Evaluating potentials of Internet- and Web-based SocialTV in the light of privacy

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Abstract—In the current information technology age, the demand of tools that meet social interaction needs, e.g. SocialTV and Internet-based media advertisement, is gaining in importance. Thus privacy becomes a matter of concern in this respect. Social interactions comprises privacy risks and threats that may enable abuse, e.g., man-in-the-middle attacks based on profile analysis at the server-side. Since in the area of SocialTV current software as well as hardware solutions are mostly server-centric, one cannot fully eliminate accidental or intentional risks and threats even by the reconstruction of users’ personal information and their interdependencies. In this paper, we report on results of an evaluation of the potentials of SocialTV by considering end-users’ privacy based on lab and field trials. In these trials we enabled eighteen people of various ages and expertise to use centralized as well as decentralized (group-centric) solutions for SocialTV by means of a Web-based software prototype. Further, we describe the followed methodology used by the evaluation in order to allow porting it for future evaluations in other social contexts.

Index Terms—SocialTV; Privacy; CSCW; Group-centric settings; Decentralized solutions;

I. INTRODUCTION

The Internet is now accepted as the de facto information support system in many important areas of our professional as well as leisure life activities. Considering the development of social and collaborative tools and software, one can notice a shift taking place from single-user-centered usage and approaches to tools and applications that support multi-user requirements. Considering the media consumption, e.g., movies, music etc., the World Wide Web (Web) is playing the predominant important role as a distribution platform to share end-user experiences including those related to TV events such as Google’s YouTube etc. Ethnographic research has shown that people enjoy TV watching as a part of socializing with friends and family when co-located or geographically-distributed; thus SocialTV is considered as a social experience [1]. Many TV service providers recognized the importance of social activities around their television programs, moved them onto the Web, and equipped their TV offers with a social component. Hayes cites in [2] that the BBC viewers contributions and comments, for instance via email and newspapers, grow from approx. 1 million contributions per year in 1990 up to millions of contributions per day in the last years. He also cites that ABC Social, an ABC channel rubric, allows to interested people for adding comments to any ABC series episode and that 6 million Web-enabled TVs were sold in this year which represents 15 percent of sales in the U.S. market where 70 percent are predicted for 2014. Indeed, Google recently announced GoogleTV [3], a Web-oriented embedded solution in cooperation with Sony and Logitech with explicit focus on social network integration.

The integration of social activities concern either synchronous real-time interaction schemes or those of asynchronous nature. An example for synchronous real-time interaction is chatting with friends or family while watching TV. Conversely, asynchronous interactions are mostly represented e.g. via comments in forums. Both interaction forms are generally supported through cooperative and social software components enabling functionalities, such as those known from wikis, RSS feeds, or blogs and integrated in different ways in Internet and Web based TV solutions. In our opinion current approaches in the SocialTV area do not adequately consider privacy as non-functional requirement (NFR) from the beginning in the design of respective solutions. In general, even when privacy is considered early, it is mostly contemplated separately from other NFRs (i.e. privacy vs. usability or awareness conflicts with privacy in multi-user systems). With increasing awareness of users about the misuse of their data, the success of existing and further emerging cooperative and social services in the future will largely depend on the consideration of privacy.

Due to the lucrative nature of Internet entertainment generally and Web entertainment especially [4], Internet and Web-based SocialTV demand more attention on privacy in order to avoid potential breakdowns and to guarantee the success of solutions being developed. Further, research and privacy-
respecting approaches are needed primarily because current approaches and solutions do not fully eliminate accidental or intentional risks and threats. Hence, the focus of this paper is put on evaluating privacy-preserving approaches for Internet-based SocialTV. SocialTV implies many new opportunities concerning human-computer interaction (HCI), and the advantages that go along with it, for both users and TV provider. To verify our approach, we extended the Web-based cooperative system CURE [5] with TV and video content diffusion capabilities. The user benefits by interacting with other users during a TV program, for instance via group chat and private instant messaging. Further users may have the opportunity to asynchronously comment e.g. episodes and leave recommendations for others. In order to avoid data misuse and to raise trust, we enabled the users to use the Web-based prototype in centralized as well as decentralized settings developed in [6].

The remainder of this paper is structured as follows. The next section discusses related work while section 3 addresses the phase of gathering requirements. Section 4 presents our approach and demonstrates its feasibility by means of first results. The paper is concluded in section 5.

