Interactive Public Displays

Uta Hinrichs ■ *University of St. Andrews*

Sheelagh Carpendale ■ *University of Calgary*

Nina Valkanova ■ *Universitat Pompeu Fabra*

Kai Kuikkaniemi ■ *Aalto University*

Giulio Jacucci ■ *University of Helsinki*

Andrew Vande Moere ■ *KU Leuven*

Large interactive displays are becoming increasingly prevalent in urban public life. This is due largely to rapid advances in display and projection technologies, input methods that enable different types of interaction mechanisms, and our expanding understanding of the potential for interaction variations and scenarios. Large displays have moved out of research laboratories into public spaces such as museums, libraries, plazas, and architectural facades, where they present information and enhance experiences in a highly visual and often interactive way. Researchers from disciplines such as human-computer interaction, architecture, social sciences, design, art, and media theory have started exploring public-display installations' potential for educational, entertaining, participative, and evocative experiences.

The design and development of these installations can be informed by previous research on, for instance, large interactive displays in collaborative and educational scenarios. However, public settings have unique characteristics and therefore impose unique challenges. Public spaces attract diverse audiences who differ in age, interests, and experience with technology and who will engage in spontaneous and often unpredictable activities, individually and in groups. In addition, public settings' spatial layouts, sizes, lighting conditions, and social connotations affect which display technologies and interaction techniques are adequate and how people will interact with and experience an installation.

Over the years, a body of research has formed around interactive public displays, including media facades,[1] museum displays,[2,3] interactive displays embedded in urban settings such as shop windows or plazas,[4-7] and community displays. The technical challenges regarding display technologies and input devices suitable for urban scenarios are still relevant. In addition, research questions regarding how to best promote meaningful, evocative public displays that offer experiences in participation, authorship, and ownership are gaining importance. Researchers are looking for alternatives to installations that serve only commercial purposes and thus are "polluting" our public environments.

This special issue follows up on Thomas Funkhouser and Kai Li's special issue on large-format displays (July/Aug. 2000), Gordon Kurtenbach and George Fitzmaurice's issue on applications of large displays (July/Aug. 2005), and particularly Stacey Scott and Sheelagh Carpendale's issue on interacting with digital tabletops (Sept./Oct. 2006), which included a discussion of public horizontal displays in museums. The articles in this special issue present snapshots of current research topics and issues that the introduction of interactive displays into public spaces has brought to the fore.

Research Questions and Challenges

Public-display installations range from large-scale media facades that people can interact with only from a distance to direct-touch interactive kiosks in plazas, coffee shops, or community centers that

 0272-1716/13/$31.00 © 2013 IEEE

provide information of local interest. The public nature and diversity of these installations present different requirements and concerns regarding interface design and interaction techniques.

For instance, a large body of research presents unique technical solutions for display installations, designed for particular public settings and display technologies. However, interaction paradigms and techniques often don't generalize across different public settings. In "Making Public Displays Interactive Everywhere," Sebastian Boring and Dominikus Baur address the challenge of designing interaction techniques that apply to a variety of settings and that maintain some independence from the particular characteristics of the public space, people's activities, and the display technology. They've devised a conceptual framework and have implemented techniques that leverage cell phone cameras to enable from-a-distance interaction with any public-display technology.

Researchers are looking for alternatives to installations that serve only commercial purposes and thus are "polluting" our public environments.

In "Beyond Information and Utility: Transforming Public Spaces with Media Facades," Patrick Fischer and his colleagues discuss how to enable and promote from-a-distance interaction with public displays from a design perspective. Considerations regarding expressiveness of interaction, performance, and participatory experience influenced their design of an electronic slingshot that lets people send messages to a large-scale media facade. On the basis of their experiences deploying the installation in a variety of urban settings, they describe how different urban spaces' contexts, sizes, and spatial structures influenced people's behaviors and experiences with the installation.

From-a-distance interaction using mobile devices isn't the only way to interact with public displays. Low-cost 3D motion tracking enables complex gesture interactions with displays. In "3D Freehand Gestural Navigation for Interactive Public Displays," Gang Ren and his colleagues tell how they apply gestural input to navigate 3D visualizations and how such interaction techniques influence social dynamics around the display.

Unlike desktop computers, public-display installations typically offer a highly limited number of applications for users. Most installations feature only one application geared toward one particular purpose. However, for some scenarios such as community settings, a public display might offer options for multiple applications (for example, local events and attractions, news, and weather forecasts). This implies that the display interface must enable users to choose between the different applications. In "Multipurpose Public Displays: How Shortcut Menus Affect Usage," Vassilis Kostakos and his colleagues discuss different design solutions and their implications on how to present multiple application options.

Finally, in "Pins and Posters: Paradigms for Content Publication on Situated Displays," Rui José and his colleagues deal with participation, ownership, and content control in the context of networked public displays to which people can add content remotely. They show how two publication paradigms inspired by analog forms of self-expression influence the content that people place on displays, and how people experience broadcasting information. They also examine the differences in how the display owners and the people interacting with the displays experience content curation.

