An Interactive Poster System to Solicit Casual Design Feedback

Computation

Education

Feedback

Interactive

Social

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AS PART OF A GOVERNMENT FUNDED GRANT IN UBIQUITOUS SOCIAL COMPUTING, WE HAVE DEVELOPED AND DEPLOYED AN INTERACTIVE POSTER KIOSK THAT INVITES CASUAL FEEDBACK ON STUDENT DESIGN WORK OR OTHER ITEMS OF INTEREST AMONG PEERS IN THE SCHOOL OF ARCHITECTURE. The system runs on a standard PC with a large LCD display and a touch-sensitive overlay. Posters reside in the system as web-page URIs. Passersby provide feedback on poster content by "finger painting" on the touch screen. The system e-mails the feedback to the poster provider. We have deployed the system in the Architecture Library for a period of three weeks. During that time, interaction with the kiosk passed through three general phases—unfamiliarity, novelty, and familiarity—with the peak interaction occurring during the middle phase. This paper describes the development and deployment of the system, the quantity and quality of the feedback it attracted, and concludes with recommendations for repeating and improving the exercise.

1 Introduction

Architectural designers in both the professional and academic worlds customarily seek feedback on their projects from mentors and peers (Cuff 1993). Feedback is given formally (e.g., periodic studio reviews and final design presentations) and informally (e.g., desk critiques and casual interaction). In many instances, however, impediments exist to soliciting and obtaining constructive feedback:

- Initial design work is done more privately and is usually unavailable to persons outside the studio.
- Periodic design reviews are usually limited to a few invited critics whose feedback may or may not prove helpful depending on many compounding factors, such as the particular interests of the critics and their personalities. Fatigue sets in during lengthy review sessions, and the quality of the real-time discussion often deteriorates towards the end.
- Others may not have enough time to provide detailed feedback at the moment it is requested.

Recent years have seen an explosion of web sites and systems devoted to social computing, including LinkedIn (www.linkedin.com), MySpace (www.myspace.com), FaceBook (www.facebook.com), YouTube (www.youtube.com), and others. These sites, to various degrees, encourage users to exhibit themselves and their creations, through writing, photography, and video, and solicit comments from peers. One might consider that such systems may be ideal for exhibiting design work and seeking feedback in an educational setting (Bryant 2006). However, there are two impediments to relying on such systems:

- Viewers must seek out the work or be directed to it, requiring a deliberate effort on their part, which detracts from the *casualness* of the interaction.
- Even though the web page content may be a fairly rich mix of media, viewer commentary is limited to text, which detracts from the design *feedback* value of the interaction. While the text may direct viewers to another web page with corresponding media content, it is non-trivial to create graphic feedback relating to another web page.

Clearly, such systems have not yet achieved the social value of traditional posters and bulletin boards. Posters still abound—even in the vicinity of networked computer clusters, as evident in Figure 1.

Traditional printed posters still excel at giving viewers information that they didn't know to look for—or know *where* to look for. A well-designed, well-placed poster doesn't need to be sought out. Viewers don't need to transcribe directions in a deliberate hunt for it. It stands in a busy public place and says, "Hey, look at me! What do you think?"

Nevertheless, traditional posters have obvious disadvantages. Physical display space is often limited, which restricts the number of posters that are privileged to appear. And, feedback on printed posters (e.g., graffiti) is generally frowned upon: it permanently defaces them and indelibly masks the underlying content. More than one feedback episode leaves an illegible mess. At best, such feedback is promptly discarded and replaced with a clean copy of the original poster. At worst, a one-of-a kind, hard-to-reproduce, original work of art has been destroyed.

We have identified a need to develop and deploy a system that allows students to seek casual feedback on their work from a wider audience and in ways that do not require a large time investment on the part of the person providing the feedback. To preserve the advantages of traditional posters and overcome the disadvantages noted above, we have developed an interactive digital poster system with a touch-sensitive screen to allow non-destructive freeform feedback on multimedia content.

FIGURE 1. COMPUTER INTERFACES HAVE NOT REPLACED TRADITIONAL POSTERS AND BULLETIN BOARDS. (IMAGE © NORTHEASTERN UNIVERSITY. USED WITH PERMISSION.)

