Designing for Bystanders: Reflections on Building a Public Digital Forum

Anthony Tang, Mattias Finke, Michael Blackstock, Rock Leung, Meghan Deutscher, Gavin Tain, Crystal Giesbrecht, Rodger Lea
Media and Graphics Interdisciplinary Centre (MAGIC), University of British Columbia
2424 Main Mall, Vancouver BC V6T 1Z4
{tonyt@ece, martinf@ece, michael@cs, rockl@cs, deutschm@ece, rodgerl@ece}.ubc.ca

ABSTRACT

In this paper, we reflect on the design and deployment process of MAGICBoard, a public display deployed in a university setting that solicits the electronic votes and opinions of bystanders on trivial but amusing topics. We focus on the consequences of our design choices with respect to encouraging *bystanders* to interact with the public display. Bystanders are individuals around the large display who may never fully engage with the application itself, but are potential *contributors* to the system. Drawing on our recent experiences with MAGICBoard, we present a *classification of bystanders*, and then discuss three design themes relevant to the design of systems for bystander use: *graduated proximal engagement*, *lowering barriers for interaction* and *supporting covert engagement.*

ACM Classification Keywords

H5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

INTRODUCTION

Large public displays are typically used for broadcasting a stream of location-relevant information, but most deployed displays of this nature are not yet interactive. This lack of interactivity may change with the increasing proliferation of high-power handheld devices (mobile phones, PDAs, MP3 players), which enable new forms of use (e.g. [4][6][12][9]). Despite the emergence of new technology that could allow users to interact with large displays, past research has found that motivating people to interact with these displays in a public space remains a real challenge [1]. An oft-cited deterrent is the potential for social embarrassment when interacting with a public display [1].

In designing MAGICBoard (shown in Figure 1), a public digital forum, we sought to address this challenge by using

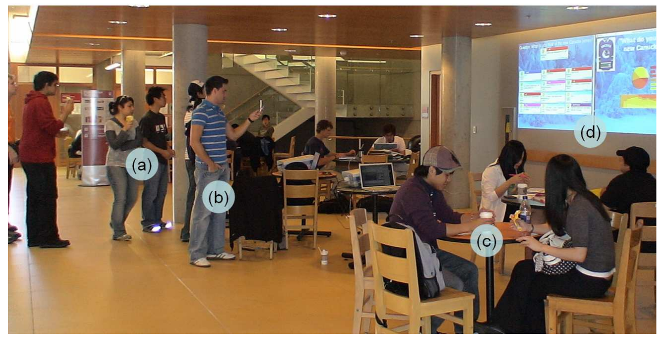

Figure 1. The MAGICBoard only comprises a small space in the overall deployment location (d), and bystanders comprise the majority of individuals near the display (a), (c). Only a single user is actually making use of the display (b).

SMS messaging as the primary means of interaction with the large display, thereby allowing users to interact with the system from the privacy of their own personal devices—a concept we call *supporting covert engagement and interaction*. The core functionality of MAGICBoard was simple: users post text-based items on the display, which persist until newer items pushed them off-screen. In designing this interactive display application, we found that many of our design choices ultimately focused on individuals who might not be actively engaged with the display itself: *bystanders.*

We situate our work in the context of using public displays as social catalysts—or artifacts/events that focus the attention of diverse inhabitants [7]. Brignull & Rogers describe, in studying people's activity patterns around a similar large display applications, described three classes of users based on their patterns of activity [1]: (i) those engaging in *direct interaction* with the large display; (ii) bystanders whose activities indicated a *focal awareness* of the display, and (iii) bystanders whose activities implied a *peripheral awareness* of the display. To motivate bystanders to interact with the system, Brignull & Rogers advocate designing applications to support *transitions* between these thresholds [1]. Our early explorations support this conceptual framework, and draw further attention to *bystanders' needs* in order to allow them to