II. RELATED WORK

A. Privacy in Social Interaction Settings

In social settings, the partial or sometimes even complete disclosure of the member’s personal information and identity is required. For instance, in the case of social networks such as LinkedIn or Xing, end-users have not only to reveal their real identity but also some private and sensitive information on their profiles (e.g. telephone numbers, private addresses and professional references etc.) in order to profit from job offers or get some recommendation letters [7]. As a consequence users lost the control over their private data and maybe personalized interaction traces they are unaware of. In respect to television content consumption, Apple’s iTunes software or its TV Set Box called AppleTV represents another example. Customers have to enter sensible data (valid credit card number at least) in order to be able to access their services. Social media software provide communication, cooperation, collaboration, and awareness functionalities that assemble the main cornerstones for social interaction as standalone software or also as embedded solutions. These solutions are considered as socio-technical systems in the CSCW as well as HCI research fields [8][9]. While HCI is generally concerned with studying interaction between humans and machines (e.g. user interaction and user interface design), CSCW is focused on exploring the effect of introducing technology support from either the organizational and social as well as technological perspectives primarily for effective collaboration and communication. SocialTV solutions integrate personal media content with rich communication and community support [10]. In general, any kind of software and/or hardware supporting these kinds of functionalities represents a classical research topic in CSCW for decades. The interesting point is that CSCW and the emerging SocialTV research share many common concerns especially those related to privacy issues when referring to the usage of functionalities with social nature. Baillie et al. [11] confirm that privacy and a lack of usage contexts in both remote joint watching and collocated watching environments are considered as potential sources of refusing the usage of SocialTV by users. While awareness mechanisms help by resolving the usage context problem, a tension arises related to privacy in this respect. Indeed, Hess states in [12] that users negatively rated awareness functionality due to privacy aspects. As many previous CSCW key literature, he confirms that awareness data is very sensitive concerning privacy. Boyle et al. provide a detailed analysis of privacy-related literature for cooperative environments considering different perspectives (such as the CSCW perspective) [13]. Boyle and Greenberg [14] show that there are privacy and awareness trade-offs. In general two problems are associated with providing awareness: (1) privacy violations and (2) user disruption. Concerning the first point, Bellotti and Sellen argue that rational people respect the privacy of others, but accidental violations happen, and (2) poor design of the environment can result in privacy violations [15]. Thus, we argue that we could leverage findings in the CSCW research field related to privacy issues for improving potentials of SocialTV solutions. Researchers in CSCW generally assume that privacy issues arise due to the way in which systems are designed, implemented, and deployed [13].

B. Contemporary SocialTV Research and Solutions

The current research in the area of SocialTV is focused on studying the design and the integration of social interaction based on ethnographical experimental studies (e.g. [10][1][11][12][16]). In the area of Internet and Web based SocialTV, there many interesting approaches exist such as AmigoTV [10], Boxee [17] and Joost [18]. While AmigoTV provides users with the opportunity to have a real-time communication with their friends, Boxee is a social media center that allows for combining Internet and TV broadcast on the TV. Joost provides a way to watch video, music, TV, and other media content over the Internet where the social aspects are limited on some program recommendation via friends.

The current solutions regardless whether they are hardware- or software-based are mostly server-centric solutions. In fact, a server-centric approach in the field of collaboration and social media implies by default a potential lack of privacy because all possible personal and identifiable data are communicated via a single point which belongs to the service provider and thus we have a conflict of interest. A server-centric approach means further that the service provider has control over the (configuration of) hardware, software, and interaction as well as communication data. Even if the service provider declares that any data handling will consider privacy regulation, the users might lose the overview over their data. Thus the users have to trust the service provider. To the best of our knowledge there is still a huge demand on work handling privacy in collaborative and social media environments. Most of the work we found in


III. PROBLEM AND REQUIREMENTS ANALYSIS

The problem addressed in this paper was initially motivated by researcher of the Media Sciences Department of the University of Siegen. In order to address privacy in SocialTV settings, an inter-disciplinary cooperation among various institutes was initiated, namely, the Chair for IT Security and the Media Sciences Department at the University of Siegen. In addition, a Web based prototype developed at the FernUniversität in Hagen was extended to provide a common framework for a SocialTV prototype with basic collaboration and social interaction functionalities. The used collaborative system is called CURE (Collaborative Universal Remote Education). CURE is used for different scenarios in collaborative work and learning which made it a perfect starting point to validate our approach. The full presentation of the results of our activities goes beyond the scope of this paper. Instead of this, we cite the main requirements which were identified and meet the focus of our approach in this paper.

