



Designing SADD: A Social Media Agent for the Detection of the Deceased

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Abstract. As the number of profiles and user generated content online continues to grow, many accounts in time will inevitably belong to those that are deceased. Questions arise as what to do with content on these profiles when it becomes known that the owner of the profile has died. Additionally, many users have several profiles spread across various social networking sites. This project describes our efforts to create SADD - A Social Media Agent for the Detection of the Deceased. This tool aims to systematically identify social media accounts that may belong to a deceased user based on related posts from other users as well as changes in profile interaction. As part of this project, we present a basic framework and prototype for the program and include survey results about the perception of this type of tool which examine how users may wish to preserve online content. This project is a continuation of previous research related to virtual memorialization of web based and virtual world content and interaction.

Keywords: SADD · Online memorials · Thanatechnology · Digital legacy
Social networks

1 Introduction

Social media use has grown exponentially over the last several years, with no signs of reversing. As more individuals turn to social media of all kinds, the number of accounts and profiles online continue to increase. The culmination of video, photos, text and other content over time is what makes up a user's profile and timeline on a particular social media site. As social media is used in many aspects of our lives, the number of users, content and time spent with these profiles continues to expand and evolve. Despite the pervasiveness of social media technologies, few studies have been conducted on the impact on those connected to the departed. Even though death is a major component of one's life, current technology design does not yet fully consider the

inevitable death of the user [1]. Death is part of life no matter how much we try to avoid the concept. In preparation we prepare wills and set aside documents in the event of our death and pay for life insurance to help compensate for end of life expenses for surviving family members. However, this preparation and protection of our digital assets are not considered as often. Our digital assets contain a wealth of information, knowledge and digital artifacts that we may wish to pass over to members of our families, or in some way preserve. Our social media accounts contain information and representations of who we were in life, thus transforming into a digital memorial of our lives (even inadvertently). In this paper, we continue to add onto our previous work examining the implications of social networking sites and virtual worlds regarding death [2–4]. This project however, concentrates on the development of a program which aims to systematically identify accounts of users that are deceased on social networking sites. Therefore, we describe our efforts to create SADD - A Social Media Agent for the Detection of the Deceased.

The automatic detection of accounts of deceased users is inherently problematic. There are many factors to explore and hurdles to overcome to automatically flag these profiles. Through the implementation of SADD we intend to expand our research on social media related to deceased user profiles and explore how other users interact with the content. SADD will also allow us to examine which types of digital content may become a person's online memorial (purposefully or inadvertently). How does one determine if an account has just become inactive rather than an account of someone who is deceased? There are many elements within the page that can be examined such as titles, posts, "liked" websites, images, videos and other connected/friended accounts. There is a plethora of content in a social media site to examine for a wide variety of purposes. Boyd and Ellison [5] describe a web-based social networking site as a service that allows users to: "(1) Construct a public or semipublic profile within a bounded system (2) articulate a list of other users with whom they share a connection, and (3) view and traverse their list of connections and those made by others within the system" (pg. 211). From the user's profile the connections, content and other activity can yield important patterns.

As the death of the user is an often under considered event in the protection of one's content, more research and focus on this topic is needed. Massimi and Charise [1] introduced the concept of thanatosensitivity, as a humanistically grounded approach to HCI concerning mortality, dying and death in the creation of interactive systems. We see a need for a multidisciplinary approach to these problems between computing and thanatology. In this paper, we expand our previous research as it is related to SADD by presenting a rationale for the program, followed by additional survey data and a discussion. Our future work section describes the next phase of the project.

2 Rationale

As part of our ongoing research, we have been examining the impact of social media and virtual worlds for the past several years. One of the overarching themes of these projects is the idea of virtual/online memorials and how users interact with profiles of the deceased. Additionally, we have proposed many questions as to how these

memorials should be designed or maintained and what to do with content. As we investigate how information can be preserved, presented and interacted with, we must also find a way to discover accounts of those that are deceased. Thus the introduction of the SADD Model. There are several benefits of the implementation of SADD such as:

1. Potentially assisting families and friends in discovering unknown accounts of loved ones that have died.
2. Assisting social networking providers with an automated process to detect deceased user's accounts.
3. Identifying these accounts can help memorialize and save content.
4. Identifying accounts of deceased users can be beneficial for security reasons.

