

# Public Display as Communication Tool for a Co-Located Community

Kshitiz Singh    Rayoung Yang

(SI 789) Computer-Supported Collaborative Work

School of Information, University of Michigan

## **Abstract**

We studied the use of multiple public displays deployed throughout North Quad Residential Hall at University of Michigan. These displays are largely being used for broadcasting official news and provoking informal interactions between residents. Our paper is focused towards use of displays as a communication channel. In particular, our research covers three aspects related to this variation of public displays. Firstly, we determined the impact of using digital displays as a communication channel on other existing channels. Secondly, we studied the origin and impact of ubiquity created by these devices. Lastly, we observed privacy issues that people have while posting content and thereby establishing their need for a brief awareness of the audience. We conclude by establishing the need for further study of public displays as a communication channel.

## **Introduction**

Public Displays are increasingly being studied under the domain of Computer Supported Collaborative Work (CSCW). An interesting fact about these public displays is that they are perceived as *information appliances* [13] rather than general-purpose computers. Hence, it grabs the interest of many CSCW researchers for studying personal and public behaviors around it. A number of research groups are studying group dynamics for augmenting use of shared display.

These displays are deployed in diverse formal and informal settings. Of the research done on public displays, there are many interesting studies that focus on use of these displays as a communication channel, i.e., for remote conversations and sharing information. Findings from these studies are primarily related to adoption of public displays, appropriateness of content and its dependency on physical characteristics, combined influence on a community and also privacy concerns associated with the use of these public displays.

A limited number of studies focuses on adoption of public displays and provide hypotheses for introducing these displays into both formal and informal settings. Huang et al. [11] focuses on deployment of IMHere: A large public display supporting instant messaging. They identified five factors that are crucial to adoption of any public display system. These factors are specificity of tasks and integration with existing work procedures, flexibility of tools for its use beyond intended purpose, visibility and exposure to others' interaction, low barriers for usage and a 'core' group of users dedicated to use of the display. These factors are important for strengthening the perception that the tool is being used and also for users to quickly understand the use and benefits of the system.

Ample amount of research has also been done for studying physical characteristics of public displays like its position and screen size and relating it to relevancy of content. They have found that content is dependent on attention time, information clutterness and mental models for public and private usage. In the study of Plasma Poster Network, authors infer that reading and interaction patterns are dependent on location of the display [6]. In a similar research, Huang et al. [9] mention that positioning of the display and the screen size are important decisive factors for determining brevity, format and dynamics of content. Also, while implementing Notification Collage, Greenberg and Rounding [8] compared preference related to peripheral content of large public displays to private peripheral display using a secondary PC monitor.

Another set of research evaluates public displays for interpreting cumulative effect on a community. Koch [12] provided an explanation for utilizing public displays to generate community awareness. He argued that public displays could provide a better sense of group and individual activities and it is crucial to provide an appropriate visualization of these activities. Dourish and Belloti [7] also infer that increased awareness can enrich existing relationships and provide triggers for forming new bonds.

There are limited research that focus on privacy aspects of public displays. Greenberg and Rounding [8] argue that these public display systems should provide better visibility of what content is being recorded and how that is being used. Belloti [4] and Boyle et al. [5] focus particularly on distraction induced by public displays. They provide justifications that these displays are more suitable for providing peripheral information. In lieu of these concerns, Huang and Mynatt [10] present effectiveness of using “Semi-Public” displays for small and co-located audience. Recently, Rucker et al. [14] have investigated how large-scale public displays can address privacy concerns at individual level.

Our study is focused on one such installation of digital displays in North Quad Residential hall at University of Michigan. This installation involves use of multiple display monitors all across North Quad Residential community. These display monitors are installed at the community center, each floor outside the elevator and also at common areas/lounges. Unlike past research that focuses on display device as a separate entity for mediating communication, we wish to analyze combined usage of public displays along with existing communication channels. We also wish to connect usage of public display for information sharing, with that of using other communication methods (face-to-face, email). Also, since multiple monitors were installed throughout the residential hall, it would also be an interesting opportunity to analyze information sharing strategies that make best use of ubiquity offered by multiple devices. While earlier research segregate their focus on creating awareness and discovering privacy issues involved with

use of public displays, none of them focus on how could awareness of audience can help owner of the content realize his/her privacy needs. Our hypothesis is also coherent with dynamic nature of privacy put forward by Ackerman [3].

