

Revisiting Privacy in Smart Spaces: Social and Architectural Aspects of Privacy in Technology-Enhanced Environments

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Abstract. Privacy violations are one of the main problems encountered in technology-enhanced environments. In order to design privacy-preserving technologies it is important to understand the social, psychological, and architectural aspects of privacy and incorporate them into the development process of future systems. Therefore, this paper illustrates the effects of privacy on human beings and explains why it is so important to maintain an individual private sphere. In the second part, the paper takes a closer look at the physical means, which are used to create an atmosphere of privacy within buildings and shows different ways of achieving personal privacy in architectural spaces.

Keywords: Privacy, Ubiquitous Computing, Ambient Intelligence, Technology-Enhanced Environment, Smart Spaces, Architecture.

1. Introduction

Since the introduction of personal computers in the early 1980s, there is an ongoing debate about the potential fears of using electronic data processing technologies to support users in home and office environments [11]. Surveys conducted during the last 30 years showed that the belief about the loss of personal privacy is associated with the quantity of personal data collected, and that the fear of privacy infringements constantly increases with the integration of computers in everyday life [14]. With the integration of computer technologies into the environments, the chances for both, intended and unintended privacy breaches will dramatically increase in the future. The reason for this is often attributed to a new quality of data collection that varies considerably from the capabilities of current computational systems. Technology-enhanced environments will significantly increase the quantitative as well as qualitative possibilities of monitoring users and also extend them to spheres, which are currently out of the reach using existing hardware [4]. Lucky [10] goes even further and envisions a future of all-knowing and all-reporting objects, and expects the old sayings that ‘the walls have ears’ and ‘if these walls could talk’ to become the disturbing reality soon. But even if this vision is a bit too pessimistic, embedded sensors and location systems will definitely lead to the disappearance of most natural and spatial borders, and thereby also eliminate economic factors, which made privacy intrusions costly in the past [15].

Today, privacy problems are mostly regarded as a result of technical malfunctions or system faults, and, if addressed at all, counter measures are limited to purely technical solutions. In contrast, privacy aspects related to the physical structure of the building itself or the social patterns used to achieve and maintain privacy in social systems are seldom addressed. In order to design privacy-enhancing technologies it is important to understand the social, psychological, and architectural aspects of privacy and incorporate them

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2. Privacy - Definitions and Concepts

When the term privacy is used today - especially in relation with information and communication technology - it usually refers to the concept of informational privacy. One of the most popular definitions is given by Westin [17], who defines privacy as ‘the claim of individuals, groups, or institutions to determine for themselves when, how, and to what extent information about them is communicated to others’. While this rather data-centric definition might be appropriate with regard to traditional computer systems, it seems quite narrow and one-sided in the context of computer-enhanced environments. In situations where different members of a social system interact with a responsive and adaptive environment, it is necessary to take a broader view and also include social, psychological, and architectural aspects. To better understand the different facets of privacy, the following paragraph briefly illustrates how the notion of privacy changed over time and how the term is used in different contexts.

Privacy as a term was first recorded in 1450, and goes back to the term of *private* (1384) coming from the Latin *privatus* with the meaning of ‘set apart, belonging to oneself’, used as the opposite to belonging to the state - *publicus, communis*. One of the first synonyms of privacy was *seclusion*. In the 19th century a new meaning modified the term and privacy became a matter of choice or right. The state of being alone is embedded in terms of freedom from interference or intrusion. While the individual has been the center of interest since the times of Enlightenment, persons now become aware of harms to their individuality. This state still lingers on. Privacy is often connoted with vulnerable characteristics. We talk about the protection of privacy, the intrusion, and the invasion of it.