FIGURE 2. THE INTERACTIVE POSTER KIOSK IN ACTION.

2 Project Context

We developed this poster system as one element of a larger project in ubiquitous social computing (USC) for interdisciplinary design studios. Per Persson coined the term *social ubiquitous computing* and defined it as "[opening up] the context awareness to other users, making the semi-public context of other people a rich structure which will enable, sup-

FIGURE 3. AN EXAMPLE OF POSTER FEEDBACK: "LOVE THE DIAGRAMS!"


```
<?xml version="1.0" encoding="UTF-8"?>
<!DOCTYPE posterlist SYSTEM "http://web.njit.edu/~twhall/PlasmaPoster/Posterlist.dtd">
<posterlist version="1.0">

   <!-- Introductory "meta posters" about the poster itself. -->
   <poster mailto="wassim.jabi@gmail.com" uri="http://wjabi.net/studio/markmeup/" time="60" />
   <poster mailto="wassim.jabi@gmail.com" uri="http://wjabi.net/studio/intro/" time="60" />

   <!-- NJIT options studio -->
   <poster mailto="jsg2@njit.edu" uri="http://wjabi.net/studio/jsg2/page1.htm" time="30" />
   <poster mailto="daw5@njit.edu" uri="http://studio.njit.edu/03mascoli/" time="30" />
   <poster mailto="aks27@njit.edu" uri="http://cnc.gadv.com/slide1.html" time="30" />
   <poster mailto="rj33@njit.edu" uri="http://wjabi.net/studio/rj33/" time="30" />
   <poster mailto="cjb7@njit.edu" uri="http://studio.njit.edu/03buchholz/" time="30" />
   <poster mailto="jjs22@njit.edu" uri="http://wjabi.net/studio/jjs22/" time="30" />
   <poster mailto="wfb2@njit.edu" uri="http://wjabi.net/studio/wfb2/WilliamBrennerPage1.html" time="30" />
   <poster mailto="jmy2@njit.edu" uri="http://wjabi.net/studio/jmy2/page1.htm" time="30" />

   <!-- Cardiff studio -->
   <poster mailto="wassim.jabi@gmail.com" uri="http://wjabi.net/studio/barling/" time="30" />
   <poster mailto="wassim.jabi@gmail.com" uri="http://wjabi.net/studio/brigden/" time="30" />
   <poster mailto="wassim.jabi@gmail.com" uri="http://wjabi.net/studio/buckley/" time="30" />
   <poster mailto="wassim.jabi@gmail.com" uri="http://wjabi.net/studio/crawley/" time="30" />
   <poster mailto="wassim.jabi@gmail.com" uri="http://wjabi.net/studio/day/" time="30" />
   <poster mailto="wassim.jabi@gmail.com" uri="http://wjabi.net/studio/gilarska/" time="30" />
   <poster mailto="wassim.jabi@gmail.com" uri="http://wjabi.net/studio/hallp/" time="30" />
   <poster mailto="wassim.jabi@gmail.com" uri="http://wjabi.net/studio/halls/" time="30" />
   <poster mailto="wassim.jabi@gmail.com" uri="http://wjabi.net/studio/hughes/" time="30" />

   <!-- Jeremy Kargon videos -->
   <poster mailto="jk@jkargon-architect.com" uri="http://wjabi.net/video/kargon01.htm" time="142" />
   <poster mailto="jk@jkargon-architect.com" uri="http://wjabi.net/video/kargon02.htm" time="299" />
   <poster mailto="jk@jkargon-architect.com" uri="http://wjabi.net/video/kargon03.htm" time="333" />
</posterlist>
```


FIGURE 4. AN EXAMPLE OF A POSTERLIST XML DOCUMENT.

port and easify social awareness, communication initiation, task coordination but also expression of social identity" (Persson 2001).

Funded by the National Science Foundation (NSF) as part of a program in "CreativeIT", the project had two principal goals:

- to transfer creative design processes and pedagogy—in particular, the studio model—from architecture to information technology (IT);
- to bring information technology to the service of creativity in design, especially through computer supported collaborative work and casual social interaction.

