careful process of extracting the recommendations, creating macro and micro themes and grouping the recommendations into these themes. Also, there is an interconnection between macro and micro themes, which increased the complexity of our study. Still, some recommendations relate to more than one theme. Despite these challenges, we believe that our systematization led to an interesting set of recommendations for digital memorials.

It should be noted that the discussion of types of digital memorials is complex and necessary, as it poses different possibilities for software engineering. Here, we are talking about systems where dead users' profiles exist. However, the term digital memorial is also used on sites that rescue and digitize documents, to maintain or preserve institutional memorials. This would be another type of application to be investigated.

As future works, the authors of this paper aim to prepare other documents regarding recommendations for digital memorials, detailing the recommendations that have been herein collected and adding recent works to corpus, such as Silva et al. (2021) and Trevisan et al. (2021). From a macro perspective, the data is still raw, as recommendations can sometimes be grouped into a single, more comprehensive recommendation. Also, other artifacts can be generated to enrich this document, such as images of good practices and the prototyping of recommendations. There are also possibilities for future research in terms of evaluations and tests with designers, studies on the level of confidence and relevance of the recommendations, and the elaboration of a taxonomy for the macro and micro themes we listed, which may evidence relevant relationships.

Finally, it is worth emphasizing that the COVID-19 pandemic has underscored the topic of death and the possibilities of afterlife tributes in digital environments, as we can witness daily by reading the news and social networks. In this sense, new applications have emerged and others can be conceived, thus contributing to the scientific and technological development of this area. All in all this research can be of great value to anyone interested in the subject.

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## Notes

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