Media Sharing Across Public Display Networks

Rui José[1], Jorge C. S. Cardoso [2], Jason Hong [3]
[1]Centro Algoritmi, University of Minho, Guimarães, Portugal
rui@dsi.uminho.pt
[2] CITAR/School of Arts, Portuguese Catholic University, Porto, Portugal
jorgecardoso@ieee.org
[3] Carnegie Mellon University
jasonh@cs.cmu.edu

Abstract. In this work, we consider the scenario of an open display network in which people can post their content to a potentially large set of public displays. This raises the key challenge of how to associate that content with the displays that may provide a more meaningful context for its presentation. The main contribution of this work is a novel understanding of how different properties of the media sharing scenarios may impact their perceived value. We have conceived 24 media sharing scenarios that represent different combinations of three independent variables: content locativeness, the personal nature of content and the scope in which content is being shared. We then invited 100 participants to express their perception of the appropriateness of those scenarios. The results indicate a clear preference for content that is both personal and locative, something that is in strike contrast with the prevailing content on current digital signage networks.

1 Introduction

Current public display systems are not yet a communication medium that can be systematically appropriated by people to publish their own content. However, the emerging principles of Open Display Networks [4], in which large-scale networks of pervasive public displays and associated sensors are open to applications and content from many sources, may create entirely new expectations in regard to the scope of media sharing on public displays. While previous research has already studied many variants of user-generated content for public displays [2][11][8], such research has mainly assumed a publication scenario in which content is posted to a specific display within a clear context of "here and now". However, open display networks create entirely new possibilities for posting user-generated content to a potentially very broad and unknown set of public displays. Unlike the traditional narrowcast model, where content from a single centralized source is distributed to a set of displays, this distribution model entails a many-to-many distribution paradigm in which content from many users can be shown wherever appropriate.

This raises the key challenge of how to redefine appropriateness, beyond the context of "here and now". Like many other forms of communication, including social networking services, media sharing on a public display occurs within the scope of a wider social context that frames the notion of what might be appropriate to present.

When content is posted on a specific display, the context in which it will be shown is implicitly defined by the inherent locativeness of the publication process. Appropriateness is directly linked to the interpretation made by the publisher about the current display setting, and any social negotiation surrounding the shared used of the display is normally implicit in the interaction process itself. However, when considering media sharing across an open-ended set of displays, this association with a specific context is lost. Alternative approaches are thus needed to support the match between content being posted by people anywhere on the network and the displays that may provide a meaningful context for its presentation.

In this study, we aim to understand how user expectations about media sharing across large networks of public displays can be affected by the nature of the content being published and the scope of publication. We assume that users can post media items for presentation across an open network of public displays. Our key research question is to understand how in that context, different properties of the content or different publication scopes may affect the perceived utility of media sharing situations.

2 Related work

A very broad range of techniques has been studied to enable display systems to accept content originating from users. One of the earlier examples, the Plasma Poster [2], allowed people to submit photos, text, and web pages to a public display using email or a web form. SMS and MMS have also been extensively used as an interaction technique for the spontaneous generation of content. For example, the Joe Blogg project [11] includes a display designed in the form of an interactive artwork where people can send pictures and text messages through MMS or SMS. Hermes [1] explored the use of Bluetooth to enable users to send pictures and other media to a display. The use of Bluetooth names as an interactive feature has been described in [8][5] as an essentially opportunistic alternative that is easily available to enable user-generated content on a broad range of mobile devices.

Despite the many techniques for placing user-generated content on public displays, Huang and Mynatt [7] observed that individuals tend not to be motivated to supply content, or else have difficulty identifying appropriate content. Similarly, Müller et al. [12] describe how public displays may be perceived as a stage in which people will only act if they feel confident about their actions and in full control over the presentation of self.

More general publication practices around large scale networks of public displays have been studied by Friday et al. [6] in a long-term analysis of the e-campus deployment at Lancaster University. Publication practices are also a central topic for Instant Places [9], an open network for public displays that allows people to systematically manage content publication. The system has been deployed across a set of locations at which participants were allowed to create and distribute digital posters for presentation on public displays. Altogether, these findings suggest that at least part of the challenges involved in making user-generated content a reality are not directly related with the interaction process itself. Instead, they seem to be more strongly

associated with the motivation, the context and the meaning of the media sharing process.

