



PROCEEDINGS

PERVASIVE DISPLAYS

THE 4TH ACM INTERNATIONAL
SYMPOSIUM ON PERVASIVE DISPLAYS

Saarbrücken, Germany

June 10-12, 2015

www.pervasivedisplays.org

EDITORS

Sven Gehring · Antonio Krüger

Florian Alt · Nick Taylor

Stefan Schneegaß



Association for
Computing Machinery

**The Association for Computing Machinery
2 Penn Plaza, Suite 701
New York New York 10121-0701**

ACM COPYRIGHT NOTICE. Copyright © 2007 by the Association for Computing Machinery, Inc. Permission to make digital or hard copies of part or all of this work for personal or classroom use is granted without fee provided that copies are not made or distributed for profit or commercial advantage and that copies bear this notice and the full citation on the first page. Copyrights for components of this work owned by others than ACM must be honored. Abstracting with credit is permitted. To copy otherwise, to republish, to post on servers, or to redistribute to lists, requires prior specific permission and/or a fee. Request permissions from Publications Dept., ACM, Inc., fax +1 (212) 869-0481, or permissions@acm.org.

For other copying of articles that carry a code at the bottom of the first or last page, copying is permitted provided that the per-copy fee indicated in the code is paid through the Copyright Clearance Center, 222 Rosewood Drive, Danvers, MA 01923, +1-978-750-8400, +1-978-750-4470 (fax).

Notice to Past Authors of ACM-Published Articles

ACM intends to create a complete electronic archive of all articles and/or other material previously published by ACM. If you have written a work that was previously published by ACM in any journal or conference proceedings prior to 1978, or any SIG Newsletter at any time, and you do NOT want this work to appear in the ACM Digital Library, please inform permissions@acm.org, stating the title of the work, the author(s), and where and when published.

ACM ISBN: 978-1-4503-3608-6

Foreword

On behalf of the entire organizing committee we proudly welcome you to the 4th ACM International Symposium on Pervasive Displays at the German Research Center for Artificial Intelligence (DFKI) in Saarbrücken, Germany. Following the path of the three previous symposia at the University of Copenhagen, Denmark in 2014, Google, Mountain View, California, USA in 2013 and at the University of Minho in Porto, Portugal in 2012, this year's edition of the symposium aims to further expand the audience by addressing the media architecture community.

As a targeted topic venue, Pervasive Displays offers participants a unique opportunity to network with a diverse but focused research community, resulting in an extremely lively event with all the energy and excitement that characterizes the emergence of a new research community. Pervasive Displays research has always attracted a broad cross-section of researchers from ubiquitous computing and HCI, and this year we have attempted to expand the scope of the symposium by encouraging contributions from art & design as well as from the media architecture community.

Furthermore, we closely collaborated with the University of Fine Arts Saar (HBK) and its Experimental Media lab (xm:lab) during the organization of the symposium. We are delighted that these efforts resulted into an increasing number of submissions from these communities, presenting research on various kinds of pervasive displays of different shapes and in numerous contexts. We thank our keynote speaker Soenke Zehle from the xm:lab for sharing his vision on ambient media and the design of a new environmentalism.

We have extended PerDis 2015 to a three day symposium, offering two tutorials held by Nigel Davis and Sarah Clinch, as well as by Patrick Tobias Fischer and an opening social event at the University of Fine Arts Saar (HBK) bringing together researchers from various disciplines with a common interest on the opportunities and challenges raised by the emergence of pervasive display systems as a new communication medium for public and semi-public spaces.

Our program committee—comprising 35 leading experts drawn from institutions in 12 countries around the world—selected 30 of the 56 papers submitted, through a single-blind review process and final selection by the program chairs. The program further includes 3 research videos along with 7 posters and 13 demos presented during our poster and demo reception on Thursday evening at the German Research Center for Artificial Intelligence (DFKI). As has been the case in previous years, we have emphasised inclusivity, aiming to showcase a wide range of work rather than maintain a low acceptance rate.

The symposium was organized by a large group of people. We would like to thank our program committee for delivering numerous reviews, our local arrangements chair Marco Speicher, our demo chairs Moritz Behrens and Michael Schmitz, our video chair Marko Jurmu, our poster chair Nora Broy, our publicity chair Nemanja Memarovic as well as our publications chair Stefan Schneegaß.

This year PerDis 2015 is supported by the ACM and SIGMOBILE, as well as by several sponsors, all of whom we would like to thank for their contributions.