A. Literature Based Requirements Analysis

The requirements motivating this work from the point of view of Media Sciences is based on media Studies. Media studies have stated quite early that mass media can enhance social relationships and enable social contacts. Television for example has always been a popular topic for social interaction and light chatter. "TV and other mass media, rarely mentioned as vital forces in the construction or maintenance of interpersonal relations, can now be seen to play central roles in the methods which families and other social units employ to interact normatively" [1]. However such interactions so far always required a change of the medium, like a switch to the personal computer or a reach to the telephone. Due to the increasing convergence of different media devices, such a change, which is seen as a break in media studies, is no longer necessary. Based on the technique of Internet enabled TV sets, future users will be able watch video content of the current TV program, while chatting with their friends on the same screen and with the same device. Following Coppens in [10], such a communicative situation consists of three decisive components: (1) Personal Content, (2) Rich communication, and (3) Community support. Especially the community support gains more and more importance. There are already several fan-communities on the Internet, which deal with special TV content, like individual shows or TV series. These can be supported with the technique of a socialTV application, so that there may evolve even more "communities of choice". Such a collective media usage may form its own "organizational neighborhood", connected on the common-interest side via TV program and on the technical side via a socialTV application.

Based on the theoretical literature, which mainly comes from the field of media studies and centers around the topics of television studies and media usage evaluation, certain requirements can be derived for the case of the socialTV applications. Such requirements can for example be deduced from the lean-back-situation, which is normally associated with the TV usage. Here an easy handling of the application is essential, so as not to disturb the most important function of TV usage, the relaxation. Further on, such a socialTV application should meet the concerns of the special communicative situation. These affect on the one hand the option to communicate in short pieces and utterances during the TV program and on the other hand more differentiated statements during commercial breaks or after the program is over. From this, the integration of synchronous as well as asynchronous means of communication is justified. These and other, similar requirements should be evaluated in a series of practical lab and field tests, to see whether they can be confirmed.

B. Advanced IT Security and Social Interaction Oriented Requirements Analysis

In addition to gathered requirements at the Media Sciences Department, an initial phase of requirements gathering was started at the Chair for IT Security primarily with focus on privacy in social interaction settings related to SocialTV needs. General requirements and privacy needs for users participating in SocialTV scenarios where identified by analyzing existing online implementations [18] [20], Set Top Box solutions [21] [17], and multiple scientific approaches [10], [1], [11], [12][16]. Further, concrete requirements were gathered through scenario based interviews with fourteen people of the department of both institutes. Three main requirements categories that were identified are: (1) Support for synchronous (i.e. watching live streams) as well as asynchronous (i.e. forums) SocialTV interaction of the users (co-located and geography distributed) with needed group and activity awareness (R1), (2) Integrated environment instead of using different windows or devices for the different components (media content, social interaction, etc.) (R2), and (3) Privacy-respecting social interaction (R3). For meeting these requirements, we extended the CURE system to fulfill the R1-R3. Figures 1 and 2 how we supported R1 in an integrated environment so also fulfilling R2. With respect to R3, Bourimi et al. [6] presented a decentralized group-centric approach by using CURE which empowers the users to host the environmental system needed for collaborative working and social interaction,
instead of a central hosting of these components. The users are responsible for hosting the data. Intra-group Communication and data sharing among different groups remain possible through e.g. a main platform of the same system. Thus, users have the possibility to choose between centralized and decentralized settings. Latter allow for complete control over their data.

Figure 3 shows the major components of the system architecture. By using Elgato’s HTTP Streaming Server [22], we were able to broadcast live streams as well as recorded media content. For this, we embedded streams in the pages of our system, which is based on the retrofitted CURE used in [6]. The detailed architecture of the prototype’s node and its anatomy can be found in [5].

