Exploration of a Mobile Design for a Privacy Assistant to Help Users in Sharing Content in Online Social Networks

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ABSTRACT

Currently available *Online Social Network* (OSN) solutions with which users can select the audience with whom they want to share online content have been shown to be inefficient in protecting their privacy. As a result, users may either censure themselves or post information about themselves that they may later regret. To address the shortcomings of existing solutions, we propose to rely on a privacy assistant that will help the users in their audience selection. Among the necessary steps for its design, we focus in this paper on the visible tip of the iceberg, i.e., the interface that will present the suggestion to the users. Our interface addresses our defined criteria and is dedicated to mobile devices. In this first design phase, we have implemented and evaluated our proposed solution with ten participants using *System Usability Scale* (SUS). We have reached a SUS score of 70.75 and found out that our proposed interface is usable and easy to understand. We finally discuss possible improvements and challenges for designing and evaluating such interfaces.

KEYWORDS

Social networks, privacy, user interface, mobile design

1 INTRODUCTION

Most of active *Online Social Networks* (OSN) users across the world access these platforms using their mobile devices [27, 28]. The leading social network worldwide, Facebook, for instance, is mainly accessed through mobile phones only [29]. With the increase of self-generated content online, users struggle to control how their own personal data are being shared with an audience as shown in several works [4, 36]. OSN so far provide different predefined and custom options to share the content with a certain audience. Facebook, for instance, provides an audience selector to choose a specific audience when generating content. Users can choose between predefined options to share their content or by defining a custom list of individuals. Although the latter one allows users to define their specific friend lists, that has to be set up manually by the end users. This, in turn, increases users' burden [20] and is rarely used [24]. Overall, users find OSN sharing solutions rather impracticable [9, 11, 15, 30]. Moreover, current OSN solutions do not correspond to users' sharing expectations [2, 3, 19]. Although several solutions have been proposed since a long time, the current state-of-the-art sharing solutions of OSN remain majorly unchanged.

Several works have investigated different *User Interfaces* (UI) for privacy assistants in OSN. Some of them investigate particularly audience selection based on social distance [13], or a combination of social categories with social distance between the users and their contact lists [22, 23], whereas some others [24, 25] propose a technical solution and a mobile UI based on content sensitivity and social tie categories. However, the usability of the latter has not been verified. In particular, a content to be shared can be appropriate for more than one social category. In such a case, showing all suggested contacts in a list view can be exhausting for the users to agree or dismiss the suggested contacts.

In this paper, we therefore propose the design and implementation of a UI for suggesting appropriate users' audience based on content sensitivity and the interpersonal relationships tailored to mobile devices. The evaluation of the content sensitivity is foreseen to rely on (on-device) deep learning techniques [14, 32, 33] and the users' social ties are foreseen to be build upon the analysis of mobile metadata already available on the phone, i.e, calls, SMS, MMS, and e-mails, as shown in Reinhardt et al. approach [25]. However, both are out of scope of this paper.

We further present the settings and results of our user study with ten participants to explore the usability of our proposed UI. Our SUS results indicate that our prototype UI is a promising solution that can be usable particularly without additional information beforehand and technical support. To this end, we show that social distance, social categories, and content sensitivity can be displayed into a usable mobile based solution.

Our paper is further structured as follows. We discuss related work in Sec. 2. We detail our approach in Sec. 3 and our evaluation in Sec. 4. We discuss our results and future steps in Sec. 5. Lastly, we conclude our work in Sec. 6.

2 RELATED WORK

Several works have proposed different UI that support users in their decisions about sharing content online. Such interfaces are based on different grouping types for controlling users' privacy. Jones et al. [12] found out that individuals construct audience groups based on six criteria, such as, social circles and cliques, as well as, social tie strength, among others. Social tie strength term was

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introduced by [8] and was based on the time duration, the emotional intensity, the intimacy and other factors that influence the strength of a social tie. Other approaches consider also social distance based interfaces [13, 23]. Social distance refers to the visualization of the tie strengths based on a distance ordering of users social contacts with respect to the end user.

Existing works base their interfaces on different sharing groups. Wang et al. [34, 35] proposed the so-called "privacy nudges" that informs users about the content being shared and the audience for a post. Particularly, in the former work [35], Wang et al. propose three privacy nudges. The first nudge shows five randomly selected profile pictures of persons that would see the post attached with a text that informs other possible larger groups (e.g, anyone on the internet). The second nudge proposes a decision time delay before a post is being shared. The third nudge informs users about the negative sentiment of a post being shared and in turn provides options to post, edit, or cancel a post within a short time span. The proposed solutions lead to a reduced amount of disclosed information. They base their results on system logs. However, such solution does not take into consideration that a certain post could be appropriate for certain categories (e.g., family members), and not for others.