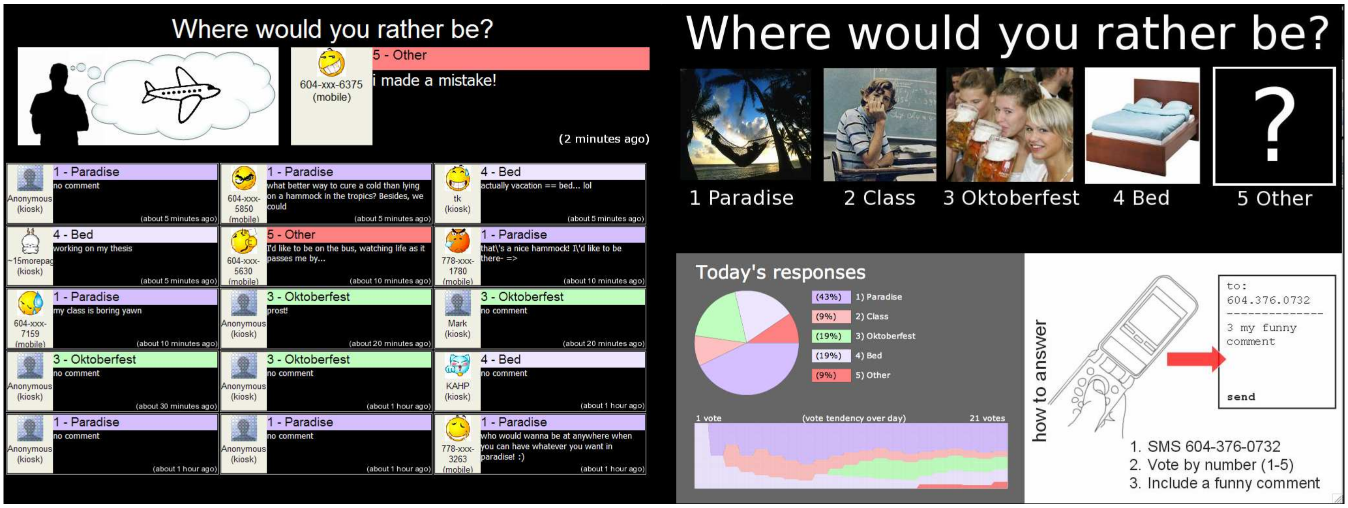

Figure 2. The MAGICBoard's two displays have different functions. The right display is intended to be viewed from a distance, and functions as the "overview." The left display is the "detail" display, and intended to be viewed up close.

more easily transition from a bystander role to a contributor role.

In this paper, we first describe MAGICBoard and its deployment, which allowed us to investigate and categorize different *types* of bystanders. From there, we re-examine several design heuristics from [6] and arrive at three thematic design implications to support bystanders' use of public displays: *supporting graduated proximal engagement*, *lowering barriers for interaction*, and *supporting covert engagement and interaction*.

MAGICBOARD: A DIGITAL PUBLIC FORUM

MAGICBoard is a public forum for trivial but amusing topics (see Figure 2). Two side-by-side projectors present the current topic, the votes and opinions of those who have commented on the topic, and a summary of the votes on the topic. The right display allows passers-by to easily glean the overall opinion of the community on different topics. Interested bystanders can engage with the system by stepping closer to view the comments themselves. They can then interact with the display by either: (1) sending an SMS message from a mobile phone, or (2) using a kiosk next to the display. The kiosk provides a basic form-based mechanism of interaction, and the SMS gateway supports more "private" entry and preparation of content [4].

Figure 2 shows each display in action: the left display shows "overview" information while the right display is the "detail view." The overview display (containing the topic and overview of the tallied votes) is intended to be viewable from a long distance: font size is large and viewable from 20 meters. The detail display is intended to be viewed from much closer, and shows the last 16 submitted comments.

MAGICBoard was constructed using the MAGIC RESTBroker, an HTTP-based toolkit intended for the rapid prototyping of large display applications [3]. At its core, the RESTBroker supports lightweight message passing using state-based channel semantics. The toolkit allowed different parts of MAGICBoard to be built and run on different client machines: the kiosk, SMS gateway, and display application are all completely separate applications communicating through this lightweight protocol.

We deployed the MAGICBoard in a common study/social hallway of the applied science building at our university (Figure 1). This corridor is a common area with a small coffee shop to the side, and a small alcove where students frequently meet to study. The two displays themselves measure about 6m × 2m and were positioned to be visible from the front door of the building throughout the day.

Our interest in MAGICBoard is unique from prior work in two respects: first, our focus on SMS interaction enables participation by users who might otherwise not partake due to the potential for *social embarrassment*, and second, MAGICBoard was deployed in a public setting with bystanders who are unlikely to know one another, whereas prior work frequently deployed such displays in social event settings (e.g. [1]), in a distributed setting [7], or in contexts with known users (e.g. [3][6]).

DESIGN LESSONS FROM DEPLOYMENT

We deployed MAGICBoard for a week near the beginning of the school year, collecting field notes, photographs and video of users and bystanders making use of and observing the display. We report the most salient observations relevant to design here.

