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Privacy dimensions in design of smart home systems for elderly people

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ABSTRACT

Predominant research on privacy in smart homes reduces privacy to the protection of personal data. Recent research about Smart Home Systems in elderly care argues that this narrow conceptualization of privacy may be insufficient to safeguard privacy of an elderly person living in such environment. Privacy requirements for Smart Home Systems in Elderly Care (SHSEC) are usually decided based on legal regulations without considering elderly peoples' specific needs. This paper investigates what values elderly people emphasize in relation to privacy in this context. To be able to study privacy beyond data protection we use the broad definition of privacy provided by Clarke (2006). Following this definition, the concept of privacy can be studied by four dimensions: privacy of the person, privacy of personal behavior, privacy of personal communications and privacy of personal data. The empirical data was collected through qualitative semi-structured interviews with elderly people, who participated in an interactive demonstration of a SHSEC. Our findings indicate that privacy in the context of SHSEC is a broader concept than the protection of personal data and therefore there is a need for a broader conceptualization of privacy concept in this context. Based on our empirical findings we can also conclude that understanding elderly's values in relation to privacy is important in order to ensure their privacy in this context. Finally we found that elderly people are willing and are capable to discuss and express privacy-related requirements in relation to SHS technology that make them an untapped resource in design of privacy solutions in the context of SHSEC.

Keywords: privacy, smart systems, elderly care, aging in place, dimensions of privacy

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INTRODUCTION

Smart home technologies are often seen as a solution for health care and elderly care in countries whose populations are rapidly aging (Bowes et al. 2012). However, the extensive monitoring, that is necessary to be able to ensure the safety of the elderly person living independently in the smart home environment and give caregivers the opportunity to quickly react in case of emergency, raises many new privacy issues (Kosta et al. 2010; Remmers 2010; Zwijsen et al. 2011). Various scholars (Cavoukian et al. 2010; Nordgren 2013) argue that it is important to address the privacy concerns before such technologies can be successfully used in elderly care.

Privacy requirements for Smart Home Systems in Elderly Care (SHSEC) are usually based on international standards and legal regulations while elderly peoples' concerns regarding privacy are not adequately investigated (Kolkowska 2015). Also, predominant research regarding privacy in SHSEC addresses privacy in a narrow sense of data protection (Camp and Connelly 2007) and perceives it as a security issue that should be taken care of by the system designers and solved by technical solutions (Shankar 2010). However the literature argues that technical solutions alone cannot solve the complex privacy challenges in this context (Zwijsen et al. 2011) and the narrow view of privacy is insufficient to be able to safeguard privacy of an elderly person living in a smart home environment (Shankar et al. 2012). Hence, the aim of this paper is to investigate what values the elderly people emphasize as important in relation to privacy in this context. To be able to study privacy beyond data protection, we will use the broad definition of privacy found in Clarke (2006): "privacy is about the integrity of the individual". Based on this definition, Clarke (2006) identified four dimensions of privacy, which are used in this paper as an analytical lens to identify elderly peoples' values regarding privacy in the context of SHSEC.

PRIVACY IN DESIGN OF SHSEC

A common misconception about privacy, which is prevailing among many IT specialists, is that the privacy is guaranteed when the access to privacy-sensitive information is restricted to only authorized people and consequently only these concepts are considered in design of SHSEC. A problem highlighted in the literature is that the elderly are often not involved in the development of SHSEC and for that reason their requirements (even privacy requirements) are generally not considered (Shankar et al. 2012). Instead, the development is driven by system designers and technicians who think they know what the elderly want and need (Frennert et al. 2013; Frennert and Östlund 2014; Shankar 2010). Most of today's development projects are technically oriented with focus on functionality and effectiveness of smart home technologies that sometimes ignore ethical concerns (such as privacy) that come as a result of these technologies embedded on the elderly's life (Bowes et al. 2012; Frennert and Östlund 2014; Zwijsen et al. 2011). Thus, various scholars (Camp and Connelly 2007; Frennert et al. 2013; Shankar 2010) argue that it is important to involve the elderly in the development of SHSEC in order to satisfy their different requirements generally and privacy requirements particularly. Camp and Connelly (2007) suggest, for instance, that Participatory Design and Value Sensitive Design should be able to consider privacy issues in the design process and to enable eliciting the elderly's preferences regarding privacy. Although these methods have successfully been used in the design of information systems (Friedman et al. 2003) for the identification of users' preferences and needs they may be insufficient for eliciting the elderly's privacy preferences in the context of SHSEC. Shankar (2010) argues that the usage of Values Sensitive Design or Participatory Design requires a full understanding of the privacy concept in the context of smart technologies in elderly care and this is, unfortunately, not the case. The elderly often have inappropriate and insufficient

