Designing for Bystanders: Reflections on Building a Public Digital Forum

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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. In particular, we revisit traditional design tenets with this focus on how bystanders transition to being contributors of public display systems, and arrive at three thematic design implications: *graduated proximal engagement*, *lowering barriers for interaction*, and that *deployment issues are actually design issues*. Drawing on our recent experiences with MAGICBoard, we reveal how these thematic issues shaped the design and deployment of the display.

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. [2][4][7]). However, despite the emergence of new technology that allow users to interact with large displays, much past research has found that motivating people to interact with these displays in a public space is a real challenge [1]. One key factor that may prevent people from using large public displays is the potential *social embarrassment* that may be experienced when using the system in front of an audience [1].

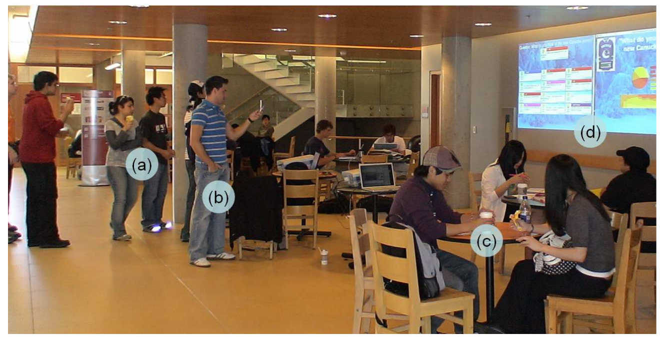

Figure 1. The MAGICBoard only comprises a small space in the overall deployment location (d), and bystanders comprise the majority of individuals near the display (a), (c). Only a single user is actually making use of the display (b).

In designing MAGICBoard (shown in Figure 1), a public digital forum, we sought to address this challenge by using SMS messaging as the primary means of interaction, thereby allowing users to interact with the system from the privacy of their own personal devices. The core functionality of MAGICBoard was simple: users could post text-based items on the display, which would then be persistent until newer items pushed them off-screen. In designing this interactive display application, we were surprised that many of our design choices ultimately focused on individuals who might not be actively engaged with the display itself: *bystanders.*

Brignull et al. [1], in studying people's activity patterns around a similar large display applications, described three classes of users based on their patterns of activity: (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 et al [1] advocate designing applications to support *transitions* between these thresholds. Our early explorations support this conceptual framework, and we show how our design process calls attention to supporting *bystanders' needs* to

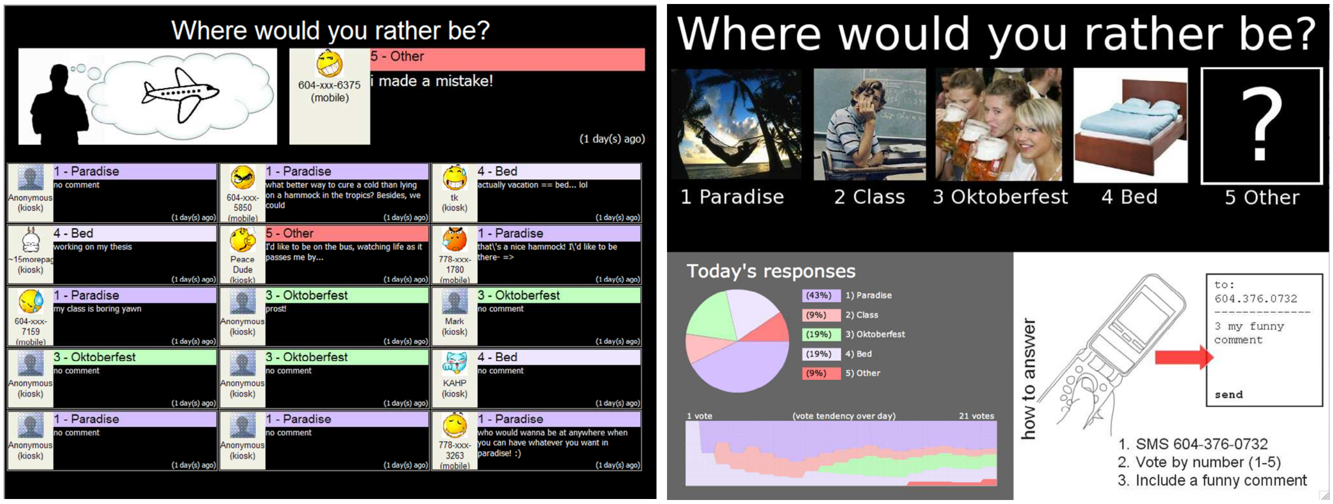

Figure 2. The MAGICBoard's two displays have different functions. The right display is intended to be viewed from a distance, and functions as the "overview." The left display is the "detail" display, and intended to be viewed up close.

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

In this paper, we re-examine several design heuristics from [4] (e.g. providing visibility of system status and purpose, communicating how to interact with the system, providing clear and timely feedback), and arrive at three thematic design implications based on our design process and observations of MAGICBoard's use: *supporting graduated proximal engagement*, *lowering barriers for interaction*, and that *deployment issues are actually design issues*. Based our deployment of MAGICBoard, we also revisit the question of how to design compelling user experiences that make use of remote interaction devices such as cell phones.