Location-based Social Networks include location information into their social graph to enable users to see where their friends are, to search location-tagged content within their social graph, and to meet others nearby [10]. The relation between physical co-presence and on-line social friendships has been studied by Cranshaw et al. [3] who have shown that such relation is strongly dependent on the entropy of the locations visited and the number of social ties that a user has in the network. The ways in which different types of interpersonal relationships may be associated with the willingness to share information between people has been studied by Wiese et al. [14]. In this study, we address a specific type of social graph in which the social object is a screen media item and the social connections are primarily aimed at enabling the presentation of that content in socially meaningful contexts. While sharing some of the properties of location-based social networks, particularly the key role of location and presence, a social network for open displays would have to support a new type of social graph that is anchored on places and their role as meaningful contexts for media display.

3. Research Methodology

Our research methodology is anchored on the perceived utility of different scenarios of media sharing across large networks of public displays and how that perception of utility is affected by three independent variables, more specifically: (a) the locativeness of the content being shared, (b) how personal that content is and (c) the scope in which it is being shared. In regard to locativeness, we consider the extent to which content is related to a local scope. We also consider the effect of how personal the content is. Considering the public nature of the displays, our notion of personal does not include any privacy–sensitive content. Instead, we are just considering authorship or the extent to which the content is an expression of identity. Like in most social networks, a media item may have been created by the person herself to express personal views or it may simply have been pulled out from some third-party external source and shared for presentation. Finally, we also consider how different sets of places can provide meaningful contexts for expressing the scope of media sharing. We assume that when posting screen media items to the display network, publishers will be asked to express their view of the respective publication scope, i.e. the set of places where the presentation of that content is seen as appropriate by the publisher.

3.1 Scenario specification

Since open display networks are not yet a reality that is part of people's everyday lives, we could not base our study on data about existing media sharing practices. We thus devised a study anchored on a set of carefully designed scenarios inspired by common media sharing situations from social media that we re-purposed for the context of open display networks. The goal was to minimize bias on possible content types and also to have scenarios that provided, as much as possible, a familiar frame

of reference for participants. We selected a set of popular services with diverse properties in regard to their goals and media sharing practices, more specifically Facebook, Twitter, Pinterest, Craiglist and Causes. For each of these services, we searched for content rankings and identified the types of content that were shared the most. We then pruned the results to exclude content that would clearly not make sense on public displays, either for privacy reasons or because of the nature of the content itself. The result was a selection of 6 media sharing situations that were to be used as seeds for the 24 scenarios in our study. Each situation was described in the form of a short story adapted to fit the specific circumstances of public displays. These stories described the whole context of the media sharing situation, clearly stating, not just the type of content, but also the intentions associated with sharing. The goal was to allow people to identify with the overall media sharing context and motivations. The result of this process is the set of 6 media sharing stories listed in Table 1.

Table 1 - The six base stories for the study embedded with different locality and personal properties

ID	Description	Locality	Personal
1	A funny video of a dance	Global	No
2	A Garage sale announcement	Local	Yes
3	Photos of new IPhone launch	Global	No
4	Food at local restaurant	Local	Yes
5	Poster World AIDS Day	Misc	No
6	Missing dog appeal	Local	No

These 6 stories include situations in which the content being shared is potentially relevant on a global scale, e.g. a funny dance video, and other scenarios where the relevance of the content is much more local, e.g. the missing dog. The world AIDS day was not considered for this variable because it was ambiguous in the sense that it was a global campaign with local initiatives that could easily be interpreted both ways. Similarly, the stories also include situations in which content being shared is not at all personal, e.g. the iPhone launch, and situations where content involves a personal form of expression, e.g. sharing a good experience at a local restaurant.

The other independent variable in our study is the media sharing scope. This defines the strategy that people can use to express where it will be more meaningful to show the content that they are sharing on the display network. For this study, we selected 4 types of connections between people and potential places for media sharing: (A) Share in the places most visited by friends [Implicit]; (B) Share in the places marked as favourite [Explicit]; (C) Share in previously visited places [Implicit]; and (D) Share where you are a frequent visitor [Implicit]. Finally, we combined these 4 media distribution strategies with each of the 6 base stories to obtain the final set of 24 media sharing embedded with different treatments of our 3 independent variables.

3.2 Scenario evaluation

Our experimental setting was thus composed by 24 media sharing scenarios, each corresponding to a different combination of 3 independent variables, more specifically, the locativeness of the content (global or local), the personal nature of

content (personal or not), and the distribution strategy used for expressing the media sharing scope (A – D).

The dependent variable is the perceived value that participants associate with each of the media sharing scenarios. To gather this data, we run a survey on Amazon's Mechanical Turk, with workers located at the USA. We divided the 24 scenarios into 4 different evaluation tasks, each consisting of a survey where participants were asked to evaluate how likely was it that they would publish content to a network of public displays in the same way as described in each of the media sharing scenarios. Their answers ranked from 1 (not at all likely) to 5 (very likely). Each task was composed by a subset of 6 of the 24 scenarios, but we selected them in a way that all the 6 base stories (see Table 1) were present on each task. To reduce bias, the order of the scenarios on each task was randomized.