We hope you enjoy the PerDis 2015 program, and that you get to enjoy Saarbrücken and our rich social program.

Florian Alt	Nick Taylor	Sven Gehring	Antonio Krüger
LMU Munich	University of Dundee	DFKI GmbH	DFKI GmbH
Germany	UK	Germany	Germany
<i>Program Chair</i>	<i>Program Chair</i>	<i>General Chair</i>	<i>General Chair</i>

Conference Chairs

General Co-Chairs

Sven Gehring, German Research Center for Artificial Intelligence, Saarbrücken, Germany

Antonio Krüger, German Research Center for Artificial Intelligence, Saarbrücken, Germany

Program Co-Chairs

Florian Alt, University of Munich, Munich, Germany

Nick Taylor, University of Dundee, Dundee, UK

Demo Co-Chairs

Moritz Behrens, The Bartlett, UCL, London, UK

Michael Schmitz, Academy of Fine Arts Saar, Saarbrücken, Germany

Video Chair

Marko Jurmu, University of Oulu, Oulu, Finland

Poster Chair

Nora Broy, BMW Group Research, Munich, Germany

Publicity Chair

Nemanja Memarovic, University of Zurich, Zurich, Switzerland

Proceedings Chair

Stefan Schneegass, University of Stuttgart, Stuttgart, Germany

Local Arrangements Chair

Marco Speicher, German Research Center for Artificial Intelligence, Saarbrücken, Germany

Program Committee

Marc Langheinrich, University of Lugano (USI), Switzerland
Nemanja Memarovic, University of Zurich, Switzerland
Jürgen Steimle, Saarland University, Saarbrücken, Germany
Jörg Müller, Aarhus University, Denmark
Ava Fatah Gen. Schieck, University College London, UK
Rui José, University of Minho, Portugal
Marko Jurmu, University of Oulu, Finland
Jens Geelhaar, Bauhaus-University Weimar, Germany
Vassilis Kostakos, University of Oulu, Finland
Alois Ferscha, University of Linz, Austria
Aaron Quigley, University of St. Andrews, UK
Marcus Foth, Queensland University of Technology, Australia
Jim Wallace Wilfrid Laurier, University Waterloo, Canada
Christian Kray, University of Münster, Germany
Enrico Rukzio, University of Ulm, Germany
Sebastian Boring, University of Copenhagen, Denmark
Patrick Tobias Fischer, Bauhaus-University Weimar, Germany
Roman Rädle, University of Konstanz, Germany
Jakub Dostal, University of St. Andrews, UK
Yuichi Itoh, Osaka University, Japan
Michael Rohs, University of Hannover, Germany
Matthias Baldauf, Vienna University of Technology, Austria
Martin Tomitsch, The University of Sydney, Australia
Hannu Kukka, University of Oulu, Finland
Mikkel Jakobsen, University of Copenhagen, Denmark
Keith Cheverst, Lancaster University, UK
Dietmar Offenhuber, Northeastern University
Andrew Vande Moere, K.U.Leuven, Belgium
Sarah Clinch, Lancaster University, UK
Roy Want, Google Research, US
Florian Michahelles, Siemens Corporation, US
Peter Dalsgaard, Aarhus University, Denmark
Scott McQuire, University of Melbourne, Australia
Nigel Davies, Lancaster University, UK
Bill Schilit, Google Research, US
Timo Ojala, University of Oulu, Finland

