Title:

Exploring factors that influence the combined use of mobile devices and public displays for pedestrian navigation

**Author:**

Jörg Müller, Marc Jentsch, Christian Kray, Antonio Krüger

**Abstract:**

Large displays are rapidly proliferating in public spaces, and could therefore be an attractive resource to support nomadic users in such contexts, e.g. by providing additional screen real estate or by augmenting services delivered through a mobile device. While previous work on combining public displays and mobile devices has identified a number of benefits of this combination, it is not yet clear if users will actually use such a system and if they do, why and when. In this paper, we present two initial user studies investigating factors relevant to user acceptance and usability in the context of a deployed system that provides pedestrian navigation support through a combination of mobile devices and public displays. Based on the results from a repertory grid analysis, we identify dimensions that are relevant for users deciding whether to use a public display or not, and discuss implications for the design of such systems.

Title:

Thanks and Tweets: Comparing Two Public Displays

**Author:**

Sean A. Munson, Emily Rosengren, Paul Resnick

**Abstract:**

Two public display systems, with different methods of posting, were deployed over several years. One, the Thank You Board, was designed to give people an outlet specifically for publicly thanking and acknowledging others in the community. The other, SI Display, showed any Twitter post directed to the display and did not have explicit usage guidelines. People preferred the flexibility of the latter, but ambiguity about its purpose and norms of usage persisted even six months after deployment and made some people hesitant to post. Also, using Twitter as the posting mechanism facilitated participation for some but also created barriers for those not using Twitter and for Twitter users who were wary of mixing their professional and nonprofessional contexts.

Title:

Interaction Techniques for Creating and Exchanging

Content with Public Displays

**Author:**

Florian Alt, Alireza Sahami Shirazi, Thomas Kubitza, Albrecht Schmidt

**Abstract:**

Falling hardware prices and ever more displays being connected to the Internet will lead to large public display networks, potentially forming a novel communication medium. We envision that such networks are not restricted to display owners and advertisers anymore, but allow also passersby (e.g., customers) to exchange content, similar to traditional public notice areas, such as bulletin boards. In this context it is crucial to understand emerging practices and provide easy and straight forward interaction techniques to be used for creating and exchanging content. In this paper, we present Digifieds, a digital public notice area we built to investigate and compare possible interaction techniques. Based on a lab study we show that using direct touch at the display as well as using the mobile phone as a complementing interaction technology is most suitable. Direct touch at the display closely resembles the interaction known from classic bulletin boards and provides the highest usability. Mobile phones preserve the users’ privacy as they exchange (sensitive) data with the display and at the same time allow content to be created on-the-go or to be retrieved.

Title:

Lessons Learned: Game Design for Large Public Displays

**Author:**

Matthias Finke, Anthony Tang, Rock Leung, Michael Blackstock

Abstract: This paper presents the design and deployment of Polar Defence, an interactive game for a large public display. We designed this display based on a model of “users” and their interactions with large public displays in public spaces, which we derived from prior work. We conducted a four-day user study of this system in a public space to evaluate the game and its impact on the surrounding environment. Our analysis showed that the installation successfully encouraged participation among strangers, and that its design and deployment addressed many of the challenges described by prior research literature. Finally, we reflect on this deployment to provide design guidance to other researchers building large interactive public displays for public spaces.

Title:

Real World Responses to

Interactive Gesture Based Public Displays

**Author:** John Hardy, Enrico Rukzio, Nigel Davies

**Abstract:**

Today, one does not have to travel far to find examples of digital signage, yet the adoption of interactive gesture based public displays remains quite rare. Subsequently, not much is known about them despite a large array of potential advantages. This paper contributes to our understanding of how people perceive, respond to and interact with such displays outside the controlled environment of a research lab. Unlike other works which have focused on isolated aspects of in-lab interaction, we present a detailed examination that addresses a wide range of responses to such a display - including those who ignore them completely. To facilitate our study we created an experimental coarse gesture based software suite and then deployed the system along with associated applications as part of an existing large scale public display network. Using this as a base, we executed four studies designed to passively observe the reactions of passers-by and followed these up with a fifth controlled experiment that compared the effectiveness of two different kinds of gesture in the context of menu item selection. To conclude, we present our key findings and highlight possible avenues of further study for the future of gesture based digital signage.