In pursuit of the first goal, we conducted a series of joint studios that teamed students in the School of Architecture with peers in the College of Computing Sciences. The student teams were tasked with designing a system of interactive kiosks to support the academic mission of the University or enhance the life of the campus. This entailed designing the placement, structure, and installation of the kiosks as well as the human-computer interface, network, and database support. Furthermore, the teams were encouraged to interface their kiosks with the SmartCampus infrastructure (under development) that will allow user identification and interaction with smart phones, via WiFi or Bluetooth channels. With this technology, it will no longer be necessary to manually copy information from a poster or tear off a paper tab. The kiosk can exchange information directly with the user's phone.

For the design studio project, the specific function of the kiosk was left to each team to decide for itself. The team proposals included:

- an interface based on GroundFX (www.gesturetek.com), projected onto pub tables, to allow patrons to interact with and vote on multimedia content projected onto the stage screen, play parlor games, or order food from their table;
- a campus marketplace to connect buyers and sellers of books, apartments, appliances, cars, and other student needs;
- a system of food service kiosks showing available meal items with their costs and calorie counts, tied to a personalized database of dietary history and needs;
- a popular interest information system to publicize and review events, dining, shopping, and other services;
- a system of social networking kiosks that highlights current events and attractions and notifies users when others with common interests are in the vicinity.

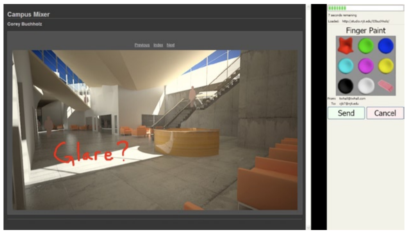
These projects represent our progress toward the first goal: to bring creativity to the development and deployment of information technology. We report the pedagogical aspects of this studio exercise elsewhere (Jabi et al. 2008).

This paper focuses especially on one element of our labors toward the second goal: to bring information technology to the service of creativity in design. In addition to employing common tools such as e-mail and video conferencing, we developed an interactive poster system to solicit casual design feedback. This provided the students with a virtual pin-up space that invited asynchronous commentary from other faculty and students at their convenience, using a finger-painting style of interaction. Students could review the feedback and update their pinups remotely, simply by reading their e-mail and revising their web pages.

3 Precedents

Though we re-invented the system in-house according to our own criteria, we were inspired in part by the "Plasma Poster Network" developed at the Fuji Xerox Palo Alto Laboratory (FXPAL) as reported by Churchill et al. (2003a, 2003b, 2004). In choosing the encoding for the digital posters and tools for annotating them, we considered several precedents:

- PDF files seemed an obvious first choice for the encoding. Most design software can export PDF, and several commercial applications provide well-developed tool suites for annotating it. However, these applications are rather expensive and perhaps too elaborate to invite quick casual feedback. To someone unfamiliar with them, their operation is not immediately obvious. They're not well-suited to run out-of-the-box on an unattended kiosk, since file-access and other "dangerous" kinds of commands must be hidden from the user while leaving the subset of appropriate



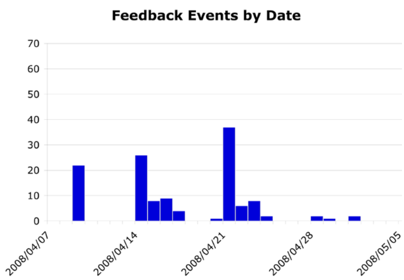


FIGURE 5. A POSTER WITH FEEDBACK IN THE CONTEXT OF THE USER INTERFACE.

FIGURE 6. POSTER FEEDBACK EVENTS BY DATE.

annotation tools exposed. Moreover, PDF files are generally static. The PDF structure does support plugins for embedded media, but the tools and knowledge to create and display such PDF files are less common.

- In contrast, HTML web pages seem well suited for sharing freeform, dynamic, frequently updated content. Social networking web sites and common desktop tools have brought authoring of media-rich HTML to the masses. In fact, HTML can embed PDF content, so it represents a superset of the possibilities offered by PDF. However, there are caveats to this, which this paper discusses later.

