
A Conceptual Framework for Content-Intensive Phone-based Interaction with Public Displays

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Abstract

The paper discusses a conceptual framework for design and evaluation of content-intensive applications that exploit mobile phone-based interaction with large public displays. We exemplify our approach through a case-study in a museum environment.

Keywords

Mobile phones, public displays, conceptual design framework, museum.

ACM Classification Keywords

H5.Information interfaces and presentation H.5.2 User Interfaces; H.5.3 Group and Organization Interfaces.

Introduction

The place of our “digital” intelligence, i.e., the world of our digital data, knowledge, and functionality, is progressively moving from our desktop PC or laptop to our miniaturized mobile devices - such as smart phones, MP3 players, or PDAs. At the same time, in the physical spaces where we live – shops, museums, archeological sites, airports, fitness centers, town squares, ... - we are progressively surrounded with digital information delivered via large public displays. Current technology enables us to integrate “the small”

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CHI 2008, April 5-10 2008, Florence, Italy

ACM 1-xxxxxx

and “the large”, and opens a number of new possibilities for creating innovative, engaging user experiences [8] that can expand our digital intelligence at individual and collective level[1]. At the same time, the need of integrating multiple devices and coordinating multiple forms of interaction and information delivery increases the complexity of the design space, and introduces new methodological challenges.

In this paper, we introduce a *conceptual framework* aimed at helping a development team to master the complexity of design and evaluation of a class of systems based on *Mobile Phone* interaction with *Public Displays*, hereinafter called *content intensive MP-PD applications*. These applications are intended not only to provide short term interactions and tasks, e.g., of a user passing by a large display and playing with it few minutes using her mobile phone. Their main purpose is to support more durable user experiences that span over time and space and engage users with multimedia content. A *content intensive MP-PD application* involves a significant amount of digital information flowing back and forth between the user and the environment, and exploit phones and public displays as interaction and information delivery channels in a way that is tailored to the user profile and the characteristics of the physical context.

Our work is based on a survey of existing applications that exploit mobile phone interaction with large displays

[1,2,3,5,6,7,9,10,11,12,13,16,17] and on the experience gained in an ongoing project called ADMIRE - ADvanced Mobile Intelligence for Reactive Environments. This project involves a multidisciplinary team of computer engineers, designers, architects, business and marketing experts, exploring the integration of Ambient Intelligence technologies with mobile phone technologies from different perspectives - ICT, user experience, urbanistics, interior design, product design, and business - in a variety of domains, including fitness, health, and museums.

In the rest of the paper, we shortly introduce our framework, and exemplify it through a design case study.

A Conceptual Framework for Content-Intensive MP-PD Applications

Our framework identifies a number of *dimensions* along which a content intensive MP-PD application can be analysed, and identifies a set of characteristics and sub-characteristics that can be considered for each dimension. These concepts, depicted in the following table, can be used by *designers* as guidelines to organize the design problem space and as checklist to describe a set of design directions in a compact way (as shown in the case study described in the next section – Table 2). In addition, the framework can be exploited by *evaluators* as taxonomy for defining the evaluation variables

Dimensions	Characteristics	Sub-characteristics
Interaction	- Mobile phone as <i>control device</i> : to play/suspend/ stop/resume time-based multimedia, to trigger operations, to navigate (hyperlink traversing)	- Mobile phone as <i>pointer</i> ([2,6,9,16]): it is used to select the control place-holders visualized on the large display - Mobile phone as <i>locus of interaction</i> [10]: control place-holders are visualized on phone display
	- Mobile phone as <i>data input device</i> [5]	
	- Mobile phone as <i>user identification device</i> [9]	
Content (dis)play	- <i>Mono-channel</i> : content is delivered on public display (using the mobile phone as locus of interaction only) [3, 12]	
	- <i>Multi-channel</i> : content is delivered on both the mobile phone and the large display [17]	- <i>Isomorphic</i> : the mobile phone content is a miniaturization of the public display content - <i>Complementary</i> : the mobile phone content complements public display content, according to different criteria, including: <i>medium</i> (e.g., the audio is played on the phone and visual contents on the public display); <i>privacy</i> (e.g., private information are displayed on the personal device, while public information appears on the public display); <i>personalization</i> (e.g., the mobile phone holds a personalized view of the content appearing on the public display - see also dimensions "Content Flow" and "Personalization")
Content Flow	- <i>Pull mode</i> : content flows (i.e., is pulled) from public display to mobile phone [9] - <i>Push mode</i> : content flows (i.e., is pushed) from mobile phone to public display [11]	
Social Interaction	- <i>Individual control</i> : one person per time holds the control of interaction and inhibits the others' control [7, 13]	In pull mode: - <i>Individual content delivery</i> : content from the public display is available only on the mobile phone of the user under control only - <i>shared delivery</i> : content from the public display is shared on the mobile phone of different users
	- <i>Multi-user control</i> : several users interact simultaneously with the application [13, 17]	In pull mode: - <i>shared delivery</i> : content from the public display is shared on the mobile phone of different users, and multiple interaction effects are visible by all - <i>personalized delivery</i> : each user has a personalized view of the content and the effects of his interaction
Personalization	- Content and interaction are <i>tailored</i> to user(s) preferences and current state of interaction and navigation [17] - Content and interaction are user-model independent [13]	
Integration with the physical space	- <i>Emerging</i> : public displays are outstanding components of the physical space [9] - <i>Disappearing</i> : public displays are smoothly integrated within the physical space (e.g., hidden in furniture) [14]	