New Research Directions

With the exploration of different types of public-display installations in a variety of real-world scenarios, research in this area has expanded from addressing just technical concerns to examining topics such as participation and engagement. With this shift, considerations from a political and social perspective have become important, as have more critical questions about public displays' meaning and potential impact. Considerations include how these technologies support methods for novel entertainment, information seeking, and social discourse and networking practices in which people can be actors rather than just passive observers. We hope the research community continues to explore how interactive displays can enhance and transform public spaces.

References

1. P. Dalsgaard and K. Halskov, "Designing Urban Media Facades: Cases and Challenges," *Proc. 2010 SIGCHI Conf. Human Factors in Computing Systems* (CHI 10), ACM, 2010, pp. 2277–2286.
2. U. Hinrichs, H. Schmidt, and S. Carpendale, "EMDialog: Bringing Information Visualization into the Museum," *IEEE Trans. Visualization and Computer Graphics*, vol. 14, no. 6, 2008, pp. 1181–1188.
3. E. Hornecker, "Interactions around a Contextually

Embedded System," *Proc. 5th Int'l Conf. Tangible, Embedded, and Embodied Interaction* (TEI 10), ACM, 2010, pp. 169–176.
4. K. Kuikkaniemi et al., "From Space to Stage: How Interactive Screens Will Change Urban Life," *Computer*, vol. 44, no. 6, 2011, pp. 40–47.
5. J. Müller et al., "Looking Glass: A Field Study on Noticing Interactivity on a Shop Window," *Proc. 2012 SIGCHI Conf. Human Factors in Computing Systems* (CHI 12), ACM, 2012, pp. 297–306.
6. P. Peltonen et al., "'It's Mine, Don't Touch!': Interactions at a Large Multi-touch Display in a City Centre," *Proc. 2008 SIGCHI Conf. Human Factors in Computing Systems* (CHI 08), ACM, 2008, pp. 1285–1294.
7. N. Valkanova et al., "Reveal-It! The Impact of a Social Visualization Projection on Public Awareness and Discourse," to be published in *Proc. 2013 SIGCHI Conf. Human Factors in Computing Systems* (CHI 13), ACM, 2013.

Uta Hinrichs *is a research fellow at the University of St. Andrews' Computer Human Interaction research group. Her research interests include supporting open-ended information exploration in public and work environments, novel interactive display technology to enhance public exhibits, and information visualization. Her research combines approaches from computer science, the social sciences, art, and design. Hinrichs received a PhD in computer science with a specialization in computational media design from the University of Calgary. Contact her at uh3@st-andrews.ac.uk.*

Sheelagh Carpendale *is a professor at the University of Calgary, where she holds research chairs in information visualization and interactive technologies. She also leads the Innovations in Visualization research group, where she draws on computer science, art, and design research processes to promote interdisciplinary research. She has received a Natural Sciences and Engineering Research Council of Canada Steacie Fellowship. Carpendale received a PhD in computer science from Simon Fraser University. Contact her at sheelagh@ucalgary.ca.*

Nina Valkanova *is a PhD candidate in information, communication, and audiovisual technologies at the Universitat Pompeu Fabra. Her main research interest is the design of dynamic digital displays and visual interfaces in shared public spaces. In particular, she investigates and conceptualizes design principles for data visualization displays, exploring the intersections between scientific and artistic design knowledge. Valkanova received a master's in mathematics and computer science from Technische Universität Darmstadt. Contact her at nina.valkanova@upf.edu.*

Kai Kuikkaniemi *is a project manager at the Helsinki Institute for Information Technology, affiliated with Aalto University. His research explores collaborative and colocated computing. Currently he's focusing on two research platforms: Kupla UI, a playful, adaptive multitouch interface for information discovery and presentations, and Presemo, a real-time Web-based participation platform for events and workshops. Kuikkaniemi received a master's in industrial engineering, focusing on business strategy and venturing, from the Helsinki University of Technology. Contact him at kai.kuikkaniemi@hiit.fi.*

Giulio Jacucci *is a professor in the University of Helsinki's Department of Computer Science. He also directs the Network Society research program at the Helsinki Institute for Information Technology. His research interests include mobile social media, tangible interfaces, multitouch displays, and information exploration. He's founder and a member of the board of MultiTouch (www.multitaction.com). Jacucci received a PhD in information processing science from the University of Oulo. Contact him at giulio.jacucci@hiit.fi.*

Andrew Vande Moere *is an associate professor in the Research x Design group at KU Leuven's Department of Architecture, Urbanism and Planning. His investigations into the symbiosis of media and space through design methodologies has led to projects on media architecture, urban displays, and using public visualization for persuasive purposes. Vande Moere received a PhD in design and computation from ETH Zurich. Contact him at andrew.vandemoere@asro.kuleuven.be.*

IEEE Computer Society is offering $40,000 in student scholarships, from $1,000 and up, to recognize and reward active student volunteer leaders who show promise in their academic and professional efforts.

Graduate students and undergraduate students in their final two years, enrolled in a program in electrical or computer engineering, computer science, information technology, or a well-defined computer-related field, are eligible. IEEE Computer Society student membership is required.

Apply now! Application deadline is 30 April 2013. For more information, go to www.computer.org/scholarships, or email chuffman@computer.org.

To join IEEE Computer Society, visit www.computer.org/membership.

IEEE computer society IEEE