The detection of these profile can allow family members to preserve content such as images, posts and videos posted or stored within the deceased's account. In previous studies, some users have expressed the desire to have content memorialized, either their own content when they are deceased or to protect a loved one's content [4]. However, the detection of posthumous profiles brings up many related issues. These issues increase in complexity if the wishes of the deceased are not known or ambiguous. Some questions to consider include:

- Who should maintain the profiles of the deceased?
- Is it known and verified that the original owner is indeed deceased?
- What was the final wishes of the deceased?
- What are the Terms of Service related to the accounts being considered?
- What content remains in the account?
- Is the content public or private information?

As many of these elements are unknown, particularly at the time of death, one should consider that their social media presence at any point may become their digital representation (digital legacy). Some of our previous research has proposed several questions that one can use to assess content as they are posting or storing content online or on a social networking site which include [3, 4]:

1. Is this content something I'm alright with if it becomes part of my digital legacy?
2. Is this content something that should be protected if something were to happen to me?
3. If this content should be protected, how can it be protected?

The main motivation in developing SADD to identify profiles of the deceased it to help those grieving and to also protect the final wishes of the deceased (if known). As more people turn to creating and maintaining a presence on multiple social networking sites, the potential for large number of profiles of the deceased will also rise. Being able to identify and protect this content is important. For some, being able to visit the profile of the deceased friend or family member can provide comfort and time for reflection. Others may not want to see the content as it may illicit various emotions reminded them of the loss. Having profiles memorialized can also be used to have "conversations" with the deceased through posting messages on one's page or timeline. One can also explore the deceased's timeline to better understand aspects of who they were, important events and feelings or just to view other people's comments. However, it is possible that over

time some users befriend other users in which they do not know in real life. Therefore, it may not be known if they are deceased in the real world. We are also interested in knowing more about how the manner of death may affect how individuals interact with SNS and virtual memorial design [4]. Using the NASH categories (Natural, Accidental, Suicide, Homicide) used for some classification of death, we may be able to capture important patterns of interaction, however, this information would need to be known of the deceased. Another interesting phenomenon related to interacting with the profiles of the deceased is RIP trolling. This is where offensive and inflammatory posts and/or images are purposefully left to cause offense. RIP trolling or sometimes referred to as memorial trolling may be an increasing problem on social media as offensive posts and fictitious profile accounts can be easily created. Phillips [6] notes that often these individuals “scour the site for the most sensitive people and the most sensitive subjects”. Some social networking site reporting tools, however, can limit some of these occurrences in a limited degree. For those effected, it can be quite upsetting. If these accounts could be automatically detected as belonging to a deceased person, actions could be taken to memorial or deactivate that page which could prevent some of these activities.

3 Framework and Preliminary Design

The preliminary version of SADD was programmed using the Python programming language (version 2.7), due to its flexibility and the large number of available libraries which make connecting to social media sites easier. Additionally, there are numerous text analysis tools available. The SADD agent is set to run at various intermittent time intervals on public Twitter posts. Twitter was chosen as our preliminary social networking site to test the program at identifying user accounts of probable deceased users. Currently, the agent is in a preliminary stage and performs searches for keywords related to death to identify deceased user profiles. For example, it may search for the term “#RIP” to see which twitter user has posted that term in relation to another user’s profile. The web component of SADD is essentially a web-crawler which mines for specific words within a subset of social networking sites.

Several features can be obtained from crawled pages as part of various indexing strategies [7, 8] such as: page content, descriptions, hyperlink structure, hyperlink text, keywords, page titles and text with different fonts. This additional structural information could provide additional information depending on the type of profile being examined and its interconnectedness to other profiles. Some information however would need to be ignored. A common word filter is used to filter out commonly used words that occur in a relatively high frequency as part of the English language. In general, these common words will have little or no importance for the agent. The filtering of common words is a useful technique that can be used for many diverse purposes. Natural languages typically contain common words that serve to connect pieces of sentences, prepositions and other common elements. These elements are often referred to as stop-words, and are typically words like “the”, “and”, “of”, and “in”. The removal of stop-words is often associated with balancing the processing speed versus retrieval quality [9]. It is argued that processing speed will be improved even though

some quality may be lost by the removal of these terms [10]. The selection of stop-words selected for this project was based on Leech et al. [11] and from a partially compiled list from the Onix Text Retrieval Toolkit [12] as well as added words through experimentation. Removal of additional terms also cuts down on the amount of information stored in the database. The ability to store all information retrieved from Twitter posts is limited.