understanding of the used technology, resulting in their limited capabilities to express privacy-related requirements in relation to this technology (Bowes et al. 2012).

An additional problem highlighted in the literature is that privacy in the context of SHSEC is often presented as a value competing with other values such as autonomy or safety (Nordgren 2013; Sponselee et al. 2008). When the elderly are forced to choose between these conflicting values they usually choose safety and autonomy before privacy even if privacy is deemed important. In this study, we want to understand what values the elderly people perceive as important in relation to privacy in the context of SHSEC. To be able to study privacy beyond data protection we use the broad definition of privacy provided by Clarke (2006). Following this definition, the concept of privacy can be studied by four dimensions: 1) *Privacy of the person* is referred to as "bodily privacy" and it is concerned with the integrity of the individual's body. Issues that are associated with this dimension include compulsory immunization, obligatory treatments (such as sterilization), blood transfusion without consent and requirements for submission to biometric measurement. 2) *Privacy of personal behavior* relates to sensitive matters, such as sexual preferences and habits, political activities and religious practices. The notion of "private space" is also related to this dimension and means that the individual should not be monitored in private places such as home. 3) *Privacy of personal communications* means that individuals should be able to communicate with each other, using various media, without the communications being routinely monitored by other people or organizations. 4) *Privacy of Personal Data* means that individuals should be able to claim the data about themselves, which should not be automatically made available to other individuals and/or organizations. Moreover, in the case where another party possesses such data, the individual must be able to exercise a substantial degree of control over that data and its use.

RESEARH METHOD

We chose an interpretative (Walsham 1993) approach for this study because the main focus in this research is to increase the understanding of elderly peoples' values in relation to privacy in the context of SHSEC i.e. to understand what privacy-related concerns they perceive and what aspects they highlight as important to address. Since it is argued in the literature (see section 2) that the elderly often do not have the necessary (technical) background to formulate the appropriate privacy requirements, we wanted to increase our participants' understanding of the SHSEC used as an example in this study. For that reason we invited all participants to an interactive demonstration of the SHSEC in a realistic setting. Our aim was to visualize functionality and usability of the system using audio and video presentations based on scenarios. During the demonstration the participants had a possibility to interact with the system and ask questions.

The SHSEC demonstrated in this study

The GiraffPlus system support independent living and is a complex system of sensors and a telepresence robot, named Giraff, which are used for monitoring and communication (see www.girafplus.eu). To be able to ensure safety of the elderly person living at home, the GiraffPlus system supports four types of monitoring: 1) Physiology monitoring: includes all services devoted to assess bodily functions, physiological parameters and vital sign monitoring; 2) Social interaction monitoring: includes all services that can contribute to facilitating social interaction with the elderly or communication between the elderly's and their caregivers; 3) Activity monitoring: includes all the services that can be used to monitor changes in the elderly's daily routines and in general facts or events that relate to them; 4) Home monitoring: includes all services devoted to monitoring environmental factors such as when the door is left open, whether the light is switched on in the home, the occurrence of gas leaks, etc. The collected data is interpreted by the GiraffPlus or can be analyzed by healthcare

professionals or other caregivers. Unwanted events or behaviors can trigger alerts or reminders to the healthcare provider or other caregivers who can then either virtually visit the elderly person via the Giraff robot or can take other relevant actions.