Kauer et al. [13] proposed audience selection based on social distance between users. In a prior UI, friend list is proposed to be shown in a rectangle ordered by tie strength based on Xiang et al. approach [37]. A user can drag the slider accordingly from left to right to expand the disclosure of a post. However, while social distance is a valuable factor in audience selection decision, content sensitivity and social ties are also some other important factors that could enhance users' privacy. Moreover, the solution is not tailored to mobile devices.

Reinhardt et al. [24] propose a technical solution consisting of analysing social ties from metadata of calls, SMS, MMS, and emails, as well as, analysing of content sensitivity of a post being shared. Based on the above analysis, they propose a mobile UI which contains a sensitive scale bar and suggestions listed by their social ties categories with a user. Suggestion audience entries can be omitted by a user. In a similar line, Gonçalves et al. [7] propose another technique, named narrowcasting, along with a UI, that provides suggestions to share a post with certain users' friends demographic categories. However, both of these solutions have not been evaluated in terms of their usability. Moreover, in the interface proposed by Gonçalves et al. [7], users have to manually configure which of the demographic groups (i.e, age, current location, gender, relationships, relationship status) they prefer to use as a selection parameter. Based on that, when a post is being shared, sub-group categories of the selected demographic are shown. For instance, users would have to then manually decide on showing or hiding content from each of age sub-groups, e.g, 10-20 years old etc. This process can be particularly cumbersome for users.

Raber et at. [22, 23] propose the so-called radar UI which consist of selecting audience based on interpersonal distance of different social categories. Their solution is compared against the Facebook interface using the AttrakDiff questionnaire [10], which measures the pragmatic and hedonic quality of a solution. Their UI displays the profile picture of each OSN friend in their respective category distanced accordingly from the center of the UI. However, the first [23] solution could not show a large number of profile picture given a category. In the follow-up solution, they [22] introduced additional functionalities to reduce the limited space issue. They provide incremental picture sizes depending on the social distance with a user and zooming within a certain area of the UI. Their UI, however, is not dedicated to mobile based solutions and does not examine the visualization of content sensitivity alone and its possible link with suggested social categories. Moreover, we additionally use a list view grouped by social categories to display the suggested audience.

3 APPROACH

In this section, we first define our criteria derived from our designed space analysis, before we present the designed and implemented UI based on them. We consider the following five criteria for designing our first preliminary interface:

(1) **Sensitivity Scale Representation.** The UI should show the sensitivity of the content to be shared. The users, in turn, can base their decision on sensitivity alone, suggested audience, or both of them.
(2) **Simplified Audience Suggestion in the Main View.** The UI should show an overview of the suggested audience within the main interface. The audience could be displayed using audiences identifiers, such as, profile picture, their initials, other generic forms, etc.
(3) **Expanded Audience Suggestion.** Users could not necessarily know or remember the profile pictures or initials of their social contacts. Thus, additionally, the suggested audience should be displayed in full to allow verification.
(4) **Social Distance.** Users have different social tie strengths with their contacts [5, 6]. This may influence the sharing decisions [31]. Moreover, users prefer OSN access control interfaces that are build upon tie strength component [16]. Thus, social distance of user's social contacts based on social ties strength ordering is a necessary criterion to be taken into account.
(5) **Editing the Suggested Audience.** Sensitivity and interpersonal relationship predictions can be prone to incorrect outcomes especially during the learning phase of the assistant due, e.g., to the individual nature of privacy. Thus, users should have the chance to optionally edit the suggested audience.

In addition to these criteria of our design space analysis, the interface must be usable. This means that the solution should adhere to usability principles of Nielsen [18] and be overall satisfactory for users to interact. The solution should, among others, have a simple interface, be easy to use, be consistent and predictable.

Our designed and implemented Android based UI provides audience sharing selection based on content sensitivity, social ties, and social distance, as illustrated in Fig. 1. The main components of the UI are (1) illustration of content sensitivity rating, (2) visualization of selected audience, and (3) an option to edit the proposed audience.

