CSCW: Colocated-synchronous applications

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As the use of personal computers took off in office space, so did a call for collaborative tools to easily facilitate group activities around these devices. An initial proposition arose to mimic the personal computer and optimize it for multiple controllers. Single display groupware (SDG) are systems which allow multiple users to manipulate information on a shared display.

At the advent of this technology, it became apparent to some researchers that there are consequences for structuring group work into one large display. There may be times when personal and private spaces are better suited for tasks. One such situation is when sensitive information must be presented on a screen, such as entering a pin or referring to notes in a confidential document. In other situations the information may not be sensitive, but the mass amount of information itself may be detrimental to the productivity of the group.

Such a circumstance arises when many users are completing independent tasks. These tasks may require some collaboration, but the user may focus largely on their own work. In this case, there may be excess clutter on the screen which is distracting to other users of the screen. Private areas can help to modularize tasks which do not require much collaboration, but need to be done to facilitate collaborative activities. An example would be a user searching the web to find good documentation on a tool they are reminded of in the meeting. They look for documentation to see if this tool fits the problem discussed. The task can be modularized, as the other members do not need to see the search process, only the results matter. Separating this work allows the other members to continue related discussions and interactions with the display without being distracted by the search. In additional, a private display will prevent a user's actions from obstructing the view of other collaborators. For instance, if a menu is selected in a public

display this may interfere with a user typing text beneath that drop down.

Another complaint of personal areas which can be mitigated with personal spaces is social stress. When collaborating with a variety and with varying comfort and familiarity, it can be stressful to feel under the public eye of your collaborators. This may discourage users from using collaborative tools or reduce the effectiveness of the tools, as the users may opt to take more independent tasks offline even when these tasks may enhance the effectiveness of the meeting.

In the following sections I will describe problems and results seen in research and industry to try and tackle these privacy considerations. These roughly fall into two categories: use of a separate, personal device in conjunction to the shared display, augmentation for users to have different views of the display.

1 PDAs

One of the first SDG systems, MMM [1], explores the area of multiple users interacting with one device. They built a multi-user editor, which may be controlled by multiple users, defined by their home area and preferences. The editors were constructed to demonstrate how multiple users could simultaneous interact with shared objects. These applications were very simplified and did not explore the concern of cluttered information, as the work focused on many of the technical challenges of supporting multiple inputs. With later work, this issue was mitigated by allowing each user to work with their independent PDA, to remotely control a shared machine or to collaborate on whiteboard applications.

In the late 1990's a trend of using PDAs as input devices for shared display control was explored. Myers et al. [9] and Rekimoto et al. [10] demonstrated how PDAs can be used by multiple users on a whiteboard application. Myers et al. also showed that the key strokes and mouse input on a PDA could simulate the respective actions on a remote machine. Greenberg et al. [3] showed that a PDA allows for a bridge between personal and public information. Users can bring personal notes and post them to a public display during a meeting.

PDAs provide a personal view and means of completing personal tasks in a collaborative environment. Unfortunately, they may also cause distraction as users will have multiple devices to keep track of during a meeting. There is

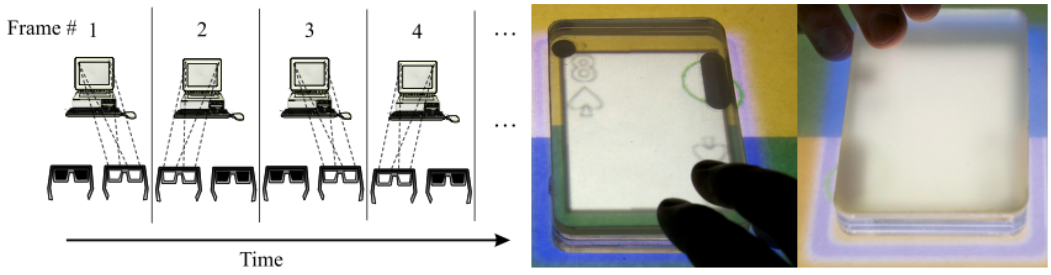
Figure 1: Wii U, [6]

also no notion of the missing information, or personal spaces, in the context of the shared display. This may cause confusion as you have to keep track of what information is available between peers, unless it is published publicly. Research into PDAs and mobile device integration did not flourish after this set of work. More recently, the integration of mobile devices into collaborative systems has re-emerged in industry but with the purpose of entertainment rather than work. The Wii U is a modern example of a hand held device cooperating with a shared display. The hand held controller, shown in Figure 1, can be used to control the Wii as a normal console controller, but can also provide a personal view in the case of competitive games.

The field of personal spaces grew into the use of augmented views. That is, allowing each user to have their own personal space by augmenting their view of the shared display. Some of these methods are discussed in the next section.

2 Augmented Views

One of the first papers to regard private areas as motivation for SDP was Shoemaker et al. [11]. The authors discussed the virtues of private space for reducing awareness overload [4] and hiding sensitive data. They built a system which showcased some of these ideals - the machine received input from two users, who saw two different views given the glasses they wore,



(a) Glasses personal view

(b) Lumisty Film overlay

Figure 2: Augmented Views

shown in Figure 2a. While this system demonstrated some benefits of private spaces, the system was very limited. For instance, it is not obvious how this would scale to many users. Also, the glasses are a barrier between the user and the system. The more recent solutions that regard private spaces have avoided body mounted devices.

Lumisight Table [7] was created to allow users to have a personal view, given their placement at the table. Each user is presented with their own view, depending on the angle from which they view the table. This is done by filtering different projected views using a special film that works on a similar principle to polarized lenses. Some projected material may be identical to the other user's, this is considered the public data.