In the next section, we outline the design of MAGICBoard, providing a description of its functionality and appearance. Next, we summarize the iterative design process we used, detailing questions we asked ourselves and our focus group as we designed MAGICBoard. Building from experiences during this process, we discuss three thematic design solutions we employed to motivate bystanders to interact with the system. Finally, we present some observations of MAGICBoard's deployment.

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 facilitates a basic form-based mechanism of interaction, and the SMS gateway supporting more "private" entry and preparation of content [2].

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 view display is intended to be viewed from much closer, and shows the last 20 submitted comments.

MAGICBoard was constructed using the MAGIC RESTBroker, an HTTP-based toolkit intended for the rapid prototyping of large display applications [2]. 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 are 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 truly public setting with bystanders and contributors who are unlikely to know one another, whereas prior work frequently deployed such displays in social event settings (e.g. [1]) or in contexts with known users (e.g. [2][4]). In the next section, we show how

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 writing an SMS on his cell phone.

the focus on SMS interaction shaped MAGICBoard's design, and later revisit the notion of public deployment when we discuss observations of its initial deployment.

ITERATIVE DESIGN AND DEPLOYMENT PROCESS

The design and deployment process for MAGICBoard was iterative and user-centric in nature. With the understanding that we would be deploying a large public display in a university environment, we began with the assumption that users would be primarily tech-savvy university undergrads, potentially carrying laptops and mobile phones. We recruited several such undergrads (primarily engineering and computer science students) as our primary focus group, and used them both early on to scope out the potential application space, and later to evaluate the application and interaction several times as we iterated on the design. As we engaged in this process, it became strikingly clear that the traditional approach of designing for "users", or "contributors" (i.e. those directly interacting with the display) was perhaps inappropriate: instead, the challenges we faced were best approached from the perspective of a *bystander*—a potential contributor who was not currently engaged with the display, but a "user" of the display nonetheless.

Early discussions with the focus group clarified several challenges involved with the design of such a large display: What would someone see on the large display? How would they understand what was going on? How would they interact with the display? How would they know *how* to interact with the display? Each of these questions seemed to have different answers depending on whether the user was already interacting with the display or not, and it seemed prudent to design for those that were not already interacting with the display (given that those interacting had already crossed some threshold [1]).

Reflecting on the decisions we made, designing for bystanders revolved around addressing problems of visibility (how would users see what was going on?), knowledge (how would users know what was going on?), and barriers to entry (how would users interact?). In the next three sections, we discuss three thematic solutions to these issues, outlining how we addressed each issue in turn.

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.

In realizing this design approach, we made more detail and content available to users as they got closer to the display. In considering our deployment location, we saw three bystander "types", illustrated in Figure 3, each with different needs:

- *Passer-by*: These bystanders are *in-transit*, passing through the area en-route to another location. Thus, the amount of time and effort they will allocate to looking at and the display was extremely limited—those that looked at the display gazed for no longer than 10 seconds. These bystanders are typically not interested in interacting with the display per say (they are en-route somewhere else), but are often curious about the display.
- *Stander-by*: These bystanders are actually *spending time in the environment* itself (akin to those with peripheral awareness [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 are not in the environment primarily to interact with the display, they have more time to understand the content of the display, so they have time to actually read content.

- *Engaged bystander*: These bystanders are interested enough in the display (those with focal awareness [1]) that they are actively staring at the display and "making use" of the content on the display.

To support each of these different types of bystanders, different aspects of the display's content were designed such that they were visually resolvable from a variety of distances, a concept we call *graduated proximal engagement.* Our aim is to create content that not only engages all three types of bystanders, but encourages them to make a transition from one type to another (e.g. *passer-by* to *stander-by*), and finally, to become a contributor to the system by rewarding them with more information and fulfilment through interaction.

- *From far away (30m),* 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 (this is 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 via 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 in 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, [6] provides users of an electronic room booking appliance varying levels of awareness about a room's use by using different visual affordances on the appliance.

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 utilizing interaction mechanisms that would provide low barriers to use [4], both in terms of fidelity of input and registration of interaction. The design tension this theme raises is the problem that the lower fidelity input reduces the 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.

Our use of the cell phone and kiosk for interaction with the display were focused on providing low barriers to entry. These two input mechanisms allowed different people to contribute publicly through the kiosk or privately on their cell phones. Those who were more easily prone to social embarrassment could still contribute to MAGICBoard without making it public.

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. [7]).

A general challenge to using mobile devices for interaction is the difficulty for others to learn how to use the display by simply watching (compared to the use of a touch-sensitive display) [4], and while we attempted to address this by providing visible instructions, the input mechanism influenced participation patterns around the display. We revisit this observation later in the next section.

A final challenge of using SMS was in providing user feedback on the device. Although we invested considerable visual design effort on the large display to provide users with feedback of their interactions (using a dedicated "Most Recent Post" area of the display to highlight recent contributions—see Figure 2, left), we ultimately chose to respond to users' contributions with a text message in return. This text message response was direct, "in-context", and our focus group were keen with type of "personal" response (i.e. since it was sent to a personal device).

Deployment is design: Location matters

The third theme that we encountered was the notion that *where* the system would be deployed was a key component of the system's overall design: first, the display's location dictates *who* would see the display (in terms of both demographic and the *types* of bystanders in the environment), and therefore who would interact with the display; second, ergonomic issues such as the overall visibility of the display content, ambient lighting and sightlines dictated colour, font size and other visual design considerations.

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 et al.'s 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.

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.

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