Figure 1 illustrates a preliminary design model of the SADD agent, with several components still to be developed. After a profile is examined, text content and structural elements are interpreted by the agent. In development for SADD, is the Grief Counselor Component and Sentiment Analysis, which is based on derivation of our previous work in affective computing [13]. Moreover, sentiment analysis of posts combined with discovered variations in a user’s timeline could yield useful results. The Grief Counselor Component is not meant to serve as a real grief counselor, but instead is the main element in determining if the profile under investigation is indeed deceased. Recommendations made by the agent included derived information about the confidence of the user’s status in addition to analysis patterns.

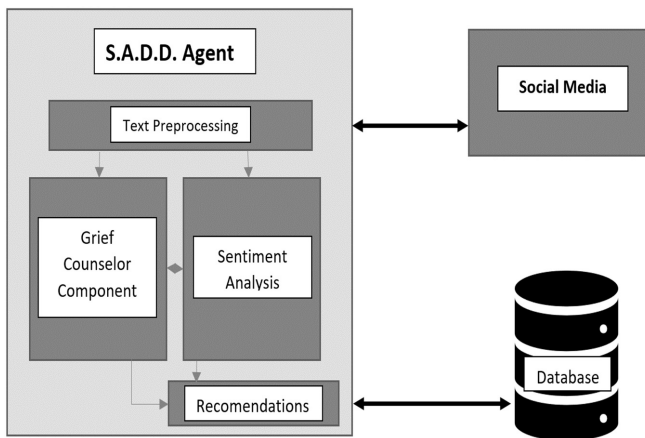


Fig. 1. SADD Agent Model

There are many difficulties to overcome in SADD’s implementation, some of which will be addressed in the future work section. First, the agent is limited in the social networks it can currently access at this time (i.e., Twitter). Also, the ability to perform social network analysis on current connections and interactions with other users as well as the ability to establish patterns in Twitter posting is under development. SADD is also susceptible to “fake news” and hoax content. For instance, it once picked up a previous hoax of a suicide of a celebrity due to numerous reposting and instances of “#RIP” in relation to the account. We also must be careful about the number of requests sent as not to have the program banned, but in doing so may cause some information to be missed. Additionally, there are limits to how many messages can be examined at one time. The database also has needed to be redesigned several times for efficiency. SADD

currently is using a MySQL database. As previously stated, there is much research that is needed to most effectively extract targeted profiles. To better understand how people interact with a feel about deceased user profiles a survey was administered and described in the next section.

4 Feedback

Using similar, but expanded questions from a previous survey, we asked a series of questions to undergraduate students at a large community college [4]. The survey was distributed electronically at the end of the Fall 2017 academic semester. Participants were selected from a limited number of technology courses such as introductory courses and various levels of computer programming. Limitations of the survey include low response rate and high level of technology use of those participating. Twenty-eight participants responded, which consisted of 16 males (57.1%) and 12 (42.9%) females with an average age of 23.3 years old. The majority were majoring in computer science, information technology, computer engineering and/or general studies. Participants noted on average they spend many hours engaged in online activity reveling high technology usage. Specifically, 2 (7.1%) noted they spend 1 to 3 h online, 15 (53.6%) spent 4 to 6 h engaged in online activities, 6 (21.4%) 7 to 9 h online, 4 (14.3) more than 9 h online and one participant (3.6%) was unsure.

When asked “Do you have a profile on any social networking site?”, 25 (89.3%) said “Yes”, and the remaining 3 (10.7%) said “No”. The primary social network of choice was Facebook, Instagram, Snapchat, Twitter, Google+ and Twitter. We also wanted to capture information about the type of content posted to participant’s profiles which is described in Table 1. In this question, participants could select more than one response. One person that selected “E. None” commenting that they consume content rather than post their own content online. Next the survey asked participants to rate the importance of the personal content that was contained on their social networking sites, which is summarized in Table 2.

Table 1. Type of posted content

Choice	Total (n = 28)
A. Pictures	20
B. Text based posts	19
C. Video	18
D. Music or other audio	7
E. None	3

Following these introductory questions, the survey became more focused on death related questions. The next question asked, “Do you know anyone that has died, but their social networking profile is still present after their death?”. Eighteen (64.3%) responded “Yes” and 10 (35.7%) responded “No”. Participants were also asked “Would you want your social networking page to remain active after your death?”.