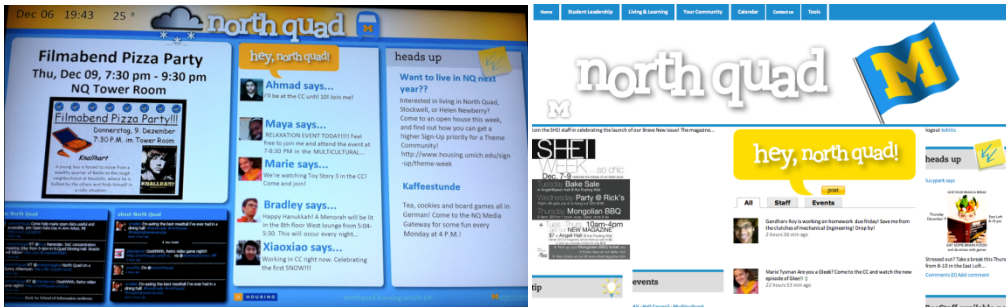
### **Site and System Overview**

The North Quadrangle (North Quad) was inaugurated in August 2010 and is newest amongst 18 residential halls at University of Michigan. The residential hall accommodates approximately 450 upper level undergrads and is home to International Impact, a theme-based community focused on multicultural world, as well as two academic learning communities: the Global Scholars Program and the Max Kade German Program [1]. There are lounges on each floor in addition to a hall living room and various community spaces such as Community Center on 1st floor, Community Learning Center on 2nd floor and Tower Room on 10th floor. A dining center and a coffee shop are also located inside the residential hall.

At North Quad, there are three displays installed at the community center and on each floor, there is one in the elevator hall. The Community Center is at the entrance of the residence and it's a place where students gather, meet peers, share good news and ask for advice. It is also seen as a center point for quality service, direction, resources and help. The display monitors are installed at the community center, each floor outside the elevator and also at common areas/lounges.



**Figure 1: Left to Right: Displays at Community Center providing information about current information about North Quad (left) and General News from BBC (right), A display outside elevator hall providing event information, post from residents and tweets, display at a lounge providing the same information as the one in elevator hall**



**Figure 2: Content fetched from the North Quad Website ([www.northquad.housing.umich.edu](http://www.northquad.housing.umich.edu))**

## Method

### *Content Analysis*

We examined 661 posts made on North Quad Website in 126 days starting from July 10th 2010 to December 13th 2010. Two researchers analyzed posts, by initially developing a classification schema based on common themes and attributes of these posts and then independently assigned

posts to content categories. Thus, we built the following table containing ten categories where each category is clarified with an exemplary post.

Category	Example	Category	Example
Residential Event Announcements	Event Date: Mon Dec 13 2010.  Location: NQ Media Gateway Tea, cookies and board games all in German!  Come to the NQ Media Gateway for some fun every Monday at 4 P.M.!	General Greeting	HEY YALLLLL
Residential Information	VOTE!!!!  Don't forget to vote, elections for NQ Council until Sunday :)	Holiday Greeting	HAPPY DIWALI!
Candidate Advertisement	Is your musical side feeling stifled?  Wish you had a PIANO here in North Quad? If elected for Co-Chair of Student Governance, I would work toward improving our music practice facilities so you can let your creative side out and quit bugging your suitemates when you practice in your room.	Congratu- lations	Celebrating the birthday of our own Vikram Sridhar!  birthday North Quad Vikram  Fellow NQ residents and friends celebrating Vikram's birthday! All smiles!
Residential Staff Posting	is working on homework due friday!  Save me from the clutches of mechanical Engineering! Drop by!	Semi-Formal Communication	NQ Spirit  I'd just like to say NQ is awesome! That is all..
Campus Event Announcement	Looking for something to do tonight?  Come to Blockbuster at the Belltower!  Enjoy the movie Iron Man 2 under the stars on the North Campus diag.	Display	Don't mind me, I'm just posting this so I can see it on the awesome North Quad TVs.
Academic	CGIS Summer Fair	Resident	North Quad Orchestra?