Another synonym of privacy is *secrecy*. Privacy in this context was first mentioned at the end of the 16th century. The absence or avoidance of publicity is the condition for secrecy. Today, data protection mechanisms use encoding techniques to provide privacy. Hence, secrecy is a mean to achieve privacy, a guarantee against violation and misuse of sensitive material. But secrecy also includes private matters, things that are not publicly accessible, such as intimacy or confidential relations. Intimacy in turn is important to develop relationships with other people. In intimate moments mutual trust is established. Confidence in relationships helps to develop the personal individuality. Therefore, privacy is an essential element in the circle of trust, intimacy, and individuality. All elements are vulnerable and only work if all aspects depend on each other.

Depending on how the term privacy is defined and the aspects it includes, there are different reasons why it is important to grant privacy to each individual. In this regard, Lessig [9] demarcates between four different motives for privacy: empowerment, utility, dignity, and regulation. But privacy is a feeble construct and easy to harm. In a very general sense, privacy violations occur every time a personal border is crossed (see [12]). As used in this definition, the term *border* has a very broad meaning, ranging from physical borders, like walls, to temporal borders, associated with the boundary between different stages in life.

3. Social and Psychological Aspects of Privacy

Social life follows certain patterns. Social structure gives us the ability to orientate ourselves and to plan future actions. But the decision-making process requires special conditions, including a state of well-being, which is a prerequisite for coming to a satisfying conclusion. The condition of well-being is therefore a basic good of life and necessary for a feeling of confidence about attaining one’s personal life goals [16]. Regular regeneration and personal development are preconditions for this state, which is only possible in an environment of privacy that gives us protection.

Conceptually, each individual has to be regarded as a separate but interactive open system. As a social being, the human enjoys interaction with others, but has also the need for protection necessary for system maintenance and system development [13]. These items are the core principles of privacy in psychological terms and might include physical, psychological, and informational separation. The basic function of privacy stays the same, although the occasions on which privacy comes to practice might change. Any discussion of privacy must consider these changes within the social structure, which gradually happen over time (e.g., changes in customs or taboos). Those norms are the rationales for requiring and maintaining a condition of separation from the public domain. What forms of privacy are satisfactory depends on the elements that currently threaten the system, such as excessive stimulation, emotional load, chemical imbalance, scarce resources, behavioural constraint, or threats of autonomy. When circumstances are hard to handle or are overwhelming, privacy offers an opportunity to step back and rethink about problems. In this sense, it is a protection from system distress.

Social interaction is based on mutual behavior expectations, which are basic mechanisms for human living together [7]. Complying with these rules requires individuals to have a good sense of the nature of the place they are in as well as the people surrounding them [2]. As modern information and communications technologies increase the connection between places and people, physical borderlines are no longer present. In such a 'virtual' society, the physical space that is perceived by individuals is not necessarily an indicator of the places or people that they may be connected to. Hence, places that are perceived to be private may actually be otherwise [8]. Through the integration of technology into the environment, our senses become insufficient to notice surveillance, or the collection of information about our person, which considerably influences the established interaction behaviours. According to Bellotti [2] the alteration of social interactions by modern information and communication technologies results in two phenomena. First, the *disembodiment* from the users' environmental context leads to the inability to present oneself appropriately due to a lacking knowledge of one's own visibility, and to respond effectively to perceived actions as their actual origins are unknown. And second, the *dissociation* from one's action leads to a state where people are no longer responsible for their actions as they are impossible to detect or identify.

4. Architectural Means for Achieving Privacy

Different areas have specific uses in specific contexts. People clearly distinguish working areas from resting places and from sanitary rooms. Every architectural space has its own social rules about behaviour. No one could shave himself in a public bus without getting the attention of all people on the bus. In a similar fashion, every environment follows a hierarchy of public and private areas. Residential house, offices, and even urban structures offer places to gather and meet as well as places for individuality. Structural barriers provide privacy by preventing observation from the outside. Different means of separation support the pattern of public and private areas within the building.