Having selected HTML as the encoding, we then considered HTML annotation precedents:

- u-Annotate (Chatti et al. 2006) provides for freeform "digital ink" annotation of e-learning content. Though the annotations are freeform, it's not clear that the original content can be so. If the content is revised or even merely re-flowed with a different font size or window dimensions, it may go out of sync with previous graphic annotations. The content is created by a privileged group (instructors) and may be constrained to conform to a specific format to avoid these issues in an e-learning context.
- Diigo (Diigo 2008) provides for textual highlighting and annotation of free-form web content. The highlighting is somewhat robust in the face of re-flowed or revised web pages: if previously highlighted text subsequently moves within the document object model, the highlighting follows it. However, the annotations are less robust: they may become visually disconnected from the highlighted text they're intended to refer to. Moreover, the highlighting and annotations are strictly text-based, not freeform, and are not well suited for non-textual graphic content.

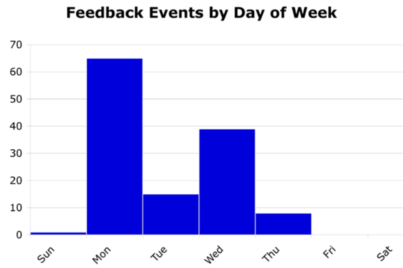
4 Implementation

In our poster kiosk application, we aim to support freeform annotation of freeform content. The strategy we have adopted is to allow designers to submit posters as HTML web pages with minimal restrictions on their structure or layout. A poster may contain live links to multiple pages of content as well as embedded interactive media such as video clips, Flash animations, QuickTimeVR panoramas, or VRML models. When a passerby chooses to annotate a poster with feedback, the application captures a bitmap "snapshot" of its current state and uses that as the background of a "digital ink" canvas upon which the user can finger-paint. When the feedback is complete, the application e-mails the inked-over bitmap to the designer. Figure 2 shows the kiosk in action. Figure 3 shows an example of the feedback it collected.

Each designer creates his or her poster content, uploads it to a web server, and submits the uniform resource identifier (URI) to the poster administrator. The administrator reviews the submission, and if the content is not inappropriate, adds the submission to a queue on a web server. The queue is encoded as an XML file comprising a "posterlist" entity with one or more child "poster" entities. The attributes of each poster include the designer's "mailto" address (to receive the feedback), the poster URI, and the time in seconds that the application should await user interaction before timing out and proceeding to the next poster in the queue. Figure 4 shows an example of a posterlist XML document.

The application retrieves the poster list from the server at regular intervals and displays the posters in sequence. A user can take unlimited time interacting with a poster, including scrolling, navigating through pages in a series, or finger-painting feedback. If there is no such interaction for a preset interval (stored as an attribute of the individual poster), the poster times out and the application advances to the next poster in the queue. Whenever it detects interaction, the application resets the idle timer for the current poster.

The bulk of the application display is devoted to the HTML view frame. A vertical strip at the right edge comprises the application control panel. A progress bar indicates the time remaining for the current poster before the system advances to the next poster in the queue. A scrolling list of poster thumbnails allows users to browse and circumvent the normal queue order. An on-screen button initiates user feedback, at which point the system



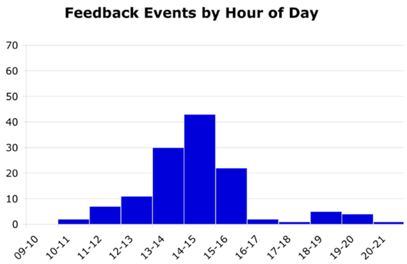


FIGURE 7. POSTER FEEDBACK EVENTS BY DAY OF THE WEEK.

FIGURE 8. POSTER FEEDBACK EVENTS BY HOUR OF THE DAY.

creates a bitmap snapshot, swaps the HTML view with an ink canvas view, and replaces the thumbnails with feedback tools. When finished, the user touches a "Send" button, at which point the application mails the feedback to the designer and returns to the live HTML view. Figure 5 shows another example of poster feedback, in the context of the user interface.