Classifying Three Types of Bystanders

Our interest in bystanders began during the design stage of MAGICBoard in our discussions with our focus group (comprised of primarily engineering and computer science undergrads): What would someone see on the large display? How would one understand what was going on? How would one interact with the display? How would one know

Figure 3. Examples left-to-right of (a) a *passer-by*, who is en route to another location, and does not linger; (b) a *stander-by*, who is sitting in the space, and therefore somewhat coincident with the display; (c) an *engaged bystander*, who is reading the detailed comments and was about to pull out his cell phone, and (d) a *contributor*, who is actively engaged with SMS on his cell phone.

how to interact with the display? It became clear that our design focus, which typically centers on "users"—those already interacting with the display, needed to be balanced with an equally concerted focus on *bystanders*—potential contributors who may not yet be engaged with the display, but "users" of the display nonetheless.

Our initial observations of MAGICBoard's use revealed three different types of bystanders: passers-by, standers-by, and engaged bystanders. We differentiate bystanders based on their behaviour and engagement with the display (illustrated in Figure 3).

- *Passers-by* (Figure 3a) were *in-transit*, passing through the area en-route to another location. Thus, the amount of time and effort they expended toward looking at and the display was extremely limited—those that looked at the display gazed for no longer than 10 seconds. And although these passers-by may have glanced at the display, most did not typically stop to interact with it.
- *Standers-by* (Figure 3b) were actually *spending time in the environment* itself (akin to those with peripheral awareness in [1]), be it at a nearby table to study, in the line-up or condiment area of a nearby coffee shop, or simply waiting for someone. While they were not in the environment primarily to interact with the display, they had more time to actually read the content and understand the display.
- Finally, *engaged bystanders* (Figure 3c) were interested enough in the display (with focal awareness [1]) that they were actively staring at the display and "making use" of the content on the display.

This classification scheme has strong similarities to those in [1] and [11], and supports the notion that bystanders have differing awareness levels of the display.

Support Graduated Proximal Engagement

Bystanders cannot be expected to be standing near the display: instead, bystanders' proximity to the display is extremely variable, affecting their visibility of the display's content. To support distal bystanders, the first approach might be to increase the size of all fonts; however, this solution is not only a suboptimal use of the display space, it also compromises the possible interactive complexity of the display. Our design approach was to support *graduated proximal engagement* where *the display can be engaged with from a variety of distances*. This design approach assumes that one's proximity to the display correlates with one's interest with the display, and aims to "reward" users for being closer to the display by providing those users with an improved experience.

- *From far away (20m),* users can see and make out the topic question (and associated picture if present) on display. Graphics summarizing the votes also show that there is a vote going on, even though it is unlikely that the details of the chart is visible from such a distance. These large visuals are intended to provide awareness of the display's purpose to *passers-by*.
- *From closer (10m),* users can make out the details of the summary charts to see the opinion of the community on the topic. Further, it is possible at this visual distance to read the last comment that was made (presented in bigger font). It is clear from this distance that comments have been posted on the display; however, one cannot read these comments. *Standers-by* capable of reading this information can make a decision about whether to engage with the display further.
- *From up close (5m),* all content on the display is visible. At this point, the user can read all of the detail on the display, and in particular, see the comments of prior users of the display and instructions on how they can vote and comment. Our hope is that *engaged bystanders* will become contributors when they are close enough to see all of this content.

Although we realize this concept of graduated proximal engagement by varying the size of visual elements on the display, it should be emphasized that rewarding users for transitioning one type of bystander or contributor to another can occur in a variety of ways. For example, [1] "rewards" users close to the display by providing them a method of interacting with the display. Similarly, [11] provide increasingly personal and explicit interaction for users of ambient public displays based on their tracked proximity to the display.

Lowering Barriers for Interaction

Because large interactive public displays are uncommon, *bystanders may not be aware that they are able to interact with the display*. Beyond this initial knowledge barrier, there is the problem that *bystanders may not be aware of how to interact with the display* and also that *users may be embarrassed to use the display* [1]. Once bystanders have overcome these two barriers, and have begun interacting with the display, we are faced with the usual problem of *providing feedback in a timely and meaningful fashion*. In consideration of these issues, we focused on providing knowledge and mechanisms to lower barriers to interaction [6]. This theme raises the design tension between lower fidelity input *vs*. feasibility of complex interactions with the display.