Title:

Flashlight Jigsaw: An Exploratory Study of

an Ad-Hoc Multi-Player Game on Public Displays

**Author:**

Xiang Cao, Michael Massimi, Ravin Balakrishnan

**Abstract:**

As large displays become prevalent in public spaces, they could be employed to create novel game experiences for the public. We present an exploratory study of an ad-hoc multiplayer game played on such public displays. The game, Flashlight Jigsaw, was deployed in a shared lab space and a public atrium for two weeks in total. Through interviews supported by observations and system logs we explored the experiences and behaviors of players and spectators. We also investigated the interrelationship between public display games and the spaces they are deployed in. The research resulted in findings regarding game play, communication, social interaction, spectatorship, and space and location around such a game. We use our findings to develop design implications for future public display games.

Title:

Interactive Public Ambient Displays: Transitioning from Implicit to Explicit, Public to Personal, Interaction with Multiple Users

**Author:**

Daniel Vogel, Ravin Balakrishnan

**Abstract:**

We develop design principles and an interaction framework for sharable, interactive public ambient displays that support the transition from implicit to explicit interaction with both public and personal information. A prototype system implementation that embodies these design principles is described. We use novel display and interaction techniques such as simple hand gestures and touch screen input for explicit interaction and contextual body orientation and position cues for implicit interaction. Techniques are presented for subtle notification, self-revealing help, privacy controls, and shared use by multiple people each in their own context. Initial user feedback is also presented, and future directions discussed.

Title:

What Makes You Click: Exploring Visual Signals to Entice

Interaction on Public Displays

**Author:**

Hannu Kukka, Heidi Oja, Vassilis Kostakos, Jorge Goncalves, Timo Ojala

**Abstract:**

Most studies take for granted the critical first steps that prelude interaction with a public display: awareness of the interactive affordances of the display, and enticement to interact. In this paper we investigate mechanisms for enticing interaction on public displays, and study the effectiveness of visual signals in overcoming the ‘first click’ problem. We combined 3 atomic visual elements (color/greyscale, animation/static, and icon/text) to form 8 visual signals that were deployed on 8 interactive public displays on a university campus for 8 days. Our findings show that text is more effective in enticing interaction than icons, color more than greyscale, and static signals are more effective than animated. Further, we identify gender differences in the effectiveness of these signals. Finally, we identify a behavior termed “display avoidance” that people exhibit with interactive public displays.

Title:

Requirements and Design Space for Interactive

Public Displays

**Author:**

Jörg Müller

Florian Alt, Albrecht Schmidt

Daniel Michelis

**Abstract:**

Digital immersion is moving into public space. Interactive screens and public displays are deployed in urban environments, malls, and shop windows. Inner city areas, airports, train stations and stadiums are experiencing a transformation from traditional to digital displays enabling new forms of multimedia presentation and new user experiences. Imagine a walkway with digital displays that allows a user to immerse herself in her favorite content while moving through public space. In this paper we discuss the fundamentals for creating exciting public displays and multimedia experiences enabling new forms of engagement with digital content. Interaction in public space and with public displays can be categorized in phases, each having specific requirements. Attracting, engaging and motivating the user are central design issues that are addressed in this paper. We provide a comprehensive analysis of the design space explaining mental models and interaction modalities and we conclude a taxonomy for interactive public display from this analysis. Our analysis and the taxonomy are grounded in a large number of research projects, art installations and experience. With our contribution we aim at providing a comprehensive guide for designers and developers of interactive multimedia on public displays.

