Personal Data for Personal Use: Case Studies in User Modeling for Context-Aware Computing

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Abstract

In this paper we focus on the user modeling aspect of Context-Aware Computing and the social contract between proactive systems and their users. In these systems that create and maintain users models, having a standard social contract provides the user with consistency and allows the system to better meet their expectations. Personal data for personal use is one example of a social contract in which privacy is assumed unless otherwise indicated by the user. This paper describes three different systems that give users a sense of control, regarding information disclosure, by limiting the use of personal information to the local domain.

Introduction

Computers interfaces continue to become more adaptive and proactive: evaluating user behavior over time, building models through implicit feedback, and taking action on the user's behalf. This highlights the need to take etiquette into consideration in order to meet user expectations and more importantly, maintain trust. In these systems, user satisfaction is dependent on the degree to which designers take into account and respect that people want to understand the system and the extent of their self-disclosure.

While people tend to think of privacy concerns being something prompted by the widespread use of the Internet, computer scientists have been considering how privacy should be maintained on computer systems for decades. In his 1969 paper, Hoffman discusses the benefits of automated systems and the problems of information privacy control in computer systems (Hoffman 69).

In this paper we present some of the privacy issues faced by designers today. In the specific realm of user modeling for Context-Aware Computing we present examples of using a standard social contract, personal data for personal use, across a number of different systems.

Context-Aware Computing

Context-aware systems are sensitive to the context in which the artifacts are used. They sense or remember information about the person and the emotional or physical situation in order to reduce computer-user communication and effort (Picard 97).

Many aspects of the physical and conceptual environment can be included in the notion of context, such as location, time, previous history, expected reaction, preferences, or personal information. By gathering and interpreting this context information, the system creates, maintains, and is driven by models of the task, user, and system (Lieberman 00).

In general, this gathering of information is accomplished through the use of implicit input channels, where what people do is considered implicit communication with the system. The computer builds a user model by remembering things about a person, the way the computer has worked in the past, and the way a person is trying to engage with the computer in the present. The end goal of context-aware design is to maximize user productivity, optimize workload and increase user satisfaction.

Privacy & Social Contracts

On of the challenges in designing these context-aware systems that monitor a user's behavior, are the social implications and privacy issues in the interactions between the system and the user. In the case of proactive agents, Norman suggests that the greatest challenge in agent design is in their interaction with human, rather than their technical implementation (Norman 94).

For the context of human-computer interaction privacy is best described as the condition of having control over

information about oneself, in terms of how much and what type of information is shared (Tavani 96). Agent-based interfaces and proactive systems should accurately meet user expectations, minimize false hopes, and ensure that people feel in control. In short, there should be a social contract between the user and the system in order to maintain a reliable relationship.

A social contract can be considered collective rules that constrain the behavior of individuals and groups living in a society in such a way as to protect the individual, while also benefiting the society as a whole (Kaufman 02). An excellent example of a social contract in a human-computer interaction is the Platform for Privacy Preferences Project (P3P), developed by the World Wide Web Consortium (specification 1.0 issued April 2002) [p3p]. P3P is a standard for automating the way that users control the use of personal information on web sites they visit. P3P-enabled web sites make information available about their privacy practices in a standard, machine-readable format. P3P-enabled browsers can then automatically compare this to the user's personal set of privacy preferences. Therefore, a user is comfortable that they will be notified of any privacy practices that are outside of the social contract to which they have agreed.

This is an example of a standard maintaining some consistency for the user in order to meet their expectations in terms of privacy control. With the same purpose in mind, we present an example of another social contract: personal data for personal use.

If we take the viewpoint that a proactive system is an extension of the user, everything it knows about the user should be kept as private as the user themselves would keep that information. Ideally, the system would know precisely when and with whom a user would be willing to share information, but outside of this ideal scenario a conservative stance is that privacy should be assumed unless otherwise indicated by the user. We summarize this approach as personal data for personal use.