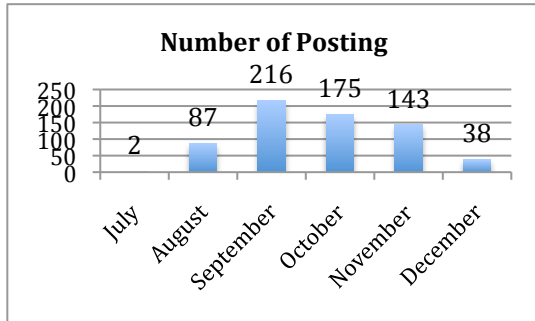
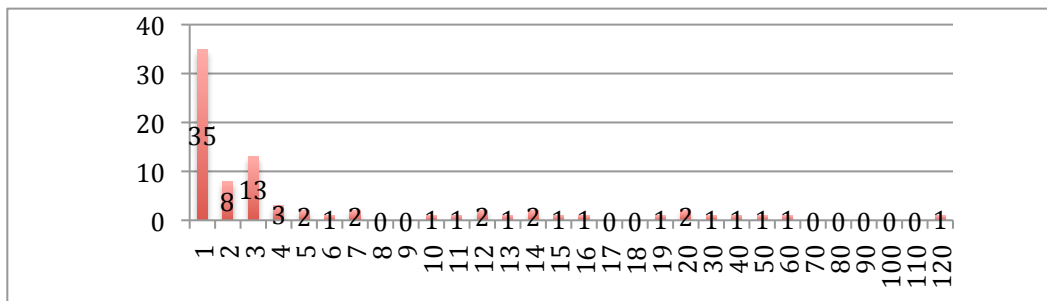
information	Read more	Group Organization	I'm trying to see if there is any interest in making a North Quad Orchestra- just a group where we get together and play sometimes.
Hall Meeting	Hall Meeting Event Date: Sun, 2010-10-24 17:00 - 18:00 Location: Tower Room Hello terrific residents of the 7100 side	Forming New Bonds	Project Runway Tonight @ 9 in Room 7177 And bring a tea cup! (Otherwise, it's pretty much what it says on the tin.)
Hall Membership	NQ FTW!! Hey north quad!! So excited for the new dorm and dormies. 7th floor shout out	Attention Seeking	Shower Singing To the gentleman living on the 8th floor, your shower singing is awesome! You belt it out like a male Whitney Houston.
Negative Feedback	Java Blu has to be the worst in hall cafe on campus. I had to throw away three hot chocolates in a row because they tasted like pure chocolate syrup. I've wasted \$8.	Sharing personal information	I'm going to Canada this weekend! Peace out NQ
Sharing Media	Jason Mraz concert!! 	Discussion	Facebook me! "TWO GUYS ON THE BIKE" So, when errone comin to visit me in my room??? 8184! 

Table 1. Post categories and examples.

The chart below displays the number of posts made on North Quad website from July to Mid-December. During July, there were two postings made by a staff at Information Technology Office in order to test the system. As residents started moving in at the end of August, number of posts started to increase. During September, when all the residents have moved in and the semester began, 216 postings were made.



**Figure 3: Number of Postings by month**



**Figure 4: Number of people by posting frequency**

There were 81 people who posted at least once on the North Quad website. Residential staff members were the primary contributors. The number of postings per person shows that 35 out of 81 people posted once. One person who posted 120 postings was the Peer Academic Success Specialist who is primarily responsible for mediating all the academic information sent by University of Michigan. The second largest number of posting by one individual was 67 by the Hall Director of North Quad residence. Eight out of ten people who posted more than 10 times were residential staffs and other two people were residence hall association representatives.

### *Semi-Structured Interviews*

We also conducted 12 semi-structured interviews that involved three administrative people at housing department, four residential staffs and three students. We targeted people with diverse responsibilities in order to explore diverse usage of public displays at North Quad. Participants were recruited through a key informant at the housing department and using accidental sampling method similar as "person on the street" sampling method. For the residential staff member, incentive was a \$10 gift card for their participation. All seven residential staff members that we interviewed are actively involved with posting content on North Quad website.

