Engaging with Death Online: An Analysis of Systems that Support Legacy-Making, Bereavement, and Remembrance

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ABSTRACT
Death is an inevitable part of life, but digital systems have been slow to address the complex issues that arise when a person passes away. As digital systems have become an increasingly important part people's lives, so too have these systems begun to play a role in a number of practices related to death, such as legacy-making, bereavement, and remembrance. In this paper, we conduct a survey of seventy-five digital systems designed to support these practices. Building on prior work, we analyzed these systems to derive findings that articulate how digital technologies reflect how people think about and engage with death. Based on these findings, we generated strategies designed to help system designers grapple with the complex needs that result from navigating death online.

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Death; dying; legacy; remembrance; immortality; personal information management; identity management; digital systems

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H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous;

INTRODUCTION
As the internet has grown in popularity, websites and applications have been developed to address how people engage with death, legacy, bereavement, and remembrance. Early examples, reflecting the prevalent aesthetics and functionality of the time, included relatively simple memorial pages and guest books where people could share memories about people who had passed away [86]. These websites had limited functionality, but provided a valuable space for people to engage in the process of bereavement and to share that experience with others [76, 86].

In recent years, systems that engage with death in some way are being built to reflect the large amount of heterogeneous digital information that people generate. Digital information touches nearly every aspect of people's lives. It is now common for people to accumulate large collections of digital information and media [53, 68], to have a number of social media accounts populated with data about their lives [71], and to hold private, personal information in online accounts and archives. These developments have had a marked impact on how people communicate, form relationships, and define their identities, and so, too, have they impacted how people engage with death, legacy, and remembrance.

Though slow to formally address these issues, some major platforms like Facebook and Google now offer people the ability to make decisions about what will happen to their information after they've passed away. Facebook, for example, allows for the bereaved to convert a person's Facebook account into a memorial account after their death [25]. In addition, many systems have been developed to help people prepare for death, mourn a person's death, or curate and share information about a person's life after they've passed away. Included in this list are websites where you can record your last wishes, where you can create a memorial page for someone who has passed away, where you can investigate your family history, and where you can use your social media data to create an avatar that people can interact with after your death.

In this paper, we survey a collection of seventy-five websites and applications that relate to death, legacy, bereavement, and remembrance. Drawing from content analysis [39], we analyze these systems and build on a body of prior work [including 7, 9, 40, 56, 61] that investigates how people use digital systems to engage with these practices. In doing so, we make two complementary but distinct contributions. The first is a better understanding of the landscape of systems that engage with death in some way. Most prior work that examines the use of digital systems before and after a person's death has focused primarily on the processes of mourning and legacy-making. Over a decade of prior work in this area has generated a large collection of design implications and guidelines designed to shape the development of the systems people use to record and reflect on digital information. We draw together this prior work and examine how this emerging category of digital systems aligns with, advances, and contradicts this research work. We extend this work by considering how genealogical practices fit into this larger

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landscape and by exploring how emerging technologies are being used to create novel ways of engaging with a person's digital materials years into the future. An additional contribution of this work is a better understanding of the how digital systems support (and do not support) particular practices, values, and ideas related to death and dying. Finally, in our discussion we point to a number of strategies for addressing gaps between the prior work in this area and the design of existing systems.

RELATED WORK

In this section, we first present an overview of existing practices related to death, legacy, bereavement, and remembrance. Our goal here is to provide context for the many different practices that take place before and after a person dies and to identify the different groups involved in those practices. We also provide an overview of research from HCI and related disciplines that investigates how people engage with death-oriented practices online.

Overview of Existing Practices

As people age, many take steps to prepare for their death. One significant way in which people do so is by crafting a legacy that they hope will shape how they are remembered after they have passed away [82]. This legacy-making process is deeply connected to a person's understanding of his or her own life, and, for some people, may also reflect a desire to pass down lessons and information to future generations [57]. To craft a legacy, people engage in a number of practices that emphasize the aspects of their life for which they would like to be remembered, such as giving away meaningful possessions [52, 72, 81]. Another way in which people prepare for their own death is to make decisions about their end-of-life care and what they would like to happen to their body after they've died. Like legacy-making, these are a complex processes that reflect a person's values and relationships with other people [11, 37].

After a person dies, the people they leave behind are impacted in a variety of different ways. People often experience grief as they mourn a person's life; this grief helps them move on and find ways to integrate aspects of the deceased's memories and experiences into their own life [87]. People experiencing bereavement are sometimes moved to engage in ritual practices to help them cope with their loss; these include constructive activities such as creating a shrine, memorial, or scrapbook [45, 46], but also reflective activities that allow them to understand how their relationship to the deceased has changed [81]. There are also a number of logistical tasks that accompany a person's passing. In addition to funereal tasks [61], people must attend to a person's estate and arrange for the passing down of a person's material and immaterial possessions.