Contents

	Page
Session I: ENGAGEMENT AND ATTENTION	1
1 People Watcher: An App to Record and Analyzing Spatial Behavior of Ubiquitous Interaction Technologies Nicholas Dalton, Ruth Dalton, and Christoph Höelscher	1
2 Understanding Display Blindness in Future Display Deployments Nemanja Memarovic, Sarah Clinch, and Florian Alt	7
3 Should Public Displays be Interactive? Evaluating the Impact of Interactivity on Audience Engagement Mettina Veenstra, Niels Wouters, Marije Kanis, Stephan Brandenburg, Kevin te Raa, Bart Wigger, and Andrew Vande Moere	15
4 Increasing user engagement with distributed public displays through the awareness of peer interactions Maximilian Müller, Nuno Otero, Aris Alissandrakis, and Marcelo Milrad	23
5 ENGAGE: Early Insights in Measuring Multi-Device Engagements Rachel Jones, Sarah Clinch, Jason Alexander, Nigel Davies, and Mateusz Mikusz	31
Session II: DEVICES AND GESTURES	39
6 Short-range optical interaction between smartphones and public displays Morin Ostkamp, Sven Heitmann, and Christian Kray	39
7 CloudDrops: Stamp-sized Pervasive Displays for Situated Awareness of Web-based Information Simon Olberding, Jürgen Steimle, Suranga Nanayakkara, and Pattie Maes	47
8 Ubi-FX: Ubiquitous Effects with Multiple Pan-Tilt Projector and Camera Units for Entertainment Hiroaki Tobita and Hajime Hata	55
9 Interaction in Motion with Mobile Projectors: Design Considerations Alexandru Dancu, Zlatko Franjic, Advije Ayça Ünliür, and Morten Fjeld	61
Session III: MEDIA FACADES	69
10 "Public Brewing" a Media Façade with a Mixed Reality Interface Daniel Drochtert, Chris Geiger, Michael Hogen, Alina Huldtgren, Okan Köse, Roman Wiche, and Lukas Loss	69
11 Blinking Lights and Other Revelations Experiences Designing Hybrid Media Façades Marius Hoggenmueller and Alexander Wiethoff	77
12 StarLight – Exploring Embodied Interactions with Media Architecture and Large Public Audiences Alexander Wiethoff, Jana Gerstberger, and Sven Gehring	83

13 Castle-Sized Interfaces: An Interactive Façade Mapping	
Patrick Tobias Fischer, Anke von der Heide, Eva Hornecker, Sabine Zierold, Andreas Kästner, Felix Dondera, Matti Wiegmann, Fernando Millan, Jonas Lideikis, Aidas Cergelis, Reinaldo Verde, Christoph Drews, Till Fastnacht, Kai Gerrit Lünsdorf, Djamel Merat, Aryan Khosravani, and Hesam Jannesar	91
Session IV: IMPLEMENTATION CONCERNS	99
14 Touch OK to Continue: Error Messages and Affective Response on Interactive Public Displays	
Hannu Kukka, Jorge Goncalves, Tommi Heikkinen, Olli-Pekka Suua, Yizei Zuo, Hannu Raappana, Mohamed Abdellatif, Olli Okkonen, Raul Jimenez, and Timo Ojala	99
15 Interaction Proxemics: Combining Physical Spaces for Spatial-dependent Interaction	
Tilman Dingler, Markus Funk, and Florian Alt	107
16 Gravity Games - A Framework for Interactive Space Physics on Media Facades	
Marcel Köster, Michael Schmitz, and Sven Gehring	115
17 Are You Feeling Lucky? : Lottery-based Scheduling for Public Displays	
Mateusz Mikusz, Sarah Clinch, and Nigel Davies	123
Session V: SPECIFIC APPLICATIONS	131
18 In-Car Touch-Screen Interaction: Comparing Standard, Finger-Specific and Multi-Finger Interaction	
Ashley Colley, Jani Väyrynen, and Jonna Häkkinen	131
19 Design sensitivities from public expression practices with non-digital displays	
Pedro Coutinho and Rui José	139
20 They want to tell us: Attention-aware Design and Evaluation of Ambient Displays for Learning	
Dirk Börner, Marco Kalz, and Marcus Specht	147
21 Construction on Display: Exploring the Use of Public Displays on Construction Sites	
Nemanja Memarovic	155
22 Collaborative Newspaper: Exploring an adaptive Scrolling Algorithm in a Multi-user Reading Scenario	
Christian Lander, Marco Speicher, Norine Coenen, Sebastian Biewer, Denise Paradowsk, and Antonio Krüger	163
Session VI: IN THE WILD	171
23 Public Photos, Private Concerns: Uncovering Privacy Concerns of User Generated Content Created Through Networked Public Displays	
Nemanja Memarovic	171
24 Insights from Deploying See-Through Augmented Reality Signage in the Wild	
Ashley Colley, Leena Ventä-Olkkonen, Florian Alt, and Jonna Häkkinen	179
25 Interactive Study of WallSHOP: Multiuser Connectivity Between Public Digital Advertising and Private Devices for Personalized Shopping	
Masafumi Muta, Soh Masuko, Keiji Shinzato, and Adiyana Mujibiya	187