Participant	Role	Posted	Participant	Role	Posted
P01	Housing Department Staff	O	P07	Residential Staff	O
P02	Housing Department Staff	X	P08	Residential Staff	O
P03	Housing Department Staff	X	P09	Residential Staff	O
P04	Residential Staff	O	P10	Resident	X
P05	Residential Staff	O	P11	Resident	X
P06	Residential Staff	O	P12	Resident	X

Table 2. Interview Participant Information

One of the key responsibilities of residential staff is to build the community. “Community building means getting to know the residents and fellow staff members, both individually and collectively, by investing time and energy into activities and events that will help facilitate the development of positive and meaningful relationships.” [2] They are also responsible for building community and promoting awareness at the Community Center location.

Title	Description	Responsibilities
Community Assistant	Providing excellent quality service and supporting students, staff, and visitors in the residence hall 12-15 hours per week	<ul style="list-style-type: none"> <li>Getting to know residents, both individually and collectively, address the needs of residents, and help with community building to meet the needs of the community.</li> <li>Build community and promote awareness at the Community Center.</li> </ul>
Peer Academic Success Specialist	Providing advice, information, and programs in support of academic activities and integrative learning 20 hours per week	<ul style="list-style-type: none"> <li>Referring students to appropriate academic resources, services, special academic programs, and related learning technologies.</li> <li>Serving at the Community Center with a focus on getting to know residents and building community.</li> </ul>
Resident Advisor	Responsible for assisting the students on their corridor, floor and throughout the building 20 hours per week	<ul style="list-style-type: none"> <li>Building community in the residence hall by participating and encouraging casual social interaction, planning and implementing social programming and demonstrating consistent availability and accessibility to residents.</li> <li>Planning and implementing both social and educational programs, while encouraging resident participation in the community.</li> </ul>

Table 3. Residential Staff Job description and Responsibilities

Participants were asked general questions about communication and information sharing at the residence, their use of various communication channels and advantages and disadvantages of displays at North Quad housing. They were also asked to share their opinions about purpose of these displays and their usefulness. Answers to these questions were used to gain an insight on

the perception that residents and staff have about the displays at North Quad and to understand its usage.

Transcripts from the interviews were further coded using grounded theory. Categories were made for themes that were crucial for our research questions. In the next section, we would elaborate on combined findings of these interviews and content analysis that we discussed earlier.

### **Findings**

From the interviews, we learned that how residential staff members use different communication channels for different purposes. Since role of residential staff is primarily to build community membership and provide resources to members, their communication patterns are mainly in-person communication to know how their residents are and be available whenever they might need some psychological support. Their role is also to disseminate information to provide awareness about events, activities and resources.

The following table represents multiple communication channels used by staff members and the residents. It also contains some instances that best describe usage of these channels.

Face-to-Face	The real personal communication like face-to-face is the mostly effectively and getting to know each other and build relationship. (S11)
Email	I check an academic email but not the RA email (S01) I have e-mails on my phone. I just automatically read through really fast and see if there's anything going on or... (S05) Usually only times I use email is the weekly email. (S11)
Bulletin Boards	Bulletin board has the same information so she does not look at it. (S05) Bulletin board is mostly for calendars, and procedure in the dorms. It's updated once a month. (S11)

Displays	<p>Displays are nice and pretty useful, information on there. It shows the time and temperature outside. They list events and stuff. Normally, I don't have time for events, but could be useful. (S02)</p> <p>If you forget about events going on, it's a good reminder. (S04)</p> <p>They can send event flyers better faster. (S07)</p> <p>It's easier to put information in a public space where people can have a look if they choose to. (S10)</p>
Website	<p>I've never been to the website. (S01)</p> <p>I've heard of the website but never used it. (S02)</p> <p>I haven't made an account on it. I visited the website at the beginning of the year, but don't use it very often. (S04)</p>
Doors	<p>I post things on the door. Every time they will open the door, they will see it. (S12)</p>
Big Signs	<p>Big sign is for throwing a party or something and want to let everyone to know about it. It's placed on the day of the event. (S12)</p>
Flyers	<p>Lot of information is got from RA or other community information or from flyers. (S02)</p> <p>Flyers do not seem to be effective. Flyers there are lot of work, to make them and print a lot. Students see flyer a lot, so they don't seem to spend a lot of time. (S10)</p>

Table 4: Communication Channels used at the resident.