Beyond post-mortem practices, there are other ways that people engage with the memory of those who have passed away. One way is by conducting genealogical research using a variety of resources including living relatives and physical and digital archives [89]. Unlike many activities undertaken post-mortem, a term that most often describes the period of time directly following a person's death, people who conduct genealogical research may never have met the people whose lives they are researching. That being said, their motivation for doing this research is often similar to the types of goals that influence the desire to craft and communicate a legacy. Conducting genealogical research and learning about one's ancestors is a way for people to better understand their own life, identity, and heritage [77]. In addition, it is a way that people uncover and curate information that they can then pass down to future generations [89].

Death, Bereavement, and Remembrance Online

People have long adapted digital systems to address needs associated with death, legacy, bereavement, and remembrance. Over time, this has materialized in several different ways—the digital archiving of formal materials like obituaries [40], the creation of websites where a person can document their experience dealing with an illness [4, 10], creation of spaces for shared bereavement, such as cyber cemeteries [86], and the use of digital media in physical or non-digital practices, such as including digital photographs of a person in funereal materials [59]. In addition, more mainstream systems, like social networks, are now developing features to support bereavement and remembrance.

Digital systems have influenced some aspects of how people engage in these practices. One significant change from traditional practices is that the internet allows more people to take part in mourning a person's death [8, 86]. Creating an online memorial for someone makes it possible for more people to learn of that person's death and to participate in the processes of grieving and remembrance [9]. Similarly, genealogical practices have also adapted in response to the digitization of government censuses and military records. While people still use physical records to do historical research, websites like Geni.com [28] and Ancestry.com [2] have made it easier for people to find information about their ancestors and to share that information with other people [81].

Researchers have also examined the ways in which social networks have influenced 1) how people curate their personal digital information and 2) how a person is remembered after they pass away. Social networks are one space in which people construct and communicate aspects of their identity to other people [21]. Though social media data does not always capture information that accurately reflects a person's life [79], social networks are a rich potential resource for information about relationships, important milestones, and even the mundane aspects of a person's daily life. This information is then available as a material for reflecting on a person's life after they've passed away [29]. Research on grieving and bereavement online also describes how people use social networks to

provide social support, express sorrow, and highlight their relationship with the deceased [29].

Though less-often studied in HCI, digital platforms also provide people with an opportunity to reflect on the lives of people they did not know or on events that did not directly affect their lives [20, 62]. In their work on exploring grieving online, Brubaker et al. observed that social network accounts can serve two related post-mortem purposes as 1) a place for people to grieve online and as 2) a place for people to publicly enact aspects of the grieving process [7, 8]. Genealogy systems and systems that memorialize public tragedies also offer people a complementary set of opportunities to both learn about the experiences of others and to better understand one's place within different communities and time periods [36, 61, 65].

In a related vein of inquiry, Friedman and Nathan describe how systems that span lifetimes may offer the ability to address issues that push the limits of what a society is ready or able to address in its current state and to also engage with issues that take long periods of time to understand or remedy [27]. This idea is explored through the discussion and creation of slow technologies. Research on slow technologies suggests that there is a need to deeply consider how to design systems that span lifetimes and to design for information that is passed down between generations [34, 66]. As we look toward a future in people have created generations of digital information, this research helps to articulate how designers and developers might give people tools to reflect on, and make use of, that information.

SURVEYING THE LANDSCAPE

Before starting the analysis, we searched for websites and applications related to death, legacy, bereavement, and remembrance. This included systems that were directly focused on these topics, such as Death Switch [19], a system that sends post-mortem messages, and systems that have another focus but that offer users the ability to engage with death or remembrance, such as Facebook, which allows users to specify a person who can manage their account after they've died.

We found these systems by searching online, by following links from news articles and by reading through lists generated by other people, such as the Online Services List created by the website The Digital Beyond [21]. We also explored popular social networks and communication platforms, and those that met our criteria were included. In addition, we searched through Google Play store, the iTunes Store, and the Apple App Store for relevant applications. This process was also informed by our experience conducting research in this area, attending formal and informal workshops on death and dying, and by our conversations with other researchers about relevant resources.

It is important to acknowledge that despite our effort to collect a variety of different types of systems, most of these 75 systems reflect a similar perspective on death and dying and primarily focus on traditions and practices based in the western world. In addition, this list of 75 systems is not intended to be exhaustively comprehensive as there are likely hundreds (or thousands) of websites and applications in this domain. These are clearly limitations of our work, but we believe that the analysis has value as a way of understanding this large body of systems.

In selecting systems for this analysis, we excluded systems that did not directly relate to the topics of study. For example, lifelogging and personal informatics systems were excluded unless they were specifically oriented toward some process related to death, legacy, or memorialization. We also excluded systems that have policies about what happens to one's information after they pass away but no system functionality to accompany that policy. For example, though a verified family member can contact Twitter to shut down an account after someone has died, Twitter has no specific functionality that relates to dying or memorialization, and it was therefore excluded from the list.