Sensitivity Assessment and Rating. Sensitive rating is one of the main factors that may enhance the users privacy in OSN. The feasibility of accurate assessment of the sensitivity degree of images [32] and texts [14, 33] have been demonstrated by several works.

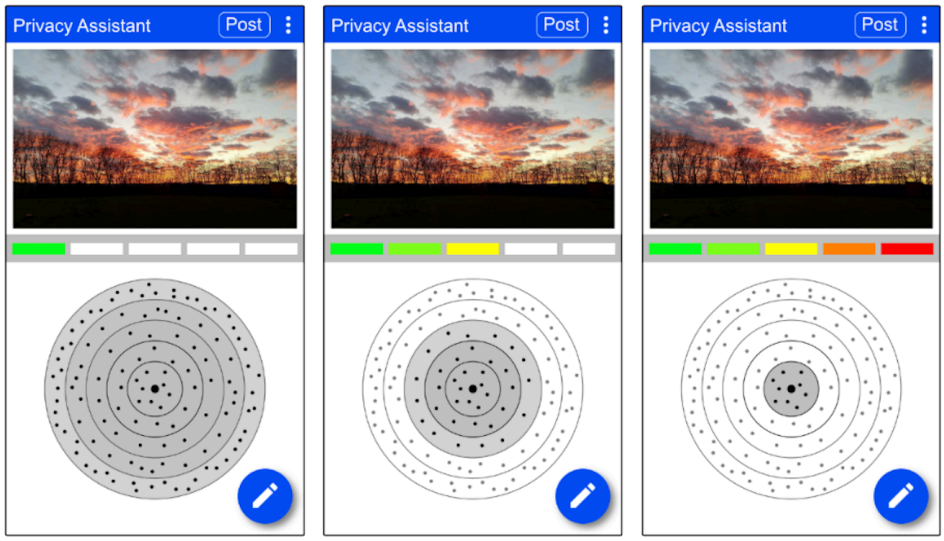

Figure 1: Our proposed solution provides audience sharing suggestions based on the sensitivity of content being shared.

Such solutions, however, have to be further investigated and be extended as on-device based sensitivity models to increase users' trust.

In our work, we explore how the results of such models would be visualized to users. We adopt a similar proposed color bar by Reinhardt et al. [24] in our UI. The sensitivity rating is designed as a bar of five elements to warn users about the likeliness of high content sensitivity. The bars are colored from green (i.e, safe to share rating from 1 to 2), to yellow and orange (i.e., slightly sensitive with a rating of 3 and 4) and red, respectively (i.e., very sensitive with a rating of 5). Sensitivity rating serves not only as a warning mechanisms but also as an influencing factor on which audience can be selected next.

Audience Selection. Users presumably share content depending on their social relationship ties. Our approach further visualize audience selection based on social tie groups and social distance. To assist users in selecting an appropriate targeted audience, Reinhardt et al. [24] proposed the integration of social ties into a UI.

We further aim to visualize the suggested audience based on social tie categories. Depending on the sensitivity level, a proper audience for a content being shared is proposed. We designed the audience selection suggestions as an onion ring. It consists of five rings, wherein each of them is associated to one of the contacts categories. Contact groups are arranged by their distancing order. The most centered rings would be dedicated to a closed category of contacts, i.e., family members. Coworkers and acquaintances would be placed in the two outer most rings, etc.

Editing proposed suggestions. Once content sensitivity and proposed audience are suggested, users can manually edit the proposed audience suggestions. This would not only serve as an editing option provided to users, but also it can be used as an additional information to personalize users' privacy preferences. Moreover, interpersonal relationships may change faster than a foreseen model can accordingly adjust to that change.

In our UI design, users can click on the floating button on the bottom right of the screen (Fig. 1). In turn, a list of all currently selected contacts are shown in Fig. 2. Users can then remove a category by tapping on the specific shown categories or they can remove individual contacts within those groups by tapping on the corresponding minus sign. Additionally, the same can be done for adding another category or contact.

4 USER INTERFACE EVALUATION

4.1 Method

Our proposed prototype UI was further evaluated in a user study that was approved by the Data Protection Officer of our institution. The user study was conducted on LimeSurvey. The planned duration of the study was 15 minutes. The user interface with all of its functionalities was presented in a static flow diagram form (as shown in Fig. 2) to ten participants, which in turn had to evaluate it according to SUS questions. SUS has been already used in evaluation of interfaces [21] based on static prototypes. Since all participants are native German speakers, we used a translated version of SUS generated from a group of SAP usability professionals [26].