Table 2. Content ratings

Rating	Total (n = 28)
A. Not at all important	6
B. A Little important	4
C. Somewhat important	14
D. Very important	2
E. Highly important	2

Only 5 (17.9%) said “Yes”, whereas the remaining 23 (82.1%) said “No”. Related to this question targeted which content participants would want protected after their death through a multiple-choice question, where more than one answer could be selected. A summary can be found in Table 3.

Table 3. Digital assets that need protecting

Category	Total (n = 28)
A. Photos	19
B. Documents	13
C. Music	5
D. Video	13
E. Intellectual property (i.e. things that you or others have created)	11
F. Personal Information (i.e. tax documents, addresses, financial data etc.)	19
G. No Response	1

Participants were also asked what they would want to happen to their digital content after their death. From twenty-seven participants that responded 13 (48.2%) reported that their wishes would be to have the content “deleted”, 8 (29.6%) reported “preserved with restrictions” and 6 (22.2%) reported that their final wishes would be for their site to remain the same as it currently is. Next the survey question asked “If a family member or friend died and had various social media accounts, would you want the ability to find out what social media accounts they had? (Assuming you do not know what social media accounts they had)”. The results were mixed 10 (35.7%) responding “Yes”, 8 (28.6%) responding “No” and 10 (35.7%) responding with “Maybe”. Tied to this question, participants were also asked “How would knowing the deceased person’s social media accounts help you? (Or not). Twenty participants responded to this question. Five (25%) of the participants responded that they would not want such information. One person noted that such private information should not be made public in any way after the person’s death. Another participant responded:

“Knowing the deceased person’s social media accounts would just upset me and make me sad seeing the individual the way that they were while they were alive. Scrolling through their social media account would just make me reminisce and have more of a difficult time with getting over their death and moving on.”

Ten (50%) of the other responses were more positive in nature for having such information. It was noted that this would allow for insight into the deceased, and that being reminded of their life could be helpful in dealing with the loss. The other five (25%) commented on how the information could be used to identify the accounts to protect the content of the deceased, either for memorialization purposes or to close the accounts. One person brought up an interesting point regarding the manner of death and the role knowing the deceased's accounts. For instance, in the case of a homicide or suicide, the person's timeline and connections may be of importance. Next participants were asked "If you died and your family and friends did not know what social media accounts you had, would you want them to be able to find these accounts?". Fifteen (53.6%) of the participants said "Yes" that they would want their social media accounts known. Nine (32.1%) responded "No" and 3 (10.7%) responded as "Maybe". One (3.6%) participant skipped the question and did not respond. Some related comments include:

- If my family and friends did not know about my social media accounts when I was alive then I would not want them to know about them when I am dead.
- They would get to know another side of me
- Because its personal, it would make me or them uncomfortable
- I would want them to see all memories about me

The survey then shifted the focus of the questions over to virtual memorials. The next question asked participants if they had ever seen or encountered an online (social networking based) or virtual memorial. From the responses 9 (32.1%) said "Yes", 15 (53.6%) said "No" and 4 (14.3%) said "Maybe". Two individuals commented: "Facebook page of a deceased was updated by a family member informing people of the death of the individual's page" and "I have seen many online memorials for famous individuals who have passed away, but never for anyone that I have known personally". Next the survey asked, "Do you currently have any documentation dictating your final wishes for your online content?". Only 2 (7.1%) said "Yes" and the remaining 26 (92.9%) said "No". Next the survey asked, "Would you feel better about your own death if you knew there would be an online memorial dedicated to you?". From this question 13 (46.4%) said "No", 8 (28.6%) said "Yes" and 7 (25%) said "Maybe" or "Unsure". The survey also questioned if they had ever received a friend request or suggestion from someone on a social media site that you know was deceased? Three responded "Yes" (10.7%) and the remaining 25 (89.3%) reported "No". No participant selected "Unsure". Lastly, participants were asked "Have you ever received a friend request or suggestion from someone you suspected was using a falsified/fake account?". Twenty-two (78.6%) responded "Yes" they believe they have had fake/falsified friend requests. Five (17.8%) responded "No" and one (3.6%) was "Unsure".