IV. APPROACH

Our approach consists of the provision of the Web based prototype as high-fidelity mean and evaluating potentials of SocialTV scenarios with the help of this prototype by conducting lab and field tests. Since the provided prototype allows for centralized as well as decentralized topologies, the end-users are able to be submitted to different evaluations and to choose themselves the adequate solution for their needs. In the following we describe the settings and experiments and the followed methodology by the evaluation.

A. SETTING AND EXPERIMENTS

The experimental phase was conducted in a qualitative way. It did not aim at gaining representative research results, but at revealing individual potential usage patterns and attitudes towards issues of data security, privacy and usability. Therefore the requirements derived do not claim to be complete. For the lab tests and the field tests 18 participants were recruited in total, with nine participants attending in each phase. The testees were taken from the age group of twens, being between 20 and 33 years. This group was chosen since studies have shown, that this age class already uses the computer and the

The resulting Web based prototype provided a kind of high-fidelity prototype for further requirements gathering. However, a need for a requirements refinement was identified. For this, we restricted the problem domain based on focusing on the privacy needs of the end-users at first term. SocialTV in general consists of two main components. First is the television component where TV program is allocated by a TV provider. The television component may be split up in other parties like content provider, third party content producer and others. In our scenario we concentrated first only on the user and the TV provider. The second main component of social television is the socializing part. This means that users can interact while watching the TV stream. The interaction comprises mainly the activities group chat, instant messages and receiving recommendations on the program. The TV consumption metadata combined with data from a personal profile provides a deep insight into user private sphere. From the privacy point of view, this is unacceptable because data can be gathered without having the user permits.

In actual fact, the user wants to interact with others without having the fear that somebody tries to gather his watching or social interaction behaviors data in order to link them to his personal profile. If the SocialTV application is offered by one company the user has no option than to trust this company or have no service. The problem in such kind of application is that users cannot retrace if the application is secure in means of not divulging sensitive data. Two usage scenarios of SocialTV are possible. On the one hand the user may employ the SocialTV application without entering the fewer amounts of personal data that are required; in this case the user leaves the full potential of SocialTV out. The other scenario where the user trusts the provider of the application and thus the user can fully utilize social television. In order to permute the latter the requirements on privacy are that users can trust the infrastructure provider and that personal data which can be abused by an attacker should be protected or avoided to accumulate.
internet especially as an "all-in-one-medium", which signals a positive attitude towards processes of media convergence and might hint at a special interest in such processes, which might be conferred from the computer to the TV set. Further entry conditions for the participants, who were all recruited by personal address, were (1) Usage of a TV set, as well as an Internet-enabled computer or laptop, (2) General interest in TV program and content, (3) Basic knowledge about online communities and membership in at least one common community (e.g. Facebook, StudiVZ or Xing), and (4) Basic knowledge about instant messaging (IM) services and user experiences with such applications.

Though homogeneity between the participants of the lab tests and the ones of the field test was required in those points, one main difference was desired and achieved: All participants of the lab test phase were students and had already had contact with the concept of SocialTV during their studies, while among the participants of the field tests were students and employed persons, who never had heard about the concept of SocialTV before. Therefore the participants of the lab test phase were able to insert some of their experiences and opinions, while the field test participants needed a more detailed introduction but were unbiased towards the application concept. Both the lab test episode and the field test episode consisted of four phases in total and took about 45 minutes each. In phase 1 the participants were asked to complete the pretest questionnaire to detect general experiences and attitudes towards TV and Internet consumption as well as on the topics of data security and privacy. Phase 2 contained the actual test with the CURE-based prototype of a SocialTV application as it is described above. The participants were asked to familiarize with the prototype for several minutes and then accomplish a set of tasks, such as to write and publish a short post, to perform a synchronous chat communication or to alter their own testing profile. In the beginning the participants were asked to perform these tasks self-reliantly, however they were assisted by the test-conductor, so as to avoid a dead end. This phase was documented with the Silverback usability testing software, which records the screen movements as well as it creates video and audio footage of each participant. The combination of audio and video material enables a complete overview over the participants’ way of approaching the prototype. To round off the testing phase, each participant took part in a semi-structured interview in phase 3, where he or she was asked about his or her experiences in dealing with the prototype and about details on the possibility of using such an application at home. Phase 4 contained one last questionnaire about the usability of the prototype and some more items about the issues of data security and privacy. This questionnaire was based on the PET-USES questionnaire, which was designed by Wolkerstorfer et al. [23] in order to evaluate the software’s (in this case the prototype’s) general usability and the extent to which the software assists the user in learning and understanding privacy related issues. For the present prototype parts of the PET-USES questionnaire were emphasized, while others were considered to be not important for the research situation. The ones reckoned most important were the issues ease of learning and user value from the usability part and the issues of data management, credential management, privacy preferences, recipient evaluation, data release and history for the part of data security and privacy.