*Strengthening face-to-face and email communications through public displays*

Our interview indicates that public displays supplement dissemination of information for the general audience, but generally it is not effective for personal communications. Once resident assistants have developed personal relationships with residents through direct face-to-face

interactions, the relationship needs to be maintained through frequent interactions using other communication channels like emails, social networking websites and more importantly, through public displays. Owing to large number of residents, it is time consuming to interact with everyone on regular basis. Displays provide the ability to change contents faster and more easily . S10 said, "*Having display helps your work. It's easier to put information in a public space where people can have a look if they choose to when something comes up.*" Hence, displays are definitely more effective than e-mails and social networking websites for augmenting existing personal ties developed through face-to-face interaction or other communication channels.

During the content analysis, we discovered that many residential staffs post messages while working at the community center such as, "*Are you a Gleek? Come to the CC and watch the new episode of Glee!! :)*". These kind of messages depict a new emerging communication pattern on displays since it might not be appropriate for the residential staff to update their duty using other communication channels such as bulletin board, emails or face-to-face. Public displays provide an effective way for outreaching the whole residential community and to invite them for an imminent informal gathering. Residential staff (S11) told us that "*Like there is one guy who I don't know really who he hangs out with besides coming to the Community Center and he's pretty quite when he does come but I think it's nice that he could he feel like he could just hang out down there when he wants to.*" Through these displays, both residential staffs and residents can easily make a public announcement and reach a broad audience in non-intrusive fashion that is unachievable through other communication channels. Hence, public displays also augment these communication channels by providing a mechanism for outreaching a large audience non-intrusively, which is not possible through other communication methods.

## mtysman says



Submitted by mtysman on Wed, 2010-12-08 13:10



Are you a Gleeek? Come to the CC and watch the new episode of Glee!! :)

## Project Runway Tonight @ 9 in Room 7177



Submitted by jshost on Thu, 2010-09-16 17:51



And bring a tea cup!

(Otherwise, it's pretty much what it says on the tin.)

### *Ubiquity created by multiple monitors*

The networked displays at the community center, every elevator halls, common areas provide easy access to information. We found that both content viewers and creators used this ubiquity created through multiple monitors to their own advantages. For viewers, the ubiquity is primarily helpful for augmenting their memory. Whereas for content creators, the ubiquity is important for forming content posting strategies to ensure that the message is conveyed effectively.

From the perspective of content viewers, ubiquity creates different behaviors associated with displays located at different locations and at different proximities. The display monitors that are situated near to residents' rooms (i.e. outside the elevator on each floor) are perceived as more customized to their information needs. However, monitors located at a considerable distance (at Community Center) are considered to be less customized and hence expectations are that they will display general information. Owing to this ubiquity, these monitors were also treated as a secondary memory. During the interviews, some of the residents conveyed that once they know about an event, monitors were particularly helpful in ignoring details to the time when it is necessary. S04 said, *"Just to see if I'm running late or anything. They have events. I haven't really gone to that many events, but there are always cultural things going on. And then, it will tell you, 'Oh, it's happening today'.... It's always good to know because I have forgotten about it then, and it's a good reminder."*

These behaviors have implications for content creators to strategize their information sharing methods. While proximal characteristics of a monitor could be used to decide whether information on it should be specific or general, further strategies could be adopted to use this

ubiquity for conveying information at appropriate times. For example, for an event, resident advisors are sending a weekly email containing a short description of all the events happening during that week and further following up with details through display monitors that were more appropriate for serving as memory for event details so that it could be used when needed. S04 said, “*Every week, there's usually weekly e-mails about what's going on in North Quad. They will give an overview of what's going on. TVs could be referred for details when needed.*” Hence, ubiquity provided by multiple instances of a technology could be utilized to the advantage of both: content providers and content viewers.

#### *Awareness of the audience*

Communicating through Public displays demands an intrinsic decision to be made by the person posting content. This decision-making involves evaluating relevancy of content, urgency and most importantly audience to whom the information is addressed. Through content analysis and interviews, we found evidence that supported that there were inherent needs to get awareness of audience before posting the content.