Ultimately, our strategy for selecting systems was to err on the side of inclusivity. If a system seemed to be on the border, we opted to include it in our survey and then later see if it could contribute to the larger analysis. In total, our search ultimately generated a list of seventy-five websites and applications.

Describing and Categorizing the Systems

In this section, we have organized the systems into four categories. We describe each category as a way of providing context for a discussion about how we interpreted the content and functionality of the systems in that category. A small number of systems were classified into more than one category. Aside from this categorization, the most significant way in which these systems vary is in the extent to which they were developed by individuals, grassroots groups, or by more established organizations like Facebook.

Of the seventy-five systems we identified, 39 are designed primarily for first person use. That is, they are designed to support a person in anticipation of their own death. Systems in this category provide people with a variety of services, including the ability to curate their social media data, to record their last wishes, to send messages to loved ones, and to specify people to whom they want to pass down information and possessions. In some cases, these systems make it possible to create viewer or receiver accounts for other people to use after the primary account holder has passed away. Though these accounts provide services to a different group of users, they do so in service of the goals of the primary user.

The next category contains 22 systems that support bereavement and grief. The systems in this category are designed for people who are in mourning or who are

interested in recording information about a person who has passed away. These systems are typically meant to be used by people who knew the person while they were alive. In addition, many of these systems were designed to be used shortly after a person's death. As such, this category is primarily composed of websites and applications that allow people to create a memorial for someone who has passed away, and also includes a small number of systems that focus exclusively on grief and bereavement.

The third category in our analysis contains 10 systems that provide people with the ability to record and share information about their ancestors or people who died in the distant past. This category includes popular genealogy websites like Ancestry.com and Geni.com. Though we've departed these systems from those in the first two categories, they clearly share some goals with each. Like the systems in the first category, some of the people who use these systems are motivated by the desire to better understand their own life or prepare for their death. Like the systems in the second category, these systems were also designed to be used by people who wanted to reflect on the lives of people who have passed away. The main distinction here is that most of this reflection and information gathering is about people who have been dead for many years. In addition, these systems often enable people to connect information about one's ancestors to people who are living as a way of generating records about one's lineage and family history. To date, few, if any, works in HCI have delved into the technologies people use to research their own family history. We chose to include them in our larger analysis because they offer critical insights about how we can build systems that allow people to engage with lifetimes of data in meaningful ways.

The fourth category of systems that we analyzed contains six systems that support public reflection and discourse around significant events or experiences, such as the Vietnam War. This category has some elements from each of the others, but is separated into its own category because these systems are designed to collect and organize information that relate around a larger theme and not a particular individual or family. In addition, these systems are typically designed to serve two goals: to memorialize people who've died and to educate the public about an event or period of time.

CONTENT ANALYSIS

Content analysis is a method used to analyze documents, imagery, and other forms of written and visual communication [39]. In this type of analysis, researchers gather materials and code these materials based on the messages communicated through text and visual imagery in those materials. Those codes are then organized into higher-level findings [39]. The steps used in this analysis method are many similarities with grounded theory, but differs in that the goal of content analysis is not to produce theory but to better understand emergent themes present in one's materials [12].

Our content analysis was informed by related literature and our own prior work exploring the design and development of digital systems that engage with death and dying. To generate findings, we first identified systems to use in the analysis (as described in the 'surveying the landscape' section). We then explored the text, imagery, and functionality provided by each of the systems and coded each of the systems according to several criteria, including: 1) the types of users supported by the system, 2) the general purpose of the system, 3) the specific functionality the system provides, and 4) the types of technologies employed by the system. After coding the systems, we drew out emergent themes, which then became the focus of a larger discussion centered on our research questions. We also worked to develop an understanding of opportunity areas for future development.

FINDINGS

In the following sections, we describe several findings that describe how the systems included in our analysis support a range of practices related to death, legacy, bereavement, and remembrance. In each section we highlight compelling or thought-provoking examples of the systems we analyzed. We also describe the ways in which these findings build on or extend prior work in this area.

As in the prior section, we would like to highlight that this analysis is focused on systems that reflect a Western understanding of these practices. This is a limitation of our work and also a way to understand the scope of our findings.

Establishing an Enduring Legacy or Remembrance

The most prominent feature that systems advertised was the ability for digital systems to help people create an enduring legacy or remembrance. This idea was based in the common narrative that digital systems, unlike many physical artifacts, could exist indefinitely. One system, B Celebrated [5], listed "*Leav[ing] a permanent site where your friends and family will celebrate your life*" as one of the services they could offer to users. A similar system—Knotify.Me [44]—described their service as one that would be available "*any time you want*" and "*at any future time*." These features connected the idea of a lasting legacy with the desire that it reflects – the hope that people will want to engage with the materials and information from a person's life after they've passed away.