It was important to communicate to bystanders how to interact with the system. Thus, our instructions were designed such that from a medium distance, one could see a cell phone as a cue that the display had something to do with cell phones. We felt that from this cue, interested bystanders could decide to approach the display, thereby becoming *engaged bystanders*; thus, the instructions could be placed in comparatively small font.

Since SMS is already widely used, we chose to support interacting with the display using SMS messaging from the phone rather than another input mechanism (e.g. web-based forms, downloadable mobile applications, etc.). The trade-off here is clearly evident: we chose to lower the barrier of entry to mobile phone users to increase the number of potential users, but in so doing, sacrifice rich interaction possibilities (e.g. [4][12]). We also provided a form-based interaction mechanism with a laptop right at the display, and we briefly discuss its impact on participation patterns in the next subsection.

Support Covert Engagement and Interaction

Many authors have suggested that a core deterrent to users making use of large public displays is the potential for social embarrassment [1]. This is likely to occur for several reasons: (1) the display is large, so actions (and errors) are made more obvious to others (compared to a laptop-sized screen); (2) it is likely the display employs an obvious input device (so users are easily identifiable), and (3) it is likely the display system employs novel or one-off software (so users are unfamiliar with how it behaves). Thus we suggest *supporting covert engagement and interaction* (though not necessarily exclusively) to draw in curious onlookers who may be understandably shy.

With MAGICBoard, we support this covert interaction using SMS messaging from users' mobile phones. In general, however, this "covert interaction" approach introduces two new design tensions: the problem of feedback *vs*. identifiability, and the problem of learnability *vs*. privacy. The first problem is providing users, who may be dealing with a novel interface (as they were with the SMS mechanism), with feedback in a timely and relevant fashion without revealing their identity. We address this issue by showing only part of the user's semi-unique phone number on the display itself, using a dedicated "Most Recent Post" area of the display to highlight recent contributions (Figure 2, left), and by responding to users' contributions with a text message in return. This SMS response was direct, and "in-context"; any errors would not reveal their identity to the public.

Many authors have observed that bystanders often learn how to use a large display because it provides useful *feedthrough* of interaction (e.g. [1][6]). Clearly, this mechanism for learning is lost with covert interaction. We address this problem by providing easily visible instructions and a straightforward interaction mechanism. Vogel & Balakrishnan provide a video of an actor on the display itself to show bystanders how to use the display [11].

Nevertheless, the covert interaction mechanism (SMS messaging) produced visibly different participation patterns compared to the overt interaction mechanism (the laptop). Parallel to [1], the laptop tended to produce a "honeypot effect", drawing in other bystanders when users made use of it; however, users making use of their cell phones to interact with the display tended to leave longer, more thoughtful messages.

Selecting the Deployment Location

Selecting a meaningful and useful location proved to be somewhat difficult, but ultimately, our choice was dictated by the nature of the bystanders in the different environments. We selected from three different environments: the *student union building*, the *lecture hall building*, and a *corridor/study hall area*.

The *student union building* had the advantage that it was the location that the most students would pass through and they would be from a variety of faculties by virtue of the building being essentially at the main hub of campus. The drawback of this location was that even in this building, we would be sharing the visual space with traditional vendors or campus clubs, and could only place the display in locations where it would not be visible to those entering the space (c.f. [1]). The *lecture hall building* was also frequented by a high number of students. A key advantage of this space was that students entering this lecture hall were primarily computer science undergrads (generally more technology savvy and likely more inclined to try the new technology). The main drawback of this space was that the space actually had no places where students could linger (e.g. sit down) and thus the entire bystander population would be completely in transit, or passers-by.

We ultimately selected the *corridor/study hall area*. This area had several key benefits: first, it was located in a central corridor near the engineering areas (thus, the demographic would be fairly technical); second, it was located near a study area (thus, students would be able to monitor the display for a period of time); third, it was located near a coffee shop (thereby attracting individuals from other faculties); fourth, the display would have clear sightlines from the front door of the area, and the area where the display was positioned was such that the display would be visible even during the day. Ultimately, the key benefit of this location was that we would be able to observe individuals under a variety of different time and motivational constraints (e.g. passing through, waiting for someone, studying, waiting in line for a coffee, etc.).

We also spent a lot of time in the environment, pilot testing the display throughout the day to determine which colours would be visible, and the sizes of fonts that would be required. Because the environment was primarily lit by natural light, we had to carefully select the location (Figure 1), placing the display in the alcove so that some of the natural light was blocked. Here, we found that only a limited colour palette would be distinguishable given the lighting conditions. Further, we tested a variety of font sizes to ensure that the content could be seen from a distance.