Through our study, we discovered that there exists a motive for seeking awareness about the audience. This motive is to find the most relevant place for communicating information to a specific audience. Some of the behaviors we observed verified absence of an awareness system and depicted a need for it. Almost all of the residents are receiving leaflets placed on their door in addition to information they are receiving from the display, as resident assistants are not sure whether the audience they wish to reach would be watching that display. One of the 9th Floor research assistants even used a header “*Attention 9th Floor*” before the actual event information. This was done in purpose for grabbing attention of only 9th Floor residents. Hence, it is evident that a better awareness of usage of these displays would be helpful for forming strategies to share information.

We even discovered that awareness of the audience would also be helpful for better realizing one's own privacy needs. Public displays provide an asynchronous channel where one might not be aware of people who will be watching the content in his/her absence. A better sense of audience looking at the display is essential for self-realization of privacy conflicts that might arise from posting on these displays. One of the resident assistants expressed concerns about her name being displayed next to an event as she wasn't sure about the audience who will be watching the display or visiting the website other than residents. She also mentioned that on some occasions some of her private information (name, phone number, room number) might be necessary for those who are genuinely interested in an event. Hence, there is a need for semi-public communication strategy for making the information interpretable by specific audience and not by others. During the content analysis, we found that many posts were using "a community jargon" for posting privacy-critical information. For example many resident advisors and community assistants used CLC (stands for Community Learning Center) for notifying that they are currently available at the community center. Hence, community norms/jargons could provide a method to camouflage the information so that it is sensible only to the targeted audience.

## **Conclusion**

Our research analyzes the communication aspects of public displays installed in North Quad Residential Hall at University of Michigan. An analysis of content already posted on the website and 12 semi-structured interviews with residents and staffs yielded insightful results that provided a firm base to our findings.

These displays are consistently used in consonance with other communication channels. They augment these communication channels by providing a mechanism for outreaching a large audience non-intrusively, which is not possible through other communication channels. Although displays are effective in strengthening existing relationships, our intuition is that it might not be

the best channel for building new relationships. In a co-located environment, face-to-face communication is more effective for building new ties.

Presence of multiple instances of a technology increases its utility of being ubiquitous. We observed that this ubiquity creates different behaviors associated with displays located at different locations and at different proximities. For viewers, the ubiquity is primarily helpful for augmenting their memory. Whereas for content creators, the ubiquity is important for forming content posting strategies to ensure that the message is conveyed effectively.

We also found an inherent need for a better awareness of audience before posting any content on these public displays. A better awareness of usage of these displays is helpful for forming strategies to share information. Awareness of the audience is also helpful for better realizing one's own privacy needs and supporting "Semi-Public" communications. Community norms/jargons could provide a method to camouflage the information so that it is sensible only to the targeted audience.

## **Discussion**

In this section, we will address some limitations of our study and design implications that follow our research. Since we observed initial implementation of the digital displays, the depth and broadness of the study suffered short-term period of deployment. However, from interviews with residential staff and residents, we were still able to draw some design implications for the display.

During first 5 months of the deployment of display, we observed residential staff members use the display to share various kinds of information. However, we observed that very few residents participated and post content on the display. Actually, the residents didn't contribute, as they were unaware of the mechanism to make a post. Use of website for making a post was not announced officially to the residents and many were not well aware of whether they can post, what kind of information they can post and how to post. For instance, many interviewees referred the display

as 'TV' or 'screen' and pointed out that it doesn't provide a mechanism to provide feedback or respond to the content. S11 said, "*There are multiple ways to get residents. Television is easy to read it, but it's difficult to have a dialogue about it... There's always things about the German Club has their dinners and to remind me to go with those things, but as I said before it's kind of impersonal, to have it up there. You don't feel as connected to it as if somebody had invited you to go to it.*"

For promoting more active participation from residents, the displays would need to lower the barrier while they respond to the content. Digital displays controlled by an external software application can support adaptation to its usage and provide a better awareness of the audience (by showing a list of users present on the system). Also, through providing support for posting by a secondary device such as keyboard or cell phone, residents can easily interact with the display directly at the location of display.

However, the usage of displays at North Quad is very limited and still remains as one-way broadcasting system like bulletin board. A more interactive and smart display system could provide more relevant content to the audience and would allow them to actively interact with it.

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