The designer may subsequently choose to make the feedback public by using it as the content of a new poster (with moderator approval, as for the original poster). Thus, the system aims to foster creativity by promoting a dialog between creators and consumers of ideas.

To maintain casualness and ease of use, the application does not require users to log in before marking up a poster and sending feedback. In the future, the SmartCampus infrastructure under development in a separate project aims to provide automated user identification by communicating with users' smart phones. In the meantime, the poster feedback is anonymous.

The kiosk hardware comprises a standard personal computer equipped with a large flat-screen display and a touch-sensitive overlay, mounted on a mobile structure. (The structure itself was digitally designed and fabricated by one of the authors and his students.) The overlay reports touch events to the application as mouse left-button events. When running unattended, the poster application occupies the full screen. We disallow exiting the application by removing the standard keyboard and mouse.

There may be any number of kiosks running the application, drawing from the same or different poster lists. The administrator may add or delete URIs in the poster lists asynchronously without interrupting the operation of the kiosks. Each instance of the kiosk application rereads its XML file periodically and updates its queue accordingly. Since the posters themselves are web pages, designers may revise them at any time.

For compatibility with existing university infrastructure and other ongoing projects, we implemented the kiosk application for Microsoft Windows XP or Vista systems. Our target display for this project was a 42-inch wide-format LCD display, 1360x768 pixels. However, the application adjusts to any display size and may or may not run full-screen, according to a preference specified at startup. In fact, the application can run on any Windows computer using the standard display and mouse or touchpad, but the touch-screen kiosk provides social opportunism and ease of interaction.

5 Deployment

Our first deployment was at a university "research showcase" held in the Campus Center on April 9, 2008. This consisted of demonstrations by one of the authors, as well as "supervised" use by visitors. Following that, we deployed the kiosk in the Architecture Library, unsupervised for a period of three weeks, from Monday April 14 through Friday May 2. Figure 6 shows the number of feedback events per date. Figure 7 aggregates the events per day of the week. Figure 8 aggregates events per hour of the day. Each event comprises an e-mail message from the application to a poster designer.

Excluding tests and demonstrations by the authors, the kiosk attracted a total of 128 feedback events during this four-week period, of which 22 occurred during the April 9 showcase and the remaining 106 occurred while unattended in the library. In the library, by far the busiest days were Mondays, with the second Monday the busiest day of all, and a precipitous drop-off in the following week.

Though it's difficult to estimate the number, it's our impression that most people who saw the kiosk in the Architecture Library had *not* previously seen it in the Campus Center. We sent an e-mail announcement to architecture faculty and students on Monday, April 14, that briefly described the placement and purpose of the kiosk. Some students in the associated studio class also encouraged their friends to try it out.

We added a new batch of poster URIs to the queue on Friday, April 18, but because Fridays are quiet days in the school those posters were not seen by many people until the following Monday, April 21. On that day, in addition to the student design work, we also added posters with audio-video content for an experiment in "content seeking students" (Kargon and Jabi 2008).