Memorial systems, primarily designed for the bereaved, highlighted the importance of creating a lasting memory of someone else. These systems described the ways that digital services could help preserve aspects of a person's life and experiences, and also brought attention to undesirable situations that might threaten a person's memory. 'You Mattered' [90], a website where people can make memorial pages for deceased loved ones, described how an advantage

of using their website was the ability to share information with people "*who didn't get to know [the deceased].*" Like systems that help people prepare for their own death, memorial websites and applications offered people the ability to create an enduring resource for people who want to know more about a person's life after they've passed away.

This was also the case for systems that document major tragedies and events, like the Vietnam Veterans Memorial Fund Android Application [84]. Unlike legacy-making systems (which are commonly used in anticipation of one's death) and personal memorial systems (the use of which is often sparked by a person's death), the systems that fell into this category were typically created years or decades after an event had occurred. Though many of these events, like 9/11 and the Vietnam War, are also marked by physical memorials, these systems were created, in part, to educate the public. These systems also provided people with an opportunity to connect with other people who had been impacted by the same experiences [62].

Other systems addressed the notion of an enduring legacy by exploring how digital systems could embody a person's life and materials. Though this idea has been the subject of science fiction for many years, these systems represent emerging developments at the intersection of death and technology. Two such systems, Eteni.me [24] and Eter9 [23], advertised the ability for a person to create an interactive avatar from their digital materials that would allow a person to "*become virtually immortal*" and "*allow other people in the future to access [their] memories*" [24]. These systems represent an emerging use of digital technologies: the ability to model people's experiences and memories using artificial intelligence and machine learning. A small collection of other systems described ways that technological developments in the future may make it possible to merge digital information and the physical body. For example, LifeNaut [49] is a service that is being developed with the expectation that we will someday be able to create new bodies for people who have passed away and then download a digital record of that person's consciousness into their new body, allowing them to achieve a sort of immortality.

In practice, the vast majority of the systems we surveyed do not appear to have been implemented as slow or multigenerational technologies, they are simply systems that have situated themselves in a medium that they expect to be around for the foreseeable future. Though this may be a reasonable strategy for the near future, some systems—including b-emortal.com [3] and Chronicle of Life [13]—have taken steps to address other concerns that arise from trying to develop technologies that span lifetimes, such as the long-term management and accessibility of digital content. Moving forward, there is an opportunity to explore two related questions: 1) how can system designers and developers address the technical and personal challenges associated with building multigenerational systems and 2) to what extent should we build systems that actually preserve personal digital information for generations?

Research on people who are grieving or who have lost a family member illustrates a potential issue associated with creating enduring records of a person's life: it can be difficult for people to be exposed to some persistent digital representation of that person after their death [54]. In this way, the ability to construct enduring records of a person's life may negatively impact the lives of people who are left behind if this process is not completed in a way that is sensitive to the many different ways that people grieve and deal with death. Additionally, while a person's digital records may have value to people in the future, it may not be worthwhile to indiscriminately preserve all of a person's digital records. Instead, it is important to consider the particular contexts in which we might realize the potential benefits of multigenerational systems.

Grappling With and Mitigating Uncertainty

Some systems framed their services as a way to address the uncertainty associated with death. In these systems, death is often depicted as something that could happen at any time and without warning. For example, Dead Man's Switch [17]—a post-mortem messaging service—motivated the use of their system by noting "*Bad things happen. Sometimes, they happen to you. If something **does** happen, you might wish there was something you had told the people around you*." The ability for digital systems to hold information in perpetuity and to reliably share that information at a critical time was seen as a way to address the possibility of an unexpected death.

Some of the systems in this category served logistical functions, such as encouraging people to communicate information about funeral arrangements and helping them formalize their plans. After Note [1], for example, provided these instructions to users: "*You can record all this in the wishes section. Indicate what music you want for your burial or cremation, what type of flowers you prefer and whether you want your funeral to be sober or festive*." A similar service, My Wonderful Life [64], allowed users to formally select 'Angels', or the *"…the people in [a person's] life who will know you've died, and will carry out your wishes.*" Other systems also allow users to assign viewer or manager accounts to people that they hope will help carry out their wishes or help manage their materials after they have passed away.