The process of selecting a location proved to be considerably more time consuming and difficult than we had initially assumed. As it turned out, the location that we ultimately chose was dictated by the needs of bystanders.

INITIAL OBSERVATIONS

We deployed MAGICBoard for a week near the beginning of the school year. During the deployment, we collected field notes and photographed/videotaped users and bystanders as they both made use of and observed the display. We also retained logs of interaction data, and analyzed them within the context of our observations. We report the most salient observations here.

SMS users seemed more engaged than kiosk users

One surprising observation that came to light was that SMS users typically entered more content than kiosk users. Based on server logs, SMS users keyed more characters and words, and clearly seemed to more carefully craft their contributions to the large display compared to kiosk users. There are likely several reasons for this type of behaviour. First, SMS users have more time to think about and compose contributions to the display because they do not necessarily experience the same *social embarrassment* as those users at the kiosk (who are, in contrast, very visibly interacting with the system). Second, SMS users are likely more committed to contributing to the system because they actually invest effort into retrieving and setting up their own devices. We would expect this to be true if more users made use of the lower-barrier kiosk, and indeed, we saw a 5:2 ratio of kiosk to SMS users. Third, there is some reason to believe that the personal device is simply more conducive to reflective thought compared to a visibly public input device.

Allow relaxed SMS interaction

The core difficulty of using SMS is the relative lag between submission of an SMS message and response by the system. This lag is imposed by the device (via menu systems, for example), and potentially in bottlenecks of the network service. Nonetheless, this lag suggests that user input via SMS should be somewhat lengthy (thereby making up for the lack of responsiveness by providing a long stream of input at once), thus implying a user's interaction with his/her SMS device is also somewhat lengthy. Ironically, it is this lengthier interaction with one's own SMS device that makes it likely that there will be "formatting errors" in the resulting input stream to the large display.

We suggest designers use a relaxed syntax when using SMS interaction for two reasons: (1) it is already difficult to contribute via SMS, and (2) rejecting a user's initial interactions with the system can be devastating.

Although we initially provided mechanisms to provide users with feedback on how to correct their contributions (via an SMS error message), we later simply relaxed the "formatting requirements" of SMS contributions. Thus, ill-formed SMS contributions were simply shown on-screen, thereby providing users with positive feedback that their contribution was valued. Better approaches may be to interpret users' SMS strings, and to infer intended commands.

Kiosk users garner more attention that SMS users

Akin to Brignull & Rogers' observation of a honey-pot effect around the keyboard [1], we found that bystanders more frequently congregated around a kiosk once a user was standing and making use of the kiosk. This effect was extremely noticeable, and users therefore seemed to appear in groups around the kiosk before disappearing. In contrast, we only prominently noticed one SMS user that clearly had a group gathered around him. It is difficult to say whether this effect was difficult to detect because we did not know where SMS users were interacting from, or whether it is an effect of the input device itself.

Regardless, it seems likely that bystanders are more likely to be interested in what a stranger is doing at a public input terminal versus a stranger using an SMS device.

Passers-by are unlikely to participate

As we alluded to earlier, passers-by are typically goal-directed in the sense that they are en route to a location or task. Thus, while many passers-by clearly gazed intently at the display to interpret it, they did so while continuing on in the direction they were headed—that is, passers-by had no intention of stopping. It is unclear whether these passers-by did not participate because they: (1) were unaware that the system was interactive; (2) were unaware of how to interact; (3) were not interested in interacting, or (4) simply had no intention of stopping while in transit. Given the number of users who were able to `make use of the display, and the fact that some passers-by *did stop* to engage with the display, the first three possibilities are put to question.

Regardless, it should be clear that there is another threshold that needs to be overcome from passer-by to stander-by. This threshold may not have been detected in the past (e.g. [1]), because displays intended for the "public" in these contexts were deployed where all bystanders were standers-by by virtue of the setting (e.g. at a party). In future deployments we aim to investigate additional approaches to encourage this transition.

RELATED WORK

The infrastructure of MAGICBoard is not unique, and owes an intellectual debt to systems like the Opinionizer [1], Messyboard [4], and Dynamo [2]. In all three of these cases, the intent was to design large shared displays that would allow individuals to post information snippets from their individual devices/clients. Messyboard and Dynamo are comparatively fairly advanced, facilitating the transfer, display and manipulation of multimedia content.