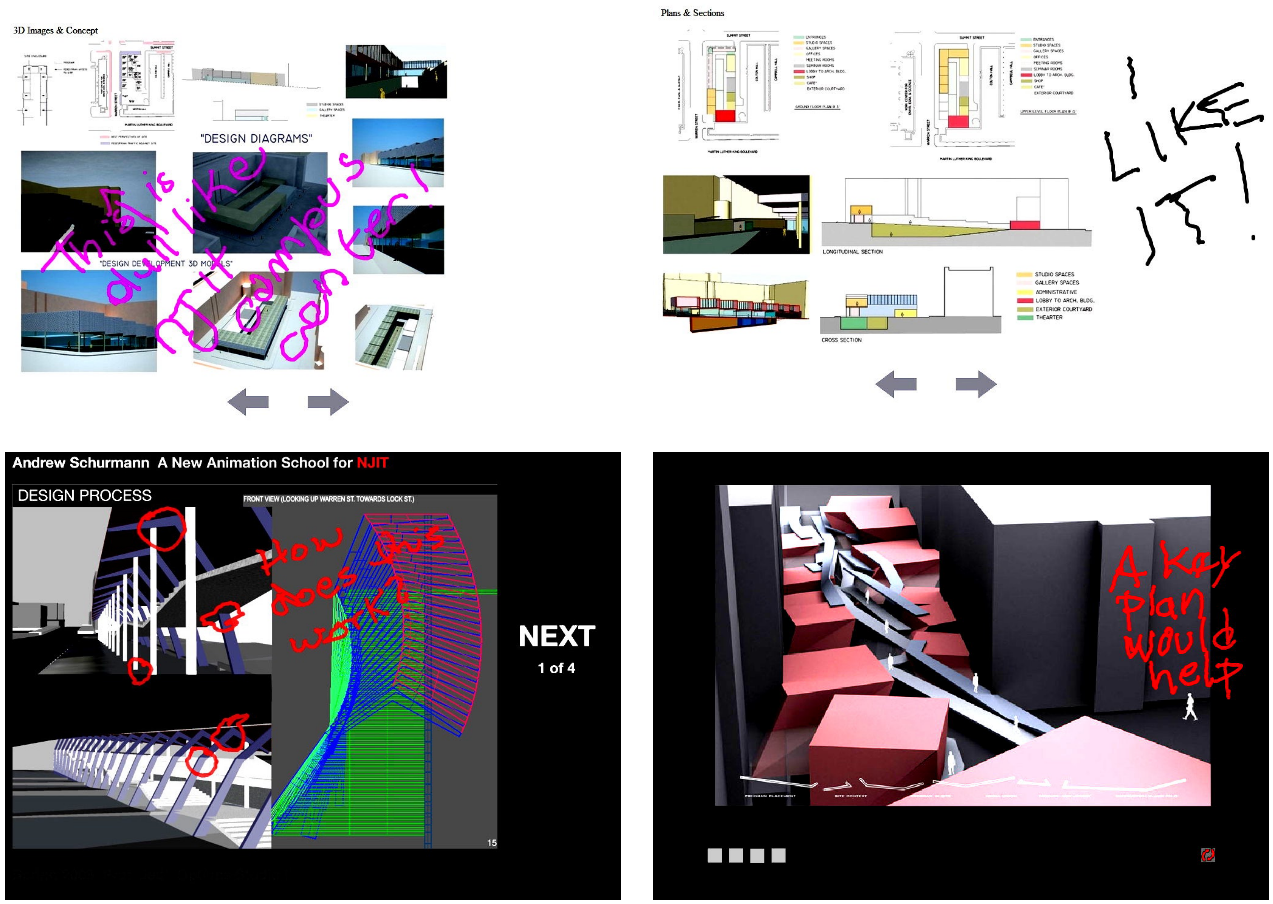


FIGURE 9. EXAMPLES OF POSTER FEEDBACK EVENT CLASSIFICATIONS:

(TOP LEFT) CRITICISM: "THIS IS DULL LIKE NJIT CAMPUS CENTER!"

(TOP RIGHT) COMPLIMENT: "I LIKE IT!"

(BOTTOM LEFT) QUESTION: "HOW DOES THIS WORK?"

(BOTTOM RIGHT) SUGGESTION: "A KEY PLAN WOULD HELP"