Another important logistical use of these systems is that they try to help people navigate how to pass down information from digital accounts and services. It can be difficult to understand how to pass down digital information as that information may not easily integrate into existing practices around death, dying, and inheritance [33]. In addition, digital systems often have policies that complicate the ability to give digital information to another person [60]. Capsoole [11], a digital account management service,

highlights some of the complexity involved: "*What happens to all of your online accounts — your 'digital assets' — if you aren't able to manage them anymore? Can your family access them on your behalf? Can they stop automatic subscription payments? Can you leave your iTunes collection to friends and family?*" Few digital systems provide functionality that supports the ability to give access to your digital information to another person. Additionally, the nature of digital systems makes it difficult to have a comprehensive understanding of what services a person used when they were alive. Until the process of passing down digital information becomes more established, third party services, like Capsoole, might serve this need or force larger systems to consider how they might address issues raised by people passing down and inheriting digital information and materials. Despite the proliferation of systems that attempt to help people get a handle on their digital collections, it is not clear that we should model the processes of passing down and inheriting digital materials on those of physical artifacts. Instead, there may be an opportunity to completely rethink the role that digital information can play in how we make sense of a person's life, relationships, and experiences.

These systems also provide functionality designed to help people influence how their life will be interpreted after they have passed away. One common way that this is done is by providing people with the ability to send post-mortem messages. This is a very popular feature among the systems we analyzed, not only do many broader systems offer this feature, but there exist several nearly identical systems that offered just this service. The messages sent by these systems have the potential to serve a number of communicative functions, such as providing people with a way to highlight meaningful aspects of their life. In addition, these services suggested that writing out messages that will be sent post-mortem can help users feel more at peace with the uncertainty of death. That being said, it is not clear that the recipients of these messages would have the same understanding of their value. A study of FutureMe, a service that allows people to create messages that will be sent at some point in the future, revealed that people who had received post-humorous messages from other people felt haunted and disturbed by those messages [69].

Several of the digital systems surveyed in this analysis are also presented as a way of helping people communicate information about end-of-life care. It can be difficult for people to communicate information about how they want to die [51] and harder still for people to make end-of-life care decisions for other people [74]. Systems like DocuBank [22] emphasize the importance of taking steps to ensure a person's ability to experience a 'good death', or one that allows them to experience the end of their life in a way that aligns with their values [80]. That being said, they do little to address the challenges of using digital systems that arise as a person ages [38].

Making a Contribution to Future Generations

The systems we analyzed also emphasized the importance of making a contribution to future generations. Literature on death and dying describes how people are motivated to share information that they believe can help them define their legacy and guide future generations [57]. A person's legacy, which is composed of some combination of material and immaterial things, is one of the primary ways in which people think about how their life will have a lasting influence [82]. The importance of making a contribution through one's legacy was reflected in the design of legacy-oriented systems such as Legacy Stories [48] and Dead Social [18], both of which provided ways for people to define their legacy and to communicate that legacy to others.

Memorial systems also made use of this idea by framing the process of documenting a person's life as a way to provide a valuable resource for future generations of people. Though digital systems capture a large amount of information about people's lives, an incalculable amount of information is either not captured or may be inaccessible after a person's death. Memorial systems offer people a way to record and organize information that might otherwise be lost or unavailable. That being said, because these remembrances are being generated by other people, they may not reflect the legacy a person hoped to leave behind after their death. In addition, as with the posthumous messages, it is not clear that future generations of people will interpret them or value them in the same way.

The idea of making a contribution to future generations also serves to motivate and frame the use of systems through which people research their family history. The information people uncover as they use genealogical resources like MyHeritage [63], Ancestry.com [2], and Geni.com [28] can help them understand where they come from and how their lives relate to those of their ancestors. On their website, MyHeritage encourages people to join by highlighting the opportunity to "*discover and treasure [their] unique family history*". Researching one's family history is framed as a way that people can use their time and energy to uncover information and generate new knowledge. In doing so, people who use these systems can contribute to future generations of their family, as well as people outside of their family who may be interested in that information as a matter of historical record. Indeed, many people use genealogical services to research historical events and time periods without having a specific connection to those periods. Researching one's family using digital records does, however, raise a concern regarding the potential to uncover information that negatively impacts your understanding of a person's life [54].

The idea of making a contribution to future generations also elicits other concerns regarding how people consider their life and their ability to leave a legacy. In our experience talking to people about what they'll leave behind when they

pass away, it is clear that many people do not identify with formal concepts like 'legacy' nor with the idea that their life will have an impact on those left behind or on future generations. Instead, the idea of a legacy is more often associated with people who have a significant amount of money, power, or social influence. Given that perspective, there is a need for systems that empower people to consider and engage with the meaningful aspects of their own life.

All of these practices—creating a legacy using online resources, creating a digital memorial for someone, and using digital services to research your family history—also highlight emerging areas where digital systems are becoming a necessary part of managing and deriving meaning from vast collections of digital data. Digital systems like Ancestry.com are valuable because the ability for a system to leverage its computational abilities makes it possible to locate and access digital records. As people generate increasingly large collections of data about their lives and the lives of other people, there is an emerging need for systems that have the ability to make use of that information and present it to the right people in the right contexts. Given the amount of data people generate over even a single lifetime, it may not be possible for individuals to productively engage with that data (and understand its potential value) without the help of digital systems.