B. Results and Discussion

In this subsection we present our results in form of graphical representations (s. Figure 4) and short analysis with respect to the testers (their experiences by using social networks and therefore their ability to formulate requirements and to evaluate proposed solutions from the privacy as well as usability perspectives etc.) are discussed. All of the lab test participants stated to have access to a TV set and an Internet connection at home. The average duration of TV usage amounts to about one hour a day, with news, documentaries, movies and TV series being the most watched content and entertainment, information and relaxation being the main motivation. All 18 participants are subscribed members in at least one online community; 16 of them also use an IM service. Important motivations here are also a need for entertainment and the social potentials of these applications, such as the support to stay in touch with friends. In connection with such applications all participants rated the issues of data security and privacy as being important to them and stated that a violation rising into prominence could lead to their exit of an application. However only very few of the participants check the data security rules of their communities regularly and accurately. At this point a gap between the participants’ sensation of the importance of privacy and their actual measurements and actions is clearly visible. It can be expected, that this might transfer to a SocialTV application, once it is domesticated and integrated into everyday life.

In general the participants of the lab tests shared a common interest in an application similar to the tested prototype, with about two thirds of them stating that they could imagine using it regularly. Here it is interesting to observe that those
participants, which are in general more active in online communities and with IM services have a greater interest in using a SocialTV application, and that the interest in a SocialTV application was less high with the participants of the field tests, who had not heard about such a concept yet. Some of the participants stated in the interview that they are already chatting a lot while watching TV by using their laptop. And in evaluating the benefit from such a application there was a general agreement among the participants that they prefer the synchronous means of communication against the asynchronous ones. However the benefit from the convergence process and the missing media break was not perceived by all the field test participants as that great that they would prefer SocialTV to classic instant messaging or the telephone. Therefore they would not accept data disclosure in such a situation. However many of the participants are willing to reveal a certain amount of their personal data in exchange for the benefit that the system could bring to them. Restricting, that these information, that they might reveal, are very limited and only part of the online identity of the participants. This means that they readily share their e-mail address in exchange for a certain convenience, but they would not pass on their telephone number or address. Despite the advantages in terms of data security of a decentralized system, most of the participants would prefer using a central SocialTV platform. One reason for this is the fear of the possible complexity, that might come with a decentralized system, since the participants might be in the position of hosting it themselves. Another one is the limitation of connection between different peer-groups, that might arise with a decentralize system and that is estimated to be a serious problem for most of the test participants. There was a strong agreement that in terms of convenience trade-offs with data security are an adequate counter value. Another important issue for all the participants is the optionality and individuality of the SocialTV application. Central for all participants was, that there is always the option to “just” watch TV and to keep up the relaxed lean-back situation. This is also very important for the awareness-function. Further on, all the participants insisted on the importance of detailed and individual privacy settings, which are under their personal control. In detail, the visibility and accessibility of their data towards third persons and the setting of the awareness-function was mentioned quite often. A transfer of trust from the TV set as a technical device to the Internet based functionality of the SocialTV application could not be observed. This might be returned to the fact, that all participants were accustomed to online communities and instant messaging and were therefore able to confer the risks connected to them.

V. CONCLUSION

In this paper, we reported on a methodology for evaluating the potentials of SocialTV with the focus on privacy as NFR from the beginning. The requirements gathering was based on a multi-disciplinary cooperation of the Media Sciences Department and the Chair for IT Security at the University of Siegen. A Web-based prototype allowing for different forms of collaboration and social interaction related to different SocialTV scenarios was developed and used as high-fidelity prototype for evaluating the scenarios and gathering new requirements. The prototype allowed for centralized as well as decentralized settings. First results show that such an approach is suitable especially because end-users’ reactions concerning privacy were different according to the expected potential benefit in a given setting. Further iterations with larger communities could lead to interesting findings.

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