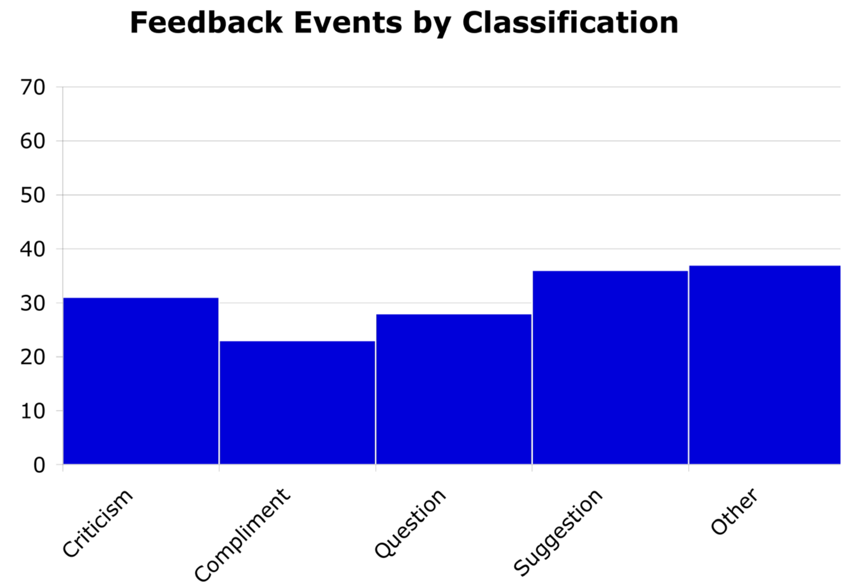
We surmise that familiarity with the kiosk gained during the previous week coupled with the novelty of new posters led to the large number of feedback events on April 21. No new posters were added after that date. Moreover, the students were focusing on their final presentations and not taking time to update the contents of their existing posters: the time for design changes had ended. In the final week, we surmise that the loss of novelty in the posters led to the cessation of feedback.

We reviewed the 128 feedback events and classified 91 of them as some combination of "criticism", "compliment", "question", or "suggestion". These are not mutually exclusive—many of the events exhibited a combination of elements. The remaining 37 events seemed unclassifiable—for example: illegible, ambiguous, or comprising personal messages. Figure 9 shows examples of these classifications. Figure 10 shows the number of events by classification. Suggestions outnumbered criticisms, questions, and compliments.

We feared that the anonymity of the feedback might lead to abuse, but were relieved to see very little. It's hard to assign a specific number—that would depend on a precise definition. In our estimation, there were about six personally insulting, vulgar, or abusive feedback events. Two were nearly identical and seem likely to be from the same user. The kiosk's large display and conspicuous situation within the library may have discouraged abuse.

6 Technical Caveats

To run unattended, the kiosk application must have complete control of the computer's user interface and must be difficult to crash or escape from by other means. It occupies the full screen (including the area normally reserved to the task bar), exposes no controls for moving, resizing, or minimizing its window, and requires the <Esc> key to exit (normally). After starting the application, the administrator removes the standard mouse and keyboard, restricting user interaction to the touch-sensitive overlay and the applica-



tion's own on-screen controls. The C# code is liberally sprinkled with try{} catch{} blocks to intercept and generally ignore exceptions that might cause the application to terminate prematurely.

The web browser control embedded in the application is essentially Internet Explorer (IE) stripped of its own navigation controls. (In Microsoft Visual Studio, it's the System.Windows.Forms.WebBrowser object.) So, the application is sensitive to IE and other system settings beyond its control. These settings need to be secured before the kiosk application starts. For example, script errors in web pages need to be silently ignored to prevent dialogs and alerts from appearing. Options to emulate a mouse right-button click with the left button or the touch-sensitive overlay, such as "touch and hold," must also be disabled since these expose unsupported and insecure command menus.

Web page links that attempt to open new windows (for example, with target="_blank") must be ignored: the application must watch for and cancel "NewWindow" events. It must also descend FRAMESET hierarchies to install event handlers to detect user interaction, to reset the application's idle timer and keep the web page alive.

Web pages that link directly to PDF documents expose other dangers. The Adobe Acrobat plugin inserts its own graphic user interface within the web browser frame, exposing insecure commands such as "Save" and "Print". The poster author can suppress these by embedding the PDF in an HTML wrapper and using JavaScript to disable the Acrobat tools. This is beyond the understanding of casual web page authors and requires technical advice and a document template.

7 Conclusions

Our interactive poster kiosk attracted significant and generally useful design feedback during its deployment. Passersby initially showed some hesitancy in interacting with it. Once they understood its purpose and operation, they were attracted by the novelty of the system perhaps as much as by the posters themselves. When the novelty wore off, the interaction declined.