Table 1: The conceptual framework at a glance

A Design Case Study: Modigliani's House

We exemplify our frameworks by presenting the design of a museum MP-PD application under development in the ADMIRE project, which has offered us a challenging case study for our approach. The application setting is Istituto Casa Modigliani - Modigliani's House Institute, a non-profit cultural institution based in Rome and devoted to preserve the heritage of Amedeo Modigliani's "Légales Archives", up to now partially kept at the Montparnasse Museum in Paris. The material is composed exclusively of artist's personal belongings, photos, and epistolaries, which have been available for a long time to the scientific community only. The mission of Modigliani's House Institute is to promote this heritage toward a wider audience, creating a "home" for it accessible to the general public in a magnificent baroque palace in Rome.

As widely documented in museum studies, normal visitors have limited, short term interest for exhibitions of epistolaries and artist's personal objects that are arranged in a conventional way, i.e., just using glass cases, shelves and explanatory text panels [4]. To motivate visitors to have something more than a "let's see-and-go" quick visit at Modigliani's House, we designed a content-intensive MP-LD application centered around Modigliani's life and the major elements of the collection, creating a variety of multimedia contents that will be available on large and small public displays and on visitors' mobile phones. We wanted to persuade people to spend time inside the exhibition, to engage visitors in a sort of virtual conversation with Modigliani, thus creating a durable learning experience and establishing a durable relationship between the visitors and the artist that

extends across space and time, during the visit and afterwards.

The design solutions adopted in Modigliani's House can be described in a compact way using the concepts of our conceptual framework, as shown in Table 2 and explained the rest of this section.

Dimensions	Characteristics/Sub-characteristics
Interaction	Mobile phone as <i>multimedia</i> and <i>navigation control device</i> , as the only <i>locus of interaction</i> , as <i>user identification device</i> , as <i>visual input tool</i>
Content (dis)play	<i>Multi-channel</i> (mobile phone + large display)/ <i>Complementary</i>
Content Flow	<i>Pull and Push modes</i>
Social Interaction	<i>Individual control/Sharable delivery</i>
Personalization	Content and interaction <i>tailored</i> to user(s) preferences (i.e., language)
Integration with the physical space	<i>Disappearing</i>

Table 2: Key Design Solutions for Modigliani's House

The multimedia contents are composed of "narrative fragments" – compact stories in form of video, images, sound commentaries, audio interviews with experts - concerning Modigliani's life and work. Modigliani was the bohemian, transgressive artist par excellence, and his posthumous legend is almost as famous as Van Gogh's. Our stories attempt to foster a deeper, more objective understanding of the controversial figure of this artist, to highlight his "truth beyond the legend",

and to have visitors involved emotionally and rationally with the multiple aspects of his suffered artistic experience. Narrative fragments are mutually interlinked and are conceptually related to the major objects of the collection.

We designed a creative arrangement of the physical space that integrates tangible exhibits (Modigliani's belongings and letters) with large and small public displays devoted to present visual dynamic media (i.e., videos and image streams). Public displays are smoothly *integrated* in the environment, being hung in the wall by means of baroque style large frames, or horizontally surrounded by glass cases where objects are contained, or hidden in large mirrors and appearing on-demand. In addition, light effects from the ceiling, the floor, or the walls, dynamically highlight relevant "moments of engagement" and acts as *contextual hooks* to attract the visitor attention on specific objects or displays. Visitors use smart phones as unifying *control device* and is a tool to interact with the visual content on the public displays (and with the physical environment, e.g., to activate hidden displays). In addition, the phone acts as *identification* devise, to identify visitors, understand their built-in preferences, and act as a *input tool* to allow users to visually specify their preferences. The phone also works as *audio channel* to listen to the sound commentaries associated with visual content on display. With respect to *social interaction*, only one person per time can hold the control, but he can synchronize his audio with other visitors and enjoy a story together. Information flows move between visitors and the environment, and across visitors, with the phone operating in both push and pull mode. Visitors can capture some audio-visual contents and store them on their phone; they can then

enjoy it later in a social setting, *pushing* them on the small screens available at the tables of Modigliani's house cafeteria.