We ran 4 evaluation panels consecutively, over a period of a month. They were all launched at about the same time of the day and their average duration was 6.5 days. The panel size (30) was larger than the number of respondents we eventually selected (25), so that we had some margin to discard recurrences. The larger panel size was also useful for discarding evaluators that did not execute their task in a responsible manner. For identifying these cases, we have followed each scenario evaluation with a verification question to ensure that respondents were paying the appropriate attention to their task. A total of 112 participants answered the 4 evaluation panels. From these, we discarded 8 survey responses done by recurrent evaluators or in which there was evidence of lack of a responsible job. At the end, we randomly discarded 4 others to get the same number of results per scenario and ended up with 100 survey responses by unique participants expressing 600 opinions about the proposed scenarios, and more specifically 25 evaluations on each of our 24 scenarios.

4. Results

The results of this study are grounded on the 100 validated responses obtained from participants. A higher result means that participants perceived the scenario as corresponding to something that they were more likely to do. Overall, the Missing Dog and the Garage Sale scenarios were the 3 scenarios that were consistently rated as being the most likely. However, our analysis is mainly focused on assessing the effects of our study variables on the sub-set of scenarios that correspond to the different treatments of our experience, as represented in Table 2.

Table 2 - Means and standard deviations of the responses

Variable	*Level*	*Mean*	*SD*
Locality	Local	3.56	1.32
	Global	2.42	1.30
Personal	Personal	3.40	1.32
	Non-personal	2.98	1.42
Distribution strategy	Dist. A	2.96	1.42
	Dist. B	3.23	1.34
	Dist. C	3.11	1.44
	Dist. D	3.17	1.41

The table shows the mean and standard deviations of the participants' responses for each of those treatments and respective levels. The characteristics that differentiate the treatments are the locality of content (2 levels), the personal nature of the content (2 levels) and the distribution strategy (4 levels).
These same results are also depicted in Figure 1, in the form of boxplots for the various variables and levels. The left and right sides of the boxes represent the first and third quartiles, respectively, and the line inside the box represents the median. Given the nature of our data, with discrete values and all the scenarios having the same minimum (1) and the same maximum (5), we decided to overlay information about the mean value (the dot) and one standard deviation below and above the mean.

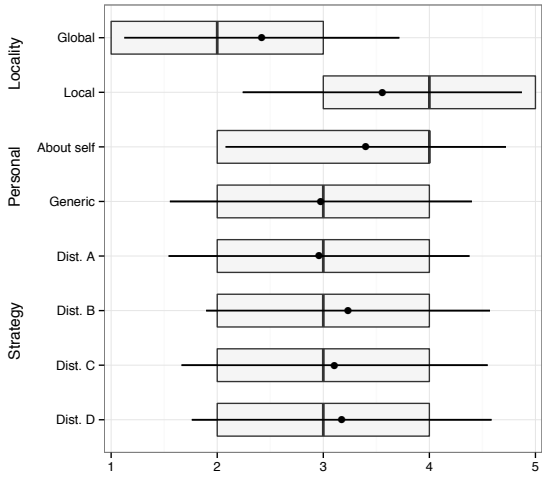

Figure 1. Boxplots of the responses for the various variables and levels.

One of the goals was to identify the effect of the locativeness on the perceived value of the media sharing scenarios. From the 6 base stories, there were 2 (Funny video of a dance in a wedding and Photos from the new IPhone launch) that represented content with potentially global scope and 3 that represented content with local scope (food suggestion at local restaurant, Missing dog and Garage sale). We excluded the World AIDS Day scenario from this analysis because of the ambiguity between local events by the local community and those events being part of a world day. The main result is that participants have clearly favoured content that was local in scope. The scenarios in which content is more locally relevant stand out very clearly in the boxplot as being the ones for which there is a more positive perception of relevance. To verify the statistical significance of these results, we ran a one-way ANOVA test between the two groups (local and global). The results confirm the existence of a statistically significant effect of locality on the perceived value associated with the sharing situation ($F1, 498 = 90.54$, $p < 2e\text{-}16$).
These results suggest that participants make a very strong association between the locative nature of content and its relevance for publication across public displays.

Our second goal was to identify the effect of the personal nature of content being published to the display network. From the 6 base scenarios, there were 2 scenarios (Garage sale announcement and Food at local restaurant) that were directly about the publisher. The other 4 scenarios (funny video of a dance; Photos from new IPhone launch; Poster on World AIDS Day and Missing dog) represented content that referred to others. This variable follows a behaviour similar to locality. Even though the boxplots for personal content seem less distinct, the median and mean values for personal content are clearly more positive than those for non-personal content. A one-way ANOVA test on the two groups of scenarios (personal and non-personal) confirms that the personal nature of content also has a statistically significant effect on the perceived relevance associated with the sharing situation ($F1, 598 = 12.3$, $p = 0.000486$). We thus conclude that participants seem to find more value in the possibility to display information that directly relates to them.