This table may be good for determined tasks where all members are seated and assigned roles, but for more ad hoc collaboration this environment is too static. The advancement of touch technology since the Lumisight Table has opened up more dynamic environments. A recent demonstration [2] shows how a spherical touch display has built in privacy, as a user on one side of the screen cannot see the other user's information. Information to collaborate on can be dragged to one shared side of the display for discussion. This is more dynamic than the Lumisight Table as users can come and go freely, observers may watch from different angles, and collaboration can happen on demand. Some downsides to the spherical display are the cost, the wasted screen real estate on the top and bottom of the screen, and the warping of information which may limit the types of complex tasks users can do.

More recent work in this area focuses on solutions for problems of a smaller scope. For instance, [5] developed a set of authentication methods which would facilitate users entering pins on shared tabletop. Likewise, [8]

use the same Lumisty film as the Lumisight Table to create a tabletop overlay, shown in Figure 2b, which limits the frame of view. A benefit of this solution is that it can easily be applied to any shared tabletop. However, this solution is still best suited for infrequent use. such as pin entry, as it is statically sized and thus not well suited for dynamic environments with set personal tasks.

3 Summary

With the presence of touch tables, and user's familiarity with touch devices there is a greater focus on these devices for single display groupware than 10 years ago. Given recent research, this is the likely direction for years to come. However, touch tables are not a ubiquitous groupware tools. I believe that some of the issues which the privacy solutions hope to alleviate are related to the failed success of tabletops. Too few good, generalizable solutions have come out to support privacy in SDG. People like to have ownership of their data and consistency in their tools. If they cannot easily interface with the groupware tools, then they will fallback on other methods they are comfortable with.

In industry, these tools seem to be advertised for entertainment rather than collaborative work. I have mentioned two examples of this: the Wii U and the Microsoft Surface. While both are great feats related to the research in this area, neither support collaborative efforts in a work setting.

The privacy slant on collaborative work does lend a reminder to future researchers that even when working in co-located environments some tasks are better suited to one user. Whether this is for personal reasons, such as social stress, or for logistical reasons, such as screen real estate and clutter, researchers should be mindful of this work when building tools that are synchronous, co-located or not.

References

[1] Eric A. Bier and Steven Freeman. Mmm: a user interface architecture for shared editors on a single screen. In *Proceedings of the 4th annual ACM symposium on User interface software and technology*, UIST '91, pages 79–86, New York, NY, USA, 1991. ACM
A multi user text and rectangle editor built to demonstrate how ownership can be assigned and how shared objects can be manipulated.

[2] John Bolton, Kibum Kim, and Roel Vertegaal. Privacy and sharing information on spherical and large flat displays. In *Proceedings of the ACM 2011 conference on Computer supported cooperative work*, CSCW '11, pages 573–574, New York, NY, USA, 2011. ACM
A demonstration on how a spherical display allows for different spaces, both personal and private.

[3] Saul Greenberg, Michael Boyle, and Jason LaBerge. Pdas and shared public displays: Making personal information public, and public information personal. *Personal and Ubiquitous Computing*, 3(1):54–64, 1999.

[4] Carl Gutwin and Saul Greenberg. Effects of awareness support on groupware usability. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, CHI '98, pages 511–518, New York, NY, USA, 1998. ACM Press/Addison-Wesley Publishing Co.
Awareness in a groupware setting may cause information overload, and can be a detriment to the focus of users.

[5] David Kim, Paul Dunphy, Pam Briggs, Jonathan Hook, John W. Nicholson, James Nicholson, and Patrick Olivier. Multi-touch authentication on tabletops. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, CHI '10, pages 1093–1102, New York, NY, USA, 2010. ACM
A set of authentication methods for tabletops which prevents leaking of sensitive data.

[6] Chris Kohler. Top analyst slams nintendos unrealistic wii u numbers, March 2013
Wii U Image reference.

[7] Mitsunori Matsushita, Makoto Iida, Takeshi Ohguro, Yoshinari Shirai, Yasuaki Kakehi, and Takeshi Naemura. Lumisight table: a face-to-face collaboration support system that optimizes direction of projected information to each stakeholder. In *Proceedings of the 2004 ACM conference on Computer supported cooperative work*, CSCW '04, pages 274–283, New York, NY, USA, 2004. ACM
A perspective based view augmentation on a table.

[8] Max Möllers and Jan Borchers. Taps widgets: interacting with tangible private spaces. In *Proceedings of the ACM International Conference on Interactive Tabletops and Surfaces*, ITS '11, pages 75–78, New York, NY, USA, 2011. ACM
The use of film as an overlay to mask sensitive data from anyone out of the viewing angle, which can be applied to any tabletop display.

[9] Brad A. Myers, Herb Stiel, and Robert Gargiulo. Collaboration using multiple pdas connected to a pc. In *Proceedings of the 1998 ACM conference on Computer supported cooperative work*, CSCW '98, pages 285–294, New York, NY, USA, 1998. ACM
Created a shared whiteboard application and remote controller, where the actions could be simulated from the input of multiple PDAs.

[10] Jun Rekimoto. A multiple device approach for supporting whiteboard-based interactions. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, CHI '98, pages 344–351, New York, NY, USA, 1998. ACM Press/Addison-Wesley Publishing Co.
A whiteboard application which shows how multiple users can interact with a freeform drawing application.

[11] Garth B. D. Shoemaker and Kori M. Inkpen. Single display privacyware: augmenting public displays with private information. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, CHI '01, pages 522–529, New York, NY, USA, 2001. ACM
Discussion on how private spaces are a virtue in SDP. An example implementation demonstrates the use of augmented views.