To ensure that the translated questions had the intended meaning, the chosen German versions of the questions were independently reverse translated into English by both US and British native speakers [26].

Demographics. In addition to SUS scale, we asked participants about their age, education background, and gender. The participants were recruited among students and acquaintances. Their age span range from 19 to 82 years with the mean of 39. Four participants were between 18-24 years, two from 25-34, three from 55-65 and one was above 65 years old. The cohort consists of a wide variety in level of education from high school graduates to PhD graduates. Four of them were high school graduates, two others had finished their apprenticeships, and three of them had university degree,

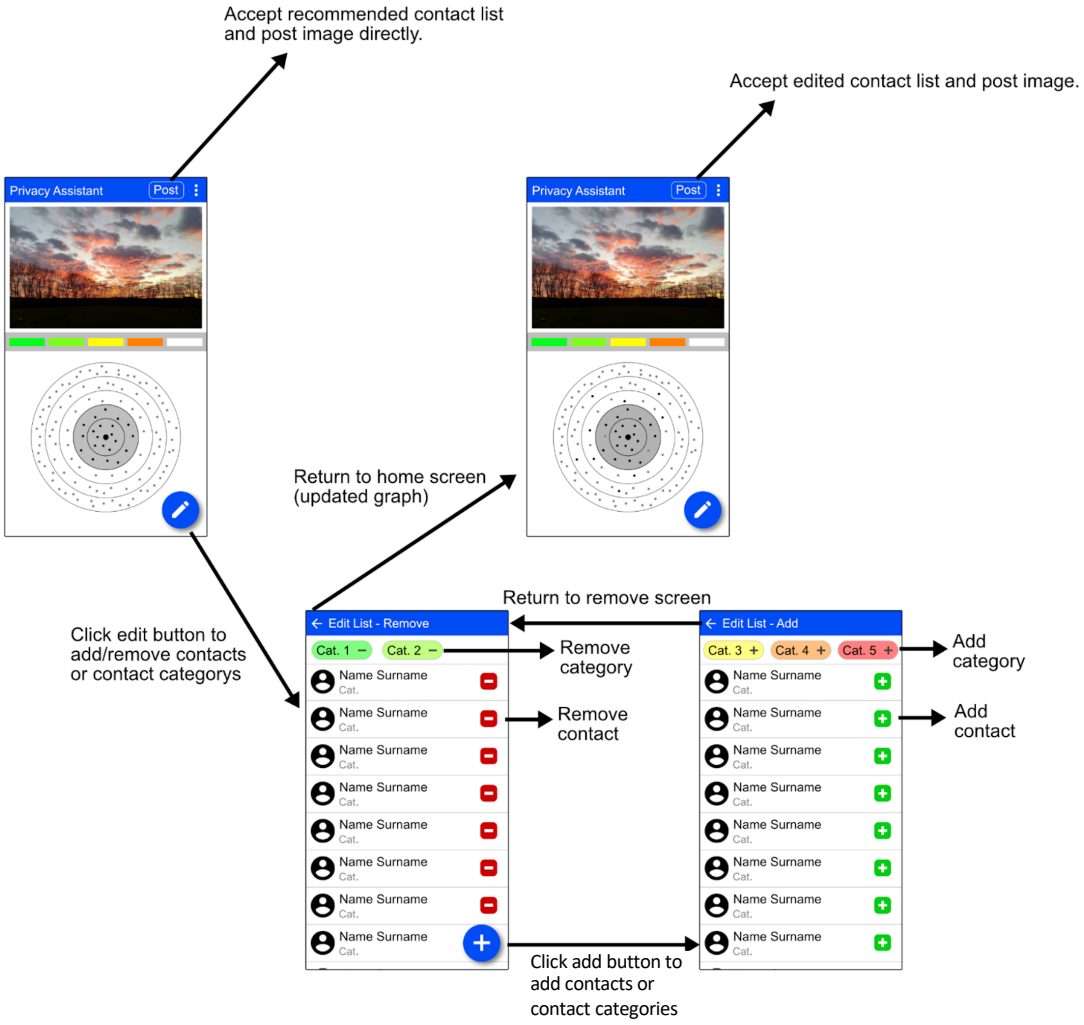

Figure 2: Presented flow diagram to the participants with the editing option of the proposed suggestions. Optional editing process of our proposed UI. Users can add or remove a category (see Ⓐ and Ⓒ) or a contact (see Ⓑ and Ⓓ) from our prior suggestions.

one of which had a doctoral degree. The participants were evenly distributed between male and female genders.