Telling and Protecting One's Life Story

The systems in our analysis also described the importance of helping a person construct and share their life story. Prior work has described how the ability to for digital systems to help people share memories about a person's life and to engage in generative practices like creating a website about that person can be a part of the grieving process [55]. After Note [1], for example, provides people with the ability to organize information along a personal timeline. The materials on their website describe how After Note could "*…ensure that you never lose any of your special moments. You can collect your most important photos, scan letters and postcards, describe valuable life events and add these to your digital timeline. This allows you to create a complete overview of your life, from the moment you were born to the present day.*" Other systems make an even stronger case about the personal significance of preserving the details of one's life— Eterni.me [24] describes how leaving behind digital materials does not ensure any sort of enduring remembrance without further curation: "*We only leave behind a few photos, maybe some home videos, or in rare situations, a diary or autobiography. But eventually, we are all forgotten.*"

As a part of the functionality these systems provide to help people record and share their life stories, several systems make it possible for people to use materials from social networks and other digital services. For example, InfiBond [42] is a service that helps people author stories using materials collected from a number of different social networks and digital systems. Infibond provides tools to aid in the curation of the information that it collects: "*Infibond automatically collects all your media from across the web and chronologically enters it on a beautiful timeline, so you can enjoy and share your life stories. infibond also makes these special moments accessible anywhere, anytime, even while you are offline.*" Across these types of systems, the materials gathered from a person's digital accounts are used in three ways: as material to spark the storytelling process, as a way to supplement or provide context for a story, or as the material from which a story is composed. Despite the potential value of this type of curatorial system, prior work on the curation of digital information rejects the notion of creating a single centralized archive for people's digital materials [50]. Though that research did not focus on legacy-oriented systems, it is clear that such systems might provide a better service if they were more sensitive to how people think about the value and use of their digital information.

Systems that help people craft narratives about their life's experiences also highlight a key tension of digital technologies: the materials held in digital accounts are both a resource for identity construction and a potential threat to a person's identity after they've passed away. As a result, several systems, such as Cirrus Legacy [15], Mind at Rest [58], and Protect Their Memories [73], frame their services as a way to protect a person's legacy. This is accomplished in several ways. The first is by deleting or removing damaging content. The website Cirrus Legacy describes their service as a way to "*take control of your digital life - both now and when you die. You may want some things to be passed to your loved ones. You may want others to disappear. With Cirrus, you decide. And you can even choose someone to take care of it all for you*." Similarly, the website Protect Their Memories [73] offers a service to help bereaved loved ones delete digital accounts connected to seven major platforms. This site highlights identity theft as another threat to how people engage with a person's information after their death, saying "*Dormant social media accounts are sought by internet 'trolls' for identity theft purposes.*" Though this is not an issue that is addressed by many systems, matters of privacy and security can complicate the ability to engage with a person's information after their death and can impact the already difficult experience of coping with the loss of a loved one.

Complexities of Engaging with Existing Practices

Some of the services we analyzed help people incorporate digital information into existing practices around death and dying. Though passing down information about particular types of accounts (e.g. financial accounts) is an established practice, digital identities and information differ in that the systems that hold that information may believe that they have some claim to the ownership of it. As a result, digital systems can influence people's ability to access the information they hold. Furthermore, people who do not the technical expertise needed to extract or export information from a particular system are dependent on those systems.

Websites like Capsoole [11] and WebCease [88] attempt to bridge the gap that exists between established death-related practices and infrastructure and the ways in which people interact with digital materials. Established practices and infrastructure include things like laws that address inheritance and ownership, traditional social and religious practices regarding death, and the various institutions that are involved in carrying out those laws and practices. WebCease and Capsoole both provide services that try to include digital possessions and information into this existing infrastructure. WebCease does this by reframing digital information as assets: *"Digital assets include a person's electronically stored content and online accounts, such as emails, photos, music, social networking profiles, career information, and blogs. They can have an emotional, sentimental, or monetary value. Digital assets usually fall into four main categories: Financial, Personal, Social, and Loyalty Rewards."* Doing so allows them to extend existing infrastructure to better address the needs presented by digital information.

In addition, it is important that we consider how to situate the dead within existing social networks. Systems like Dead Social [18], a service that allows people to craft messages that will be posted to their social media accounts after they have died, highlight the complexity of managing identities and information that are distributed through different digital accounts. Facebook and Google have taken steps to address how a person's account is managed after their death. While many people have accounts with Facebook and Google, there exist an incredibly large number of services that hold potentially private or important information about people's lives that have not established any guidelines about what happens once a person passes away. This lack of formal guidelines can complicate the grieving process and the long-term remembrance of a person's life. Though researchers have raised this issue on a number of occasions and suggested potential ways of addressing this issue, major systems have been slow to implement policy changes.