In this paper we present three projects in which the system senses and models user behavior and has an implicit contract with the user that this data is private and used only for interaction with the current user…"sensing you for your use only."

Personal Data for Personal Use

In this paper we focus on the user modeling aspect of context aware computing and the social contract between proactive systems and their users. In these systems that maintain users models, personal data for personal use is the idea that privacy should be assumed unless otherwise indicated by the user

In general people like to be in control of their own self-disclosure. For example, in human-human interaction, people have the ability to maintain separate personal and professional lives if they wish simply by controlling the information flow between one and the other. If for some reason this gets compromised, the person feels that their privacy has been violated. Having the option to decide is what gives them control over the situation.

We build systems that foster a sense of control in the realm of information disclosure by restricting the use of personal information to the local context. Additionally, this conservative privacy contract exposes users gradually to the idea of giving personal information to a proactive system, which in turn encourages them to consider the associated risks. The following three projects are all examples of personal data for personal use.

LAFCam

LAFCam, Leveraging Affective Feedback Camcorder, is a system in which a video camera recognizes and records affective data from the camera operator, in order to determine which sequences will be interesting to the camera operator at a later time (Lockerd 02). In the case of home videos, the camera operator is likely to also be the editor and narrator of the final video. It facilitates the process of browsing and provides automatic editing features by indexing where the camera operator laughed and visualizing the skin conductivity and facial expressions in the editing session.

It is easy for a video amateur to gather a large amount of video, which then needs to be edited. This task of finding the few interesting pieces can be labor intensive and time consuming, requiring the user to review hours of video. LAFCam uses three affective channels to augment the editing experience for the user. While the camera operator is shooting video they wear a glove that records their skin

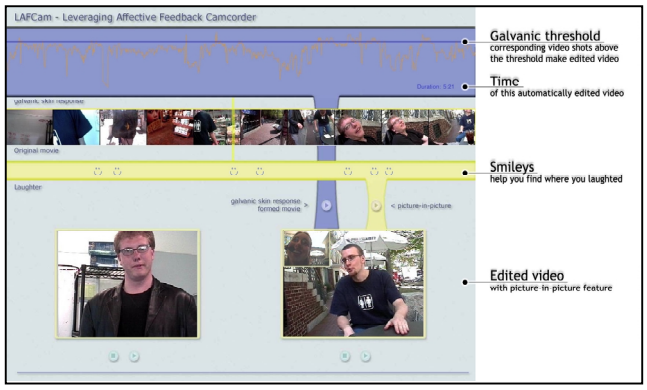

Figure 1. Video Editing Application

conductivity (Picard 01) (a measure of arousal), their speech is recorded and analyzed to detect laughter, and a second camera is mounted on the LCD display that records the operators face during the experience. This data is then aggregated in the editing session to provide pointers to what sections might be most interesting.

The LAFCam video editing application (see figure 1) visually indicates where the camera operator laughed with smiley icons, and the skin conductivity is graphed and visually correlated with the filmstrip. The face view is made available either separately or as a picture-in-picture view.

For this project, private affective data is recorded and saved on behalf of the user. This data is then displayed and made available to the user in the editing session. In this scenario of home video, it is assumed that the camera operator is also the editor; therefore, the private bio signal data is used and displayed for the user, to benefit the user, and not to be shared unless the user explicitly wants to (i.e., the user lets someone else sit in on the editing session in which the data is visible).

DriftCatcher

DriftCatcher is a project involving email analysis for social network modeling, in order to facilitate users awareness of their electronic communication networks.

The system models what different relationships and socioemotional qualities "look like" in terms of email characteristics. This involves an email agent paying attention to various features of email interactions that have social connotation. Response time, read time, compose time, word frequencies, and other such features of both the nature and content of email interactions. This allows the agent to build a model of the user's social interactions: tie strength, symmetry, foci of activity, and different kinds of social support.