Data collection and analysis

Data was collected through semi-structured individual interviews (9 elderly people) and, focus group interviews (2 focus groups with elderly people (15 persons in each group)). Each group of respondents was invited to the research and innovation apartment and participated in an interactive demonstration, as described earlier in this section. All comments and concerns regarding privacy that were raised by the participants during the demonstration were noted. The semi-structured interviews were conducted with individuals and groups approximately two weeks after the demonstrations. The interviews consisted of two parts. In the first part, the informant was asked to describe his/her expectations, feelings, about the technology's (GiraffPlus) role in elderly care, whether they saw any benefits and/or problems related to privacy and use of such techniques. The second part of the interview focused on the respondent's opinions on privacy in relation to the four areas of monitoring presented in the earlier section. During this part of all interviews, scenarios were used as an aid to steer the communication. Each interview lasted approximately one hour. All interviews were recorded and transcribed.

Data was analyzed in three steps. First, values were identified in the collected material by paying attention to actions or words that showed approval or disapproval, actions and words intended to achieve a certain goal or result and actions showing a consistent tendency to choose a specific direction (Kluckhohn 1951). The first step of the analysis resulted in a list of values. In the second step, the values were categorized according to the four dimensions of privacy: privacy of a person, privacy of personal behavior, privacy of personal communications, and privacy of personal data, described in section 2. In the third step similar

values were grouped together, and the categories were labeled. Results from the analysis are summarized in the next section.

THE FOUR DIMENSIONS OF PRIVACY IN THE CONTEXT OF SHSEC

Table 1 summarizes results from our analysis. The results are structured according to Clarke's (2006) four dimensions of privacy. Each part includes the description of the specific dimension in the context of SHSEC and presents the concerns related to privacy, which the elderly perceive and the aspects they highlight as important to address.

Table 1. Summary of elderly peoples values in relation to the four dimensions

Privacy of the person is in the context of SHSEC related to monitoring of bodily functions and physiological parameters through sensors placed on the elderly person's body or through other technical devices. Values emphasized in relation to this dimension: • It is important that it functions the same as it does today when tests are taken (such as blood samples) at a hospital i.e. the tests are taken by a competent person, no one else is in the room etc. • It is important to recognize and respect the elderly's boundaries. • It is important to have a choice to take the tests at the hospital, it feels more safe and comfortable.
Privacy of personal behavior: is in the context of SHSEC related to environmental monitoring and activity monitoring and also to the existence of technology in home (in our case the Giraff-robot and sensors). Values emphasized in relation to this dimension: • It is important that a suitable technology is used (i.e. not cameras). • It is important that the sensors are installed restrictively in private places (bathroom bedroom). • It is important to be informed about the extend and reason for monitoring • It is important that, if possible, the elderly themselves (no other stakeholders) decide about the extent of monitoring. • It is important that the data is interpreted carefully (agreement about how the data should be interpreted) • It is important that privacy-invasive actions are not taken as a result of an incorrect interpretation of the collected data • It is important to be able to control the technology (the Giraff-robot) • It is important to be able to control who visits the home (physically or virtually) • It is important to make individual adjustments of the solution to the specific needs (health condition, time) • It is important that the elderly are involved and approve the monitoring services • It is important to get a proper introduction and explanation about implemented services and technology

Privacy of personal communication is in the context of SHSEC related to social monitoring services, that include all services that can contribute to enabling social interaction with the elderly or communication between the elderly's and their caregivers. Values emphasized in relation to privacy in this dimension: • It is important to ensure confidentiality of the conversations between the elderly person and his/her caregivers • It is important that the data is interpreted carefully (agreement about how the data should be interpreted) • It is important that privacy-invasive actions are not take as a result of an incorrect interpretation of the collected data • It is important to get a proper introduction and explanation about how the services work
Privacy of personal data is in the context of SHSEC related to how the data collected by the SHSEC system is handled and protected. Values emphasized in relation to privacy in this dimension: • It is important to know what data is collected and for what reason • It is important to be able to decide who has access to the data (relatives, home care personal, healthcare personnel) • It is important to know how the data is handled (interpreted, how long it is stored) • It is important to be able to read/see what data is documented • It is important to be able to decide what parts of the data should be deleted

DISCUSSION

Based on our analysis we would like to highlight two main findings that are important to consider in design and implementation of SHSEC:

First, the commonly used conceptualization of privacy as the protection of personal data, albeit important, is only one of the privacy dimensions that the elderly people consider as important in the context of SHSEC. In our study, the elderly raised a lot of concerns and needs regarding privacy in relation to all of the four dimensions of privacy. For instance the elderly emphasized, that it is important to always remember that their homes are private. Our respondents explained that the need of respecting privacy of their homes applies to the physical persons as well as to the technology and to the people who virtually visit their homes using the Giraff-robot. As one of the respondents put it:

> *Privacy is also related to home. Some people just do not like when other people [or technology] come to their homes without warning and/or without a clear reason for the visit. In this way the technology is scary! I can see when a physical person enters my home, but I don't know when someone is watching me through the technology. I don't even know what they are able to see and when.*

Perceiving privacy through the four dimensions influences the view of privacy problems and solutions in this context. For instance, installing cameras in the elderly person's bedroom is a violation of the elderly's privacy and it cannot be solved by encrypting the images during transmission and storage. Hence, based on our empirical findings we argue that by looking at privacy in a narrow sense as the protection of personal data results into a disregard of many important privacy concerns during the development and implementation of the SHSEC, which undoubtedly results into an insufficient or incomplete protection of the elderly's privacy. Indeed a broader conceptualization of privacy is needed in order to help systems designers of SHSECs to pay attention and to consider privacy issues that go beyond data protection.

Second, it is important to understand the elderly peoples' values in relation to privacy in the context of SHSEC. Based on our analysis we can conclude that the designers' intentions are not always in line with what elderly people consider as important in design of SHSEC. For instance the Giraff-robot is designed to be remotely moved around in the elderly persons' home by a caregiver or a relative, who virtually visit the elderly person at home. This solution was chosen because the designers did not want to put the responsibility of operating the robot on the elderly person. However according to our analysis the fact that the elderly are not able to control the robot was experienced as a privacy violation. The elderly emphasized the importance of having control over the robot itself and its movements at home. One of the elderly also told us during the interview that after she attended the demonstration of the GiraffPlus system in the research and innovation apartment, she had repeated nightmares about the Giraff-robot soundlessly following her in her home. All elderly agreed that having the robot following them without having control feels very unpleasant. The elderly also pointed out that the sense of privacy is increased if they are able to decide when the robot is turned on and off and also if they are able to approve who "visits them" using the robot and when.

> *It is extremely important to feel that you can control the technology! It's important that I can steer the robot and switch it off. I would like the robot to react on a voice commando "please follow me now". This is a completely different feeling, because it is me who is in charge.*

The elderly emphasized the value of control in relation to all four dimensions of privacy. Other values that were emphasized in relation to all dimensions were: flexibility (of the solution), personalization of the services, and awareness of the implemented technology and services. We argue that considering and understanding of the elderly people values is important to be able to find usable and privacy-friendly SHSEC design solutions. Finally we would like to point out that the elderly who participated in this study were both willing and interested in discussing privacy issues in relation to the demonstrated SHSEC. They were also capable of expressing various, significant privacy-related requirements in this context. Thus the common assumption that the elderly lack sufficient (technical) knowledge and awareness to be able to formulate privacy requirements in relation to smart technologies might be misleading. We believe that by using proper methods, introductory presentations, and visualizations (demonstrations with scenarios and movies) we can successfully involve the elderly in the design of SHSEC in general and in eliciting privacy requirements in relation to such systems in specific.

CONCLUSION

In this paper, we have investigated the concept of privacy in the context of SHSEC by studying values that the elderly people emphasize in this context. We used Clarke's (Clarke 2006) broad, general definition of privacy as a starting point of our analysis. According to this definition privacy is about the integrity of the individual and has four dimensions: privacy of a person, privacy of personal behavior, privacy of personal communications, and privacy of personal data. Based on our analysis, we found that privacy in the context of SHSEC should be seen as a multidimensional concept, where the four dimensions of privacy are important to

consider. We also found that understanding of elderly people's values in relation to privacy is important in order to ensure their privacy in this context. Finally we found that elderly people are both willing and capable to discuss and express privacy-related requirements in relation to SHS technology and thus they should be involved in the design of SHSECs in general and in eliciting privacy requirements in relation to such systems in specific.