5 Discussion

Although the number of participants in this survey was limited, the results will be helpful for future design considerations. The responses from this survey showed consistency with previous survey results [4]. In this particular survey, however, there were several additional questions about attitudes toward the automatic detection of content. The focus of these questions was to include the assessment of younger participants who typically have more of a high degree of technical knowledge and use social media extensively. Feedback from this demographic is important as they will be likely to continue using social media in the future, which may provide key insights. Maciel and Pereira [14] note the importance of exploring the concept of death within this age group as it applies to the web due to their high use of the Internet and social media in general. Participants from the survey responded that they do post a range of content on their social media profiles, primarily consisting of pictures, text and video. However, many responses varied in the importance level of such posts, with the majority (50%) saying they only viewed their content as “somewhat important” overall. This is contrast with the type of content they viewed as needing protection in the event of their death. When participants were asked overall if they would want their digital assets (which would include social media content and presence) to be deleted, preserved or to leave it as it was at the time of their death, results were mixed with only 48.2% wanting the content deleted.

When asked about wanting to know the social media accounts of a friend or family members after their death, particularly, if such accounts were not known, result also varied. Where 10 (35.7%) responded “Yes”, 8 (28.6%) responding “No” and 10 (35.7%) responded with “Maybe”. Some viewed knowing such information as an invasion of privacy, where others viewed knowing such information as helpful. As related to SADD, the identification of the accounts of deceased users to both preserve and memorialize the page or to shut down the profile is important. On some social networking sites, any active account can still appear in search results or become listed as potential “friends”. As noted by Goldberg [15], receiving a “friendship request” from someone that you know is deceased can be unsettling. From the survey results, though limited in occurrence (three users or 10.7%) had said yes, they have had this happen. As the number of users increase, this trend may also rise. From a security standpoint these accounts should be limited (memorialized) or deleted to make sure that active accounts are not the target for hacking attempts. If no one is monitoring the account, it could be used by a hacker to send unsolicited content to other users or control could be gained over stored content. If the username and content is compromised on one account, it may be a similar password and username on other accounts which could then also be hacked. Security concerns were also noted by several participants in the survey as a reason to know about such accounts.

Having your final wishes known and the ability for someone to carry out those final wishes is important for users of social media and online content to consider. Not only is knowing what online services you were participating is needed, but also passwords and other account information. However, as discussed by Massimi and Charise, relying on passwords alone may not be enough in the case of systems requiring biometric

authentication [1]. These types of systems would prove to be problematic in the case of a deceased user unless backup measures are in place. Often, the final wishes of the deceased are not known in addition to not knowing their account information, including passwords. As asked in the survey, participants typically did not have any documentation dictating their final wishes for online content. Only two (7.1%) noted they did have such documentation whereas the remaining 26 (92.9%) did not. There has been some research proposed that would allow for self-destructing data as proposed through *Vanish* [16]. Although the aim of *Vanish* is privacy and security of archived data, this idea/approach would be helpful in the case of a user's death.

6 Summary and Future Work

In future research we intend to experimentally test SADD in a variety of situations. There is a great need for additional features to be added to the program such as social network analysis tools, additional keyword combinations and the ability to filter out erroneous information. We also intend to expand its functionality for several social networking sites. Additionally, we plan for more specific surveys asking users additional questions. For instance, would users be willing to have their account monitored systematically to see if they are still alive to protect their content and to make sure that their final wishes are carried out? This would require preplanning and monitoring of their activities online. Should SADD like components be designed and added automatically to social networks?

One limitation of this study was the small sample size. This is reflected in our analysis in the application of the SADD framework. In our next phase, our aim is to combine data collected from several previous studies for a more in-depth analysis to better understand implications of online memorials (both social networking based and virtual). This will help to better understand how users interact with such data to better design SADD. A better understanding of what and how users comment and interact with online memorials can also lead to better text based analysis of posts on pages of the deceased. It may also be possible to examine text posted by living users who are having suicidal ideation which could theoretical be identified for intervention. "Suicidal ideation is defined as thinking about, considering, or planning suicide" [17, p. 226]. Worldwide there are close to 800,000 people that die by suicide annually [18]. However, this may be difficult to detect as social network posts may be in contradiction to the actual person's thoughts or posted content. It may also be difficult to know the actual person's information or location to provide help.

Through an interdisciplinary approach between computer science and thanatology we may be able to design a working program to help identify profiles of deceased users. The goal is to help protect the final wishes of the deceased and to assist the bereaved. In this paper we have described our project SADD - A Social Media Agent for the Detection of the Deceased, in its preliminary form. As the amount of digital content belonging to those that have died increases, the need for automatic detection and content protection will become progressively important.

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