Additionally, while it may be practical for people to use existing digital templates and tools to organize a person's digital materials it is not clear that those technologies benefit people who might find more meaning in practices that are more tailored to the nature of their relationship with the deceased.

Engaging in Collective Communicative Practices

Even a brief overview of the systems we analyzed makes it clear that there is a tremendous emphasis on sharing the information. In some cases, this reflects the nature of a particular practice. Legacy-making, for example, is often viewed as a communicative activity. People create a legacy with the goal of communicating something about their experiences and values. From the perspective of the person who is crafting a legacy, that legacy is not fully realized unless it is communicated to others in some way. Public memorialization is another process in which people can expect to engage in collective engagement and meaning-making. The Vietnam Veterans Memorial Fund App [84], for example, frames contributions to the application in terms of how they would support public reflection on the Vietnam War.

Of the seventy-five systems we included in our survey, nearly all of them describe the ability to share information and experiences with other people as one of the features they provide. This is not entirely unexpected, as sharing information is an important part of the human experience, and one of the advantages of digital systems is that they make it easier to share information with other people across time and space [75]. This emphasis on sharing does, however, elicit questions about how these applications can support both sharing and the desire to engage in private, reflective practices. In addition to opening up experiences of death, mourning, and remembrance to more people and to more contexts [7], the use of digital systems also engages the system itself as a stakeholder in the need to maintain and communicate information about those experiences. As such, the notion of engaging in private experiences, like using the diary services offered by Boxego [6] and Passing Bye [70], evokes questions about how digital systems can ensure the privacy of that information over the course of a lifetime and about what it means for something to be private or personal when it is mediated by a digital system.

DISCUSSION

Building on prior work, our findings illustrate the complexities that result from how digital systems engage with topics related to death, legacy, bereavement, and remembrance. In this discussion, we explore a number of topics that emerged from our analysis. In particular, there are some notable ways in which the systems we've analyzed do not support or address key aspects of practices related to death, legacy, bereavement, and remembrance. In this section, we draw attention to the ways that systems underspecify how people can and should engage with these practices. For each topic, we draw out design opportunities that demonstrate how systems better support user needs.

Supporting Varied Perceptions of Legacy and Meaning

The systems we studied did not provide much guidance for people who do not identify with the values and practices they support. That is, systems highlighted the importance of practices like working to establish a lasting legacy, curating one's materials to influence how they represent your life and experiences, making a contribution to future generations, and protecting your digital materials. However, while it is understandable that an individual would want to engage in these practices, not all people share the values and contexts that give these practices a particular socially reinforced value or meaning. For example, people who do not plan to have children may not be motivated by systems that focus on the ability to pass things down to future generations. Other people may not feel a strong connection to their family or their heritage. Similarly, some people may

be interested in thinking about how their life will be remembered through their digital information, but may not be interested in taking the deliberate steps needed to carry out those practices. Finally, some people may not want curated digital materials to play a role in how they are remembered.

Each of these situations is an opportunity to think about how digital systems can help people reflect on existing practices and provide people with ability to engage in those practices in a way that aligns with their values. For example, if a person does not think that children are a part of their legacy, there should be systems that acknowledge the validity and importance of their experiences and that help them articulate aspects of their life that may have more personal significance. Similarly, there is an opportunity to consider how we can build systems do not intrinsically frame the legacy or impact of a person's life within a larger consideration of their family history.

Engaging with Provenance and Ownership

While many of the systems supported the idea of creating repositories of information that span lifetimes and generations, they did not address complexity that arises from creating systems and functionality that exceed the human lifespan. Facebook's Legacy Contact [25] is one example – it allows people to specify a person that will manage their Facebook account post-mortem but does not describe how that process would work over more than one generation. Questions regarding the long-term management of one's digital information go unanswered by these systems. Certainly, these questions are not unique to Facebook, few social media sites and digital account providers have taken steps to implement even this basic functionality. As such, there is a need to better understand how long people want their digital information to be available after they've passed away and expectations for people who have been assigned to manage another person's information.

Another related issue stems from trying to understand how the information held in digital accounts will be accessed if and when systems stop operating. One potential way to address these issues is to support a process by which a person can extract information from systems. However, low adoption of existing features indicates that systems need to developed in a way that is part of broader conversations about death and dying that occur both online and offline. For example, systems could prompt users to engage in the co-creation or co-organization of valued digital materials with family members.