Conclusions

We hope that our framework can provide a contribution to the methodological discussion on phone-based interaction with situated large displays. Our experience in ADMIRE is that a conceptual tool like the one depicted in this paper has a number of advantages, especially in the very early stage of a project. It helps a team of designers to focus on the key features of the application under development and to discuss design problems and take decisions at the proper level of abstraction, before concentrating on the detailed solutions.

We have not tested yet our approach for evaluation. Still, we believe it may help evaluators of MP-PD systems to identify the most important aspects to be assessed, and can pave the ground towards defining quality criteria and measurement procedures for this class of applications [18]

Acknowledgement

This work is partially supported by ADMIRE Project partners: Politecnico di Milano, Politecnico di Torino, Teuco-Guzzini SpA, Accenture Foundation, Modigliani's House Institute, The Herman Hesse Museum in Lugano.

References

- [1] Agamanolis, S. New Technologies for Human Connectedness, ACM Interactions, 12, 4 (2005), 33–37

- [2] Ballagas, R., Rohs, M. and Sheridan, J.G. Sweep and point and shoot: Phonecam-based interactions for large public displays. In Extended Abstracts CHI 2005, ACM Press (2005), 1200-1203
- [3] Bezerianos, A. & Balakrishnan, R. (2005). Canvas Portals: View and space management on large displays. *IEEE Computer Graphics and Applications*, 25(4). 34-43
- [4] Bannon L. et al. Hybrid Design Creates Innovative Museum Experiences. *CACM* March 2005, 48, 3, 62-65
- [5] Czerwinski M, Robertson G., Meyers B., Smith G., Robbins D., Desney T. Large Display Research Overview, In Proc. CHI 2006, April 22-27, 2006 Montreal, Quebec, Canada, 69-74
- [6] Jiang, H., Ofek, E, Moraveji, N. and Shi, Y. Direct pointer: direct manipulation for large-display interaction using handheld cameras. In Extended Abstracts CHI 2006, ACM Press (2006), 1107-1110.
- [7] Izadi S., Brignull H, Rodden T., Rogers Y., Underwood M. Dynamo: A public Interactive Surface supporting Cooperative Sharing and exchange of Media. Proc. UIST'03, Vancouver, BC, Canada, ACM Press (2003), 159-168
- [8] McClelland I. User Experience' Design: A new form of design practice takes shape. In Proc. ACM CHI 2005, April 2-7, 2005, Portland, Oregon, USA. P.1096-98
- [9] Mitchell, K., Race, N.J.P., Suggitt, M. iCapture: Facilitating Spontaneous User-Interaction with Pervasive Displays using Smart Devices, in Proc. Mobile Devices as Pervasive User Interfaces and Interaction Devices (PERMID) 2006.
- [10] Paek T, Agrawala M., Basu S., Drucker S., Krisjansson T., Logan R., Toayna K., Wilson A. Towards Universal Mobile Interaction for Shared Displays. In Proc. CSCW'04, Nov 6-10 2004, Chicago, Illinois, USA, ACM Press (2004), 266-269
- [11] Raghunath, M.T., Ravi, N., Rosu, M.C., Narayanaswami, C. Inverted browser: A novel approach towards display symbiosis. In Proc. PerCom 2006, 71-76.
- [12] Robertson, G.G., Czerwinski, M., Baudisch, P., Meyers, B., Robbins, D., Smith, G., and Tan, D. Large display user experience. *IEEE CG&A special issue on large displays*, 25(4), 44-51.
- [13] Russell, D. M., Drews, C. & Sue, A. (2002). Social aspects of using large interactive displays for collaboration. In *Proc. UbiComp 2002*, 229-236.
- [14] Russell D.M, Streitz N.A., Winograd T. Building Disappearing Computers, in *CACM*, 48, 3, 2005, 42-48
- [15] Swaminathan, K. & Sato, K. (1997). Interaction design for large displays. In ACM's *Interactions* (4), pp. 15-24.
- [16] Vogel, D. & Balakrishnan, R. (2005). Distant freehand pointing and clicking on very large high resolution displays. *Proc. UIST 2005*, 33-42.
- [17] Vogel, D. & Balakrishnan, R. (2004). Interactive public ambient displays: transitioning from implicit to explicit, public to personal, interaction with multiple users. *Proceedings of UIST 2004*, 137-146.
- [18] Zhang, D. and Adipat, B. Challenges, methodologies, and issues in the usability testing of mobile applications. *IJHCI* 18, 3 (2005), 293-308.