Results. The interface reached a total SUS of 70.75 (of a total of 100) which lies in the margins of about a good score [1]. Based on averaged results of all the users question-wise, our UI performed particularly good in the forth question, i.e., the users found that they would not need support from a technical person to use the system. This is further backed up by the tenth question, i.e, users do not need to learn many things before they could use the interface. We reached however particularly a rather lower score on the first question, i.e., users think that they would not use the system that frequently. This can be attributed to the fact that users' social media usage vary between users. Some of them may not share content online frequently, and as a consequence, use the interface not often.

5 DISCUSSION

Limitations. We evaluated our proposed UI with ten participants. The UI was rated high in terms of being easily adaptable from the users. While the obtained results allow us to gain preliminary insights about the usability of our approach, additional efforts are necessary. Our study, however, remains limited. The study was conducted using an online survey using a static format. Moreover, we did not directly compare any of the current OSN UI with our proposed approach. Furthermore, the correlation between the acceptance of our designed interface and the participants' privacy concerns can be a promising direction that was however not investigated. Lastly, the user study results may be biased towards a more positive feedback, since we recruited also acquaintances.

Future Work. To further evaluate the usability of our proposed interface, we plan to evaluate it with (1) more users, (2) in more details, and (3) compare it with other alternatives. Moreover, we

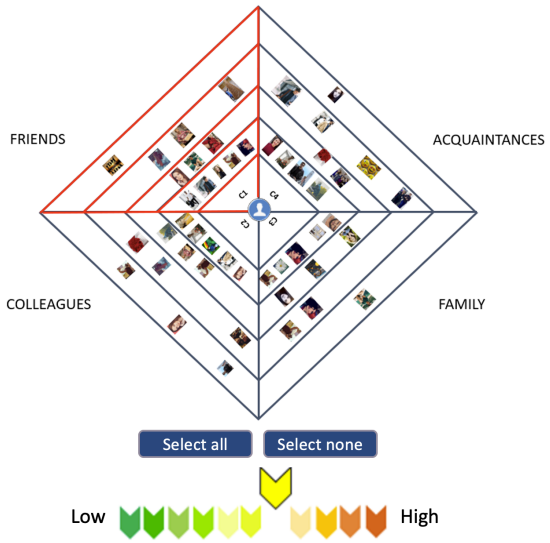

Figure 3: The main interface of an additional designed UI.

also aim to integrate our approach with the models for content sensitivity prediction and social ties. Lastly, for all of the interfaces, we plan to introduce a double coding of content sensitivity degree.

In addition to our proposed UI, we are considering other interfaces for evaluation. In Fig. 3, we show, for instance, the main part of an additional interface we are currently working on. Depending on the content sensitivity being shared, (1) specific layers within a category, (2) a category or (3) more of them can be proposed. The selection is displayed with a red bordering. The layers represent the social distance of the audience from the user. C1, C2, C3, and C4 contains contacts of the respective categories that are closest to the user. They are accessible by tapping within the triangle, where in turn, the list of closest friends is shown. The second layers would display the next most interacted users up to the last layer with the least interacted users. Users can choose between adding or removing layers of contacts by tapping directly two times in a layer. They can also edit the categories, layers of categories, and individual contacts, same as the prior editing process shown in Fig. 2.

We are particularly working on designing and evaluating additional new interfaces. Moreover, we plan to include questions about social media usage, privacy concerns using *Internet Users' Information Privacy Concerns* (IUIPC) scale [17], and other questions in the survey questionnaire. Lastly, we plan to compare different solutions against each other and the prototype proposed by Reinhardt et al. in a user study [24].

6 CONCLUSION

In this paper, we propose a mobile-based UI with the aim to be further fully developed into a single personalised sensitivity-aware solution. The proposed UI of our privacy assistant is based on the identified criteria for sharing content in OSN. Our ultimate goal is to provide a user-friendly solution and to increase users' privacy protection when sharing content online. While our study was exploratory, our introduced prototype UI achieved a SUS of 70.75, in a user study with ten participants, and can be considered as a promising direction in designing privacy assistants for providing automatic sharing decisions to the users. As a future step, we are exploring the design and extensive evaluation of other user interfaces that satisfy our specified criteria, i.e., content sensitivity visualization, a simplified and extended suggestion of the audience to share the content with, their social distance with the user, and an option to edit the proposed audience.

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