Privacy is often associated with specific locations, like houses or apartments. These are the places where privacy happens. Some of these locations are more private than others, e.g., public places, such as cafés, or the individual living room of a house. Certain places are per definition private places inside the living area, like the bedroom or the bathroom. In those places individuals can express their personal identities, and find shelter from public surveillance. They are places of regeneration: "Our homes are the places we most expected to be let alone in solitude or to deal selectively with others" [1]. Homes are places that are shielded from the outside. But also within the building different degrees of privacy and publicity are distinguished within the family context. The degree of privacy is usually reflected in the floor plan. Rooms follow a hierarchically system to guarantee the seclusion of private rooms [5]. Historically this structure reflects religious and social hierarchies. In virtually every society some activities remain private, for example, religious practices or biological functions such as defecation [1]. Every room partition developed out of security, ceremony, or privacy aspects [5], which are culturally depended and changes over the years [18].

In this context, Chermayeff and Alexander [5] identified nine different categories relevant for connecting public and private areas. In their combination, those categories exemplify the complex dimensions of private and public space. They cannot describe the patterns of private and public areas individually, instead they

have to be regarded as key units of a bigger system. Consequently, a place for privacy and regeneration should be acoustically blocked, filtered against smells, bacteria and pollution, and separated from traffic. The key elements resemble a structural pattern, in which physical elements provide different settings for privacy. Besides the factors identified by Chermayeff and Alexander, physical size is another important factor for the creation of privacy. Personal privacy in a bathroom is easier to maintain than on a public beach. A room as a small unit to control can be easier regulated regarding the conditions of climate, traffic, sound, and visual privacy.

Physical barriers are the main means to separate public from private areas. Every separation unit has its own function: to separate, isolate or give controlled access [5]. This function manifests the hierarchy of barriers, buffers, screens, filter, passages, sluices, or crossings of the floor plan. Walls, for example, are effective barriers for security as well as acoustical or visual isolation. Besides separation units, sluices as elements of connection, are another important tool for preserving privacy. Sluices have the quality of semi-public or semi-private areas. They are passages where people can meet, or lead from a room of solitude to a room for gathering. Their function is not secondary as they hold the quality to control access. Buffer areas in general have more than one function. For example, entrance areas physically seclude from unwanted access, but might also function as acoustic shields, depending on their size.

With regard to technology-enhanced environments, the complex term of privacy has to be extended to the architectural domain. For attaining a state of solitude, the acoustical barriers are important means. But if the privacy is used in the context of controlled access, acoustical barriers are obsolete. In this sense Allen [1] argues that it is fairly common to postulate a 'private space,' whose penetration by odors, sounds, and objects of human origin is deemed an invasion of personal privacy. For example, drifting cigarette smoke is in most cases not regarded as a violation of personal privacy [1]. Even so the smoke might bother others, it does not give any personal information about the person smoking. In general, privacy is created through physical means, such as walls, but only social conventions give meaning to these kinds of separation units. As conventions change over time, they need to be filled up with context information, which is not only culturally dependent but also influenced by technological developments.

5. Conclusion

Privacy has multiple functions and embraces diverse areas of life. Being a cluster of concepts, various aspects gather around the notion of privacy. All those aspects have to be reflected in order to create environment, which meet fundamental privacy standards. In technology-enhanced environments social behavior will play a far more important role than in present technologies. As physical frontiers and sensual borderlines blur, common principles like – if I can see you, you can see me – no longer fit. This disintegration arise feelings of uneasiness, which might not only lead to the rejection of those systems, but even evoke fears. Those diffuse fears are often manifested in privacy and security concerns about the technologies. Several studies with existing technologies confirm these tendencies (see ,e.g., [6]).

As explained above, privacy is a social space where personal development and regeneration happens. Technology-enhanced environments have to provide this space, and learn “how people manage accomplishments such as addressing, attending to and politely ignoring one another [3]”. Hence, privacy should not become a matter of trust or mistrust. Instead, it is the designer’s task to build up confidence in technology and reduce privacy concerns and fears towards it, right where the interaction between users and technology happens.

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