Our research aims are also aligned with McCarthy [8] and Karhalios [7] in attempting to design *social catalysts* by using large displays. In particular, these displays are intended to be artifacts that catalyze social engagements between individuals. McCarthy designed and deployed a range of such displays, focusing on the ability of such displays to provide appropriate information for those attending to the content, and on how interaction with such displays may occur. Karhalios focuses more on the interactions that may occur around such artifacts across distributed sites, displaying deliberately abstract/ambiguous representations of remote sites.

The particular focus we bring in this paper, however, is on the use of large displays by individuals who are largely unknown to one another. In this sense, the deployments of Blueboard [10], Opinionizer [1] are more closely related to the work presented here because they focus on the social aspects of the interaction between strangers. In contrast most other projects explore deployments and interactions within work groups (e.g. [2][4][8])

Russell & Sue point to several notions of social behaviour around such displays [10]: learning interaction through observation, learning etiquette around such shared displays, and turn-taking. In the particular context of BlueBoard, many of these issues arise because of the need to be within close physical proximity to others when interacting with the display. In a similar way, interacting with the Opinionizer necessitates being in a focal location (at the keyboard) [1], drawing attention to the interactions between these users.

With MAGICBoard, we explored a different tact by allowing users to interact from (technically) anywhere via a wireless link to the board (through SMS). In this sense, some of the notions of physical and control etiquette and behaviours discussed by [10] are no longer relevant; instead, the classifications and discussions of bystanders from [1] and [11] are more relevant. These works are interested in casual "use" of large displays by bystanders, and the present work brings additional attention to that issue.

CONCLUSION

In this paper, we have taken a reflective approach on the design of a large public display called MAGICBoard. The design philosophy emphasizes the importance of designing for *bystanders* rather than the traditional focus on *users.* Since the goal of large public displays is to engage users, we must first understand how to engage *bystanders*, since it is these bystanders that ultimately become users.

ACKNOWLEDGEMENTS

We thank Joel Lanir, Kirstie Hawkey, Karen Parker, and Sidney Fels.

REFERENCES

1. Brignull, H., and Rogers, Y. Enticing people to interact with large public displays in public spaces. In *Proc. INTERACT '03*, 17-24.
2. Brignull, H., Izadi, S., Fitzpatrick, G., Rogers, Y. and Rodden, T., Introduction of a Shared Interactive Surface into a Communal Space. In *Proc CSCW '04*, 2004, 49-58.
3. Erbad, A., Blackstock, M., Friday, A., Lea, R., and Al-Muhtadi, J. MAGIC broker: a middleware toolkit for interactive public displays. To appear in *PerWare '08 Workshop at IEEE PerCom 2008, March 21, Hong Kong.*
4. Fass, A., Forlizzi, J.. Pausch, R. MessyDesk and MessyBoard: two Designs Inspired By the Goal of Improving Human Memory. In *Proc DIS 2002*, (2002), 303-311.
5. Greenberg, S., Boyle, M., and LaBerge, J. PDAs and shared public displays: Making personal information public, and public information personal. *Personal Technologies 3*, 1 (1999), 55-64.
6. Huang, E. M., Mynatt, E. D., Russell, D. M., and Sue, A. E. Secrets to success and fatal flaws: the design of large display groupware. *IEEE CG&A 26*, 1 (2006), 37-45.
7. Karahalios, K. and Donath, J. Telemurals: linking remote spaces with social catalysts. In *Proc CHI 2004*, 615-622.
8. McCarthy, J., Using public displays to create conversation opportunities. in Workshop on Public, Community and Situated Displays, held in conjunction with ACM CSCW2002, (2002).
9. Myers, B. A., Stiel, H., and Gargiulo, R. Collaboration using multiple PDAs connected to a PC. In *Proc. CHI '98*, 285-294.
10. Russell, D. and Sue, A. Large interactive public displays: Use patterns, support patterns, community patterns. In O'Hara et al. (eds): Public and Situated Displays: Social and Interactional Aspects of Shared Display Technologies, 2003, Springer.
11. Vogel, D., and Balakrishnan, R. Interactive public ambient displays: transitioning from implicit to explicit, public to personal, interaction with multiple users. In *Proc. UIST '04*, 137-146.
12. Wang, J., Zhai, S., and Canny, J. F. Camera phone based motion sensing: interaction techniques, applications and performance study. In *Proc. UIST '06*, 101-110.