Regarding the ability to express the scope of the publication act, we wanted to observe to what extent people would be sensitive to the 4 distribution strategies embedded in the media sharing situations. The box plots for the distribution strategy show no obvious difference among the various strategies. A one-way ANOVA test on the four groups of scenarios corresponding to the four types of distribution strategies ($F3, 596 = 1.052$, $p = 0.369$) indicates that we cannot confirm any statistically significant effect of the distribution strategy on the perceived relevance. Possibly, participants did not have a strong idea about these forms of content distribution or they may simply have failed to make any meaningful distinction between them. All our distribution strategies were to some extent local as they all implied regular physical presence to the places where the displays were located. Therefore, in any of the scenarios, the scope of publication, even if composed by very different sub-sets of displays, was inherently local and seen as appropriate.

Still, the only distribution strategy that was based on an explicitly formed group of displays (those marked as favourite) was the best-ranked one. Even though our results cannot confirm the statistical significance of these findings, they seem to suggest a tendency towards a more explicit control over the set of displays where media is shared.

5. Conclusions

This study has analysed the perceived value of different scenarios of media sharing in open display networks. We have considered the effects of two types of content properties, more specifically, how local and how personal the content is, and also the effect of the social connection of the publisher with the places where content may be shown. The main result is a clear preference for content that is both local and personal. While this may seem at first as an obvious result when we consider the social networking framework, it is in fact in strike contrast to the types of content that can be commonly found in most public displays. This seems to confirm the idea that future open displays networks, where everyone can have some possibility to publish content, are likely be revolve mainly around situated content that is fundamental different from what we have today in current digital signage systems [4]. In our future

work, we intend to explore new types of connections between publishers and displays to assess alternatives models to create a meaningful relationship between screen media items and display opportunities.

6. REFERENCES

1. Cheverst, K. et al. 2005. Exploring bluetooth based mobile phone interaction with the hermes photo display. 7th international conference on Human computer interaction with mobile devices services MobileHCI 05 (Salzburg, Austria, 2005), 47–54.
2. Churchill, E. et al. 2003. The Plasma Poster Network. Public and Situated Displays Social and Interactional Aspects of Shared Display Technologies. (2003), 233–260.
3. Cranshaw, J. et al. 2010. Bridging the Gap Between Physical Location and Online Social Networks. Human Factors. 1968 (2010), 119–128.
4. Davies, N. et al. 2012. Open Display Networks: A Communications Medium for the 21st Century. Computer. 45, 5 (Mar. 2012), 58–64.
5. Davies, N. et al. 2009. Using bluetooth device names to support interaction in smart environments. International conference on Mobile systems applications and services Mobisys 09 (Kraków, Poland, 2009), 151–164.
6. Friday, A. et al. 2012. Reflections on Long-Term Experiments with Public Displays. Computer. 45, 5 (May. 2012), 34–41.
7. Huang, E.M. and Mynatt, E.D. 2002. Shared Displays for Small Communities: Optimizing for Privacy and Relevance. WS Public, Community and Situated Displays (2002).
8. Jose, R. et al. 2008. Instant Places: Using Bluetooth for Situated Interaction in Public Displays. Pervasive Computing, IEEE. 7, 4 (Dec. 2008), 52 –57.
9. José, R. et al. 2013. Pins and Posters: Paradigms for Content Publication on Situated Displays. IEEE Computer Graphics and Applications. 33, 2 (2013), 64–72.
10. Li, N.L.N. and Chen, G.C.G. 2009. Analysis of a Location-Based Social Network. 2009 International Conference on Computational Science and Engineering.
11. Martin, K. et al. 2006. Engaging with a situated display via picture messaging. CHI 06 extended abstracts on Human factors in computing systems CHI 06 (Montréal, Québec, Canada, 2006), 1079–1084.
12. Müller, J. et al. 2010. Requirements and design space for interactive public displays. Proc. of the international conference on Multimedia (New York, New York, USA, 2010), 1285.
13. Scellato, S. et al. 2011. Exploiting place features in link prediction on location-based social networks. Proc of the 17th ACM SIGKDD international conference on Knowledge discovery and data mining-KDD11 (New York, New York, USA, Aug. 2011), 1046.
14. Wiese, J. et al. 2011. Are you close with me? Are you nearby? Investigating social groups, closeness, and willingness to share. Human Factors (2011), 197–206.