REFERENCES

Bowes, A., Dawson, A., and Bell, D. 2012. "Implications of Lifestyle Monitoring Data in Ageing Research," *Information, Communication & Society* (15:1), pp. 5-22.

Camp, L. J., and Connelly, K. H. 2007. "Beyond Consent: Privacy in Ubicomp," in *Digital Privacy: Theory, Technologies, and Practices*, A. Acquisiti, S. Gritzalis, C. Lambrinoudakis and S. De Capitani di Vimercati (eds.). New York, NY: Taylor and Francis, pp. 327-347.

Cavoukian, A., Fisher, A., Killen, S., and Hoffman, D. 2010. "Remote Home Health Care Technologies: How to Ensure Privacy? Build It In: Privacy by Design," *Identity in the Information Society* (3:2), pp. 363-378.

Clarke, R. 2006. "What's 'Privacy'? ." http://www.rogerclarke.com/DV/Privacy.html [accessed November 2015].

Frennert, S. A., Eftring, H., and Östlund, B. 2013. "Older People's Involvement in the Development of a Social Assistive Robot," *Social Robotics : 5th International Conference, ICSR 2013, ,* G. Herrmann, M.J. Pearson, A. Lenz, P. Bremner, A. Spiers and L. Ute (eds.), Bristol, UK Springer International Publishing Switzerland, pp. 8-18.

Frennert, S. A., and Östlund, B. 2014. "Review: Seven Matters of Concern of Social Robots and Older People," *International Journal of Social Robotics* (6), pp. 299–310.

Friedman, B., Kahn, P. H., Jr., and Borning, A. 2003. *Value Sensitive Design and Information Systems*. New York: M.E. Sharpe.

Kluckhohn, C. 1951. *Values and Value-Orientations in the Theory of Action: An Exploration in Definition and Classification.* New York: Harper & Row.

Kolkowska, E. 2015. " Privacy Principles in Design of Smart Homes Systems in Elderly Care," *proceedings of Human Aspects of Information Security, Privacy, and Trust Third International Conference, HAS 2015 Held as Part of HCI International 2015,,* T.e. al. (ed.), Los Angeles, CA, USA, August 2-7, 2015, pp. 526-537.

Kosta, E., Pitkänen, O., Niemelä, M., and Kaasinen, E. 2010. "Mobile-Centric Ambient Intelligence in Health- and Homecare-Anticipating Ethical and Legal Challenge," *Science and Engineering Ethics* (16:2), pp. 303-323.

Nordgren, A. 2013. "Privacy by Design in Personal Health Monitoring," *Health Care Analysis* (23:2), pp. 148-64.

Remmers, H. 2010. "Environments for Ageing, Assistive Technology and Self-Determination: Ethical Perspectives," *Informatics for Health & Social Care* (35:3-4), pp. 200–210.

Shankar, K. 2010. "Pervasive Computing and an Aging Populace: Methodological Challenges for Understanding Privacy Implications," *Journal of Information, Communication and Ethics in Society* (8:3), pp. 236 - 248.

Shankar, K., Camp, L. J., Connelly, K., and Huber, L. 2012. "Aging, Privacy, and Home-Based Computing: Developing a Design Framework," *Pervasive Computing* (october-december), pp. 46-54.

Sponselee, A.-m., Schouten, B., Bouwhuis, D., and Willems, C. 2008. "Smart Home Technology for the Elderly: Perceptions of Multidisciplinary Stakeholders," in *Constructing Ambient Intelligence* M. Mühlhäuser, A. Ferscha and E. Aitenbichler (eds.). Berlin, Germany: Springer Berlin Heidelberg, pp. 314-326.

Walsham, G. 1993. *Interpreting Information Systems in Organizations*. Chichester: John Wiley & Sons.

Zwijsen, S. A., Niemeijer, A. R., and Hertogh, C. M. P. M. 2011. "Ethics of Using Assistive Technology in the Care for Community-Dwelling Elderly People: An Overview of the Literature," *Aging & Mental Health* (15:4), pp. 419-427