26 Enter the Circle: Blending Spherical Displays and Playful Embedded Interaction in Public Spaces	
Julie Williamson and Daniel Sundn	195
27 The Role of Tangible Interaction in Exploring Information on Public Visualization Displays	
Sandy Claes and Andrew Vande Moere	201
Session VII: IMAGINATIVE INTERFACES	209
28 ShadowTouch: a Multi-user Application Selection Interface for Interactive Public Displays	
Ivan Elhart, Federico Scacchi, Evangelos Niforatos, and Marc Langheinrich	209
29 Exploring the Potential of Depictions with Sun Reflections	
Patrick Tobias Fischer, Eva Hornecker, Johann Gielen, Johannes Hartmann, Marco Schmandt, Anna Rack, Marie Bornemann, Felix Dondera, and Herbert Grinda	217
30 An Interactive Curtain for Media Usage in the Shower	
Markus Funk, Stefan Schneegass, Michael Behringer, Niels Henze, and Albrecht Schmidt	225
Poster Track	232
31 Multi-User Usability Guidelines for Interactive Wall-Display Applications	
Andrea Nutsi and Michael Koch	233
32 autoUI-ML: A design language for the flexible creation of automotive GUIs based on semantically represented data	
Matthieu Deru and Robert Neßelrath	235
33 Cast Together: Inclusive and Unobtrusive Mobile Interactions with a Situated Display	
Lauren Norrie and Roderick Murray-Smith	237
34 CEPBoard Collaborative Electronic Performance Board and Editor for Production Environments in Industry 4.0	
Vladimir Pavlov, Sönke Knoch, and Matthieu Deru	239
35 WeatherUSI: Crowdsourcing Weather Experience on Public Displays	
Evangelos Niforatos, Ahmed Fouad, Ivan Elhart, and Marc Langheinrich	241
36 There is more to Interaction with Public Displays than Kinect: Using Wearables to Interact with Public Displays	
Stefan Schneegass	243
37 A Real-Time Bidding Platform for Public Displays	
Tilman Dingler and Albrecht Schmidt	245
Demo Track	247
38 The Knowledge Window: How Does Technology Improve Printed Posters	
Constantin Taivan	247
39 VEII: A Toolkit for Editing Multimedia Content of Interactive Installations On-site	
Thomas Kubitzka, Sascha Thullner, and Albrecht Schmidt	249
40 An application framework for place-based displays with mobile interaction	
Rui José, Maximilian Müller, André Felix, and Bruno Silva	251

41 Demo: Making Lottery-based Scheduling Decisions Visible	
Mateusz Mikusz, Sarah Clinch, and Nigel Davies	253
42 Physically Guiding Touch Screen Interaction with Public Displays	
Ashley Colley, Lasse Virtanen, Jani Väyrynen, and Jonna Häkkinen	255
43 BIM—MAR: Assembling physical objects by virtual information	
Boyana Buyuklieva and Marcin Kosicki	257
44 Lichtform: A Shape Changing Light Installation	
Philipp Schardt, Michael Schmitz, Hannes Käfer, and Eric Hofmann	259
45 An Interactive Planetary System for High-Resolution Media Facades	
Marcel Köster, Michael Schmitz, and Sven Gehring	261
46 Common Gestures: Visual Design for a Collaborative Archive Interface	
Soenke Zehle, Henrik Elburn, and Christopher Kaiser	263
47 PaperFlow: A Gamified Multitouch Application to Increase Motivation and Participation in Scientific Research	
Christopher Kaiser and Michael Schmitz	265
48 Application features to convey peers? interactions to engage users in a display network	
Maximilian Müller, Nuno Otero, Aris Alissandrakis, and Marcelo Milrad	267
49 Cognitive Monitoring via Eye Tracking in Virtual Reality Pedestrian Environments	
Daniel Sonntag, Jason Orlosky, Markus Weber, Yecheng Gu, Takumi Toyama, and Eshan Nadjaran Toosi	269
50 Collaborative Newspaper Demo: Exploring an adaptive Scrolling Algorithm in a Multi-user Reading Scenario	
Christian Lander, Marco Speicher, Denise Paradowski, Norine Coenen, Sebastian Biewer, and Antonio Krüger	271
Video Track	273
51 Breathing Display: Exploring the Effects of a Responsive Installation on Peoples Behaviour in Public Space	
Giuseppe Miccoli, Angeliki Bakogianni, and Ava Fatah Gen. Schieck	273
52 AUR: Augmented Urban Reality	
Ava Fatah Gen. Schieck, Ana Maria Moutinho, Efstathia Kostopoulou, Russell Freeman, and Shanaka Senevirathne	275
53 Archive Interfaces: Toward the User as Co-Curator	
Soenke Zehle, Henrik Elburn, Christopher Kaiser, and Simon Paehler	277