With a model of the user's social network, the DriftCatcher webmail client is in a position to organize and visualize mail according to social information. This makes it easier for the user to see online communication in a social context rather than the temporal context of current email applications.

In the realm of email and email analysis it is of utmost importance that the user feel their privacy is secure and the system is not sharing information unbeknownst to them. DriftCatcher system implemented on a Unix mail server with a separate agent for each user; therefore, each user's email data and analysis is isolated from one another. Additionally, the information gathered by the agent is accessible through the webmail client; however the client only has access to the agent for the particular user currently logged in. The social network model information is then as secure as the user's email itself. Therefore DriftCatcher is able to benefit each user without compromising their private data, and user is secure that they are in control of with whom they share the additional social network data made available through the webmail client.

Modalities of Interruption

Traditional human computer interfaces focus only on a small number of modalities to interact with users. Even though recent work provides evidence that there are substantial advantages in efficiency using multimodal interfaces (Oviat 00)(Colquhoun 75), its main focus is on combining input modalities – such as speech, pen, touch, hand gestures, eye gaze, and head and body movements– rather than using multimodal outputs. These interfaces are not taking advantage of the fact that humans have extraordinary sensing capabilities, which are in use all the time. Current computer interfaces use at most two modalities for conveying information; sound and visual modalities are the most often used, ignoring important modalities such as olfactory, and tactile.

In order to demonstrate the benefits of using other perceptual channels into current computer interfaces this project explores the use of ambient displays in the context of interruption. An interface communicates with users through several channels by using multiple ambient displays as an external interruption in the form of heat (see figure 2), light, smell, sound, and vibration. These interruptions are designed to get users' attention away from their current task, such as writing e-mail on a desktop computer.

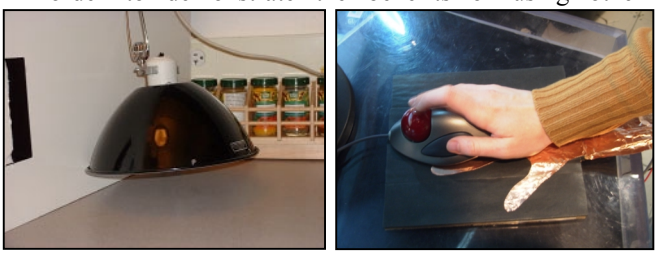

Figure 2. Thermal interruption generator

The system collects data regarding user's performance and the perceived effect of each of the modalities, such as writing speed, spelling errors, and reaction time after being interrupted by one of either five different modalities (heat, light, smell, sound, vibration). The system then dynamically selects and configures the interruption modality to use based on the effectiveness from each modality on a particular user. Thus maximizing the effectiveness of the interruption through proper modality selection.

In this project, inherent physiological disruptive effects of an interruption modality are used by the interface to adapt the modality itself. All data collected belongs to a lower physiological level, which is only used to affect/improve the interface for whom the data was collected. Without compromising any privacy issues.

Conclusion

In this paper we have advocated a particular social contract with a conservative stance on privacy, personal data for personal use. In LAFCam, this is exemplified by the control that the camera operator has over who is involved in the editing session. This in turn gives the user control over who gets to see the affective data that was gathered and is displayed in the editing session. Similarly, in DriftCatcher, the user knows that only people who have their password are able to log on and view their webmail client. Therefore, they can be secure the social network modeling information made available on the client is as secure as their email itself. In the modalities of interruption project, all data is physiological, and users are aware that the system is using this for their benefit only.

As computers continue to become more adaptive and proactive, designers need to take into account human desire to be in control, particularly concerning self-disclosure. In this paper we have discussed social contracts as a way to foster accurate perception of privacy, and presented three projects involving systems sensing and modeling user behavior with the contract of "sensing you for your use only." This social contract restricts the use of personal information to the local context of the user. A system acting as an extension of the user, would ideally know precisely when and with whom a user would be willing to share information, but until we are there we use the conservative standpoint that privacy should be assumed unless otherwise indicated by the user.

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