Two features of such a system seem particularly important to maintain a steady stream of useful interaction:

- Familiarity: Community members need to understand that they're welcome to interact with the kiosk by touching it. This goes against the etiquette of *look but don't touch* that normally applies to posters and computer displays. It wants a user interface that's bold enough to be obvious yet subdued enough that it doesn't detract from the poster content. The allocation of screen real estate and the graphic design

FIGURE 10. POSTER FEEDBACK EVENTS BY CLASSIFICATION.

of the user interface is itself a design challenge. Priming the system with casual demonstrations helps to spread familiarity.

- Novelty: The initial novelty of the system attracts some interaction that is irrelevant to the poster content: users just want to play with the touch screen. After the breaking-in period, users focus more on providing useful feedback. Once they've had their say, they're no longer attracted to ongoing interaction with the same content. They require revised posters or poster lists to maintain their interest. Over an extended period, it might be a good strategy to devote the system to exhibiting different themes or classes of work for periods of one or two weeks at most. When there's no novel content to exhibit for a longer period, it might be a good idea to stow the kiosk to preserve its novelty for its next deployment.

There are technical challenges in developing and deploying such a system. In particular, there are considerable issues of security and robustness in allowing designers to submit posters as live web pages to be displayed on an unattended kiosk. Administrative vetting of posters before adding them to a poster list is only partially effective. The system must be on guard against anything that attempts to expose additional interface objects such as menus, tool bars, or new windows.

Our experience has been positive, and we hope to continue improving the system's effectiveness, robustness, and portability.

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Figure 1 is from the web site of the Northeastern University Department of Art + Design. The authors thank Fred McGrail, Director of Communications and Public Relations, for permission to use it.

9 References

Bryant, T. (2006). Social software in academia. In *Educause quarterly* 29(2):61-64. Boulder, Colorado: Educause.

Chatti, M. A., T. Sodhi, M. Specht, R. Klamma, and R. Klemke (2006). u-Annotate: an application for user-driven freeform digital ink annotation of e-learning content. In *Proceedings of the 6th international conference on advanced learning technologies* (ICALT), 1039-1043. Washington, DC: IEEE Computer Society Press.

Churchill, E. F., L. Nelson, and L. Denoue (2003a). Multimedia fliers: information sharing with digital community bulletin boards. In *Proceedings of communities and technologies*, 97-117. Deventer, Netherlands: Kluwer Academic Publishers.

Churchill, E. F., L. Nelson, L. Denoue, and A. Girgensohn (2003b). The plasma poster network: posting multimedia content in public places. In *Proceedings of human-computer interaction—INTERACT '03*, ed. M. Rauterberg, M. Menozzi, and J. Wesson, 599-606. Amsterdam, Netherlands: IOS Press.

Churchill, E. F., L. Nelson, L. Denoue, J. Helfman, and P. Murphy (2004). Sharing multimedia content with interactive public displays: a case study. In *Proceedings of the 5th conference on designing interactive systems: processes, practices, methods, and techniques*, 7-16. New York, New York: ACM Press.

Cuff, D. (2003). *Architecture: The Story of Practice*. Cambridge, Massachusetts: MIT Press.

Diigo (2008). Web highlighter and sticky notes, social bookmarking and annotation, social information network. http://www.diigo.com/ (accessed April 17, 2008).

Jabi, W., T. Hall, K. Passerini, C. Borcea, and Q. Jones (2008). Exporting the studio model of learning. In *Proceedings of the 26th conference on education and research in computer aided architectural design in Europe* (in publication). Antwerp, Belgium: ECAADE.

Kargon, J., and W. Jabi (2008). Content seeking students: site-and-sound bites as participants in ubiquitous social computing. In *Proceedings of the 2008 EAAE/ARCC Conference* (in publication). Copenhagen, Denmark: The Royal Danish Academy of Fine Arts.

Persson, P. (2001). Social ubiquitous computing. In *CHI 2001 Workshop on Building the Ubiquitous Computing User Experience*, ed. M. Newman, K. Edwards, and J. Sedivy. Palo Alto, California: PARC. http://www.parc.com/csl/projects/ubicomp-workshop/positionpapers/persson.pdf (accessed July 19, 2008).