Designing for Personal and Private Use

Digital systems often provide functionality that supports shared practices, such as creating a public memorial website where people can share memories about a person who has passed away. This functionality clearly plays valuable role in the grieving process for some people, but there is also a reason to consider how systems could better support private reflection and grief. Systems designed to help mourn a person's death are most often depicted as a way to participate in collective practices and fall short in providing private or non-public ways of helping people grieve another persons death. Contributing to and engaging with collective resources can, of course, be a meaningful part of how a person moves on from the loss of another person. There is, however, an opportunity to support other forms of engagement and reflection though the design of systems that allow people to generate and organize materials that they do not intend to share.

Building for Non-Use Post-Mortem

In addition to understanding how people engage with these systems, it is important to understand how they do not engage with them. Though it is hard to quantify the popularity of the different systems we analyzed, only a few seem to have attracted a large user base. Indeed, in the time since we originally did this analysis, several of the systems have ceased operations. Many people who are engaging with practices related to death and dying do not make use of the systems that are available. In some cases, this is because people do not know about the existence of these systems or how to find online resources to meet their needs. Others may not be interested in using digital systems in this way. It would be interesting for the HCI community to conceive of a legacy system that invites interaction long before someone enters the end of their life or to consider how existing digital materials might be utilized more meaningfully to help people reflect on particular aspects of their life and experiences.

While non-use of these systems during a person's lifetime is a likely scenario for many people, non-use post-mortem is another issue entirely. Without the ability to declare one's wishes, it is nearly impossible to exercise control over the long-term fate of one's digital information. Over time, a person's digital information is subject to changing norms, practices, and system designs. In the long term, it is likely that the emerging ability for systems to make sense of large collections of information will make it possible for people to make use of this data in new ways that we cannot yet imagine. This tension between post-mortem use and non-use illustrates the importance of providing accessible ways for people to articulate their long-term desires for how their information will be used.

Moving Forward

Despite a great deal of work in this area, there are clearly a number of open questions that remain regarding the development of systems that engage with death, legacy, bereavement, and remembrance. It was our intention to examine how existing systems talk about (and embody) these practices and to use this information to better understand opportunity areas for further research work and development. As computer systems become more capable and complex, and as people generate more digital information, we hope that these findings and discussion

points will provide researchers, designers, and developers with information that can help guide the creation of novel technologies.

CONCLUSION

In this paper, we analyzed seventy-five systems using content analysis. These systems were analyzed and sorted into four major categories, reflecting different user groups and motivations for each category of systems. Building on prior work, we drew out salient themes. The findings from this work articulate how digital systems often provide functionality that support particular narratives—idea of an enduring legacy, the uncertainty that arises from both life and death, the desire to make a contribution to future generations, the ability for digital information to both protect and threaten a person's life story. In addition, this work describes how the digital systems support particular types of death-oriented practices, such as the involvement of traditional stakeholders and collective practices related to bereavement and remembrance. We then discussed how these findings might be employed to help better support the emerging needs resulting from the use of digital systems that span lifetimes and generations.

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APPENDIX – LIST OF SYSTEMS

We felt that it was important to provide access to the list of systems we selected for this analysis. Note that in the time it took to get this work published, several of the systems have ceased operations and others have been acquired. Nevertheless, we hope that the list will be a useful resource.

Table 1: List of Systems

Afternote.com	Afterwords.cc	B-emortal.com
Bcelebrated.com	Boxego.com	Capsoole.com
Chronicleoflife.com	DeathSwitch.com	DeadMansSwitch.com
Deadsocial.org	USLegalWills.com	Docubank.com
Estatemap.com	Eter9.com	Everplans.com
Ghostmemo.com	Infibond.com	Knotify.me
Lifenaut.com	Mindatrest.co.uk	Mywonderfullife.com
Mygoodbyemessage.com	Mymoriam.com	PartingWishes.com
PassingBye.com	Securesafe.com	Thedocsafe.com
RememberedVoices.com	ToLovedOnes.com	CirrusLegacy.com
MyVuture.com	WebCease.com	LegacyStories.com
Eterni.me	AimHolographics.com	Facebook Legacy Contacts
Google Inactive Account Manager	StoryCorps.com	9/11 Memorial App
Digital Memorial App	WW2 Memorial App	MH370 Memorial App
Vietnam Veterans Memorial App	ForeverMissed.com	FuneralFinder.com
GoneTooSoon.org	Heart2Soul.com	iLasting.com
KeepTheirMemoryAlive.com	Imorial.com	Legacy.com/ns/
Journal-of-life.com	Mem.com/site/stories	MemorialMatters.com
MuchLoved.com	ProtectTheirMemories.com	Remembered.com
Tributes.com	YouMattered.com	The HealGrief App
Help For The Grieving App	Geni.com	Ancestry.com
BillionGraves.com	MyHeritage.com	FindMyPast.com
GenesReunited.co.uk	ZoomPast.org	FamilySearch.org
RootsWeb.ancestry.com	Famicity.com	MyGriefAngels.org
Grief Support Network App	Flutter App	Never-Gone.com

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