Title:

How to evaluate Public Displays

**Author:**

Florian Alt1, Stefan Schneegaß1, Albrecht Schmidt1,

Jörg Müller2, Nemanja Memarovic3

**Abstract:**

After years in the lab, interactive public displays are finding their way into public spaces, shop windows, and public institutions. They are equipped with a multitude of sensors as well as (multi-) touch surfaces allowing not only the audience to be sensed, but also their effectiveness to be measured. The lack of generally accepted design guidelines for public displays and the fact that there are many different objectives (e.g., increasing attention, optimizing interaction times, finding the best interaction technique) make it a challenging task to pick the most suitable evaluation method. Based on a literature survey and our own experiences, this paper provides an overview of study types, paradigms, and methods for evaluation both in the lab and in the real world. Following a discussion of design challenges, we provide a set of guidelines for researchers and practitioners alike to be applied when evaluating public displays.

Title:

Screenfinity: Extending the Perception Area of Content on Very Large Public Displays

**Author:**

Constantin Schmidt, J¨org M¨ uller1;2 Gilles Bailly1

**Abstract:**

We propose and validate a model of the perception area of content on public displays in order to predict from where users can read. From this model, we derive Screenfinity, a technique to rotate, translate, and zoom content in order to enable reading while passing by very large displays. Screenfinity is comfortable to read when close, supports different content for different users, does not waste screen real estate and allows expert passers-by to read content while walking. A laboratory study shows that expert users are able to perceive content when it moves. A field study evaluates the effect of Screenfinity on novice users in an ecologically valid setting. We find (1) first time users can read content without slowing down or stopping; (2) Passers-by stopping did so to explore the technology. Users explore the interaction, the limits of the system, manipulate the technology, and look behind the screen.

Title:

Foot Position as Indicator of Spatial Interest at Public Displays

**Author:**

Bernd Huber

**Abstract:**

Motivated by and grounded in observations of foot patterns in a human-human dialogue, this study explores expressions of spatial interest through feet at public displays. We conducted an observation and recorded user foot orientation and position in a public information display environment leading to data about 84 interaction sessions. Our observations show that characteristic foot patterns can be matched with two user intentions: (A) Users who seek access to specific information, and (B) users who don’t seek specific information. With the goal to detect intention through foot patterns, we classified characteristic foot patterns with a SVM pattern recognition algorithm, which resulted in a detection accuracy of 84.4%. This work can be valuable for researchers designing context-aware public displays.

Title:

Public Ubiquitous Computing Systems: Lessons from the e-Campus Display Deployments

**Author:**

Oliver Storz, Adrian Friday,

Nigel Davies, Joe Finney,

Corina Sas, and Jennifer G. Sheridan

**Abstract:**

Lancaster University’s e-Campus project is exploring the creation of large-scale networked displays as part of a public, interactive pervasive computing environment. For the project, we built and deployed three experimental display systems that vary in technology, location, scale, and user community, and they’ve given us a rich set of experiences. We’ve summarized 13 lessons learned from this experience. The lessons certainly apply to researchers planning similar deployments. We also believe they will generalize to other public ubicomp installations.

Title:

Worlds of Information: Designing for Engagement at a

Public Multi-touch Display

**Author:**

Giulio Jacucci12, Ann Morrison1, Gabriela Richard3, Jari Kleimola1, Peter Peltonen1,

Lorenza Parisi4, Toni Laitinen1

**Abstract:**

In designing for engagement at a public multi-touch installation, we identified supporting multiple users and allowing for gradual discovery as challenges. In this paper, we present Worlds of Information, a multi-touch application featuring 3D Worlds, which provide access to different content. These 3D widgets gradually unfold and allow for temporal navigation of multimedia in parallel, while also providing a 2D plane where media can be shared. We report on a field trial at an exhibition using questionnaires and video ethnography. We studied engagement through questions adapted from Flow, Presence and Intrinsic Motivation questionnaires, which showed that users, overall, had a positive and social experience with the installation. The worlds effectively invited multiple users and provided for parallel interaction. While functionality was discovered gradually through social learning, the study demonstrates the challenges of designing multi-touch applications for walk-up-and-use displays.

Title:

Sensing and Reacting to Users’ Interest: an Adaptive Public Display

**Author:**

Gianluca Schiavo, Eleonora Mencarini, Kevin B. A. Vovard, Massimo Zancanaro

**Abstract:**

In this paper we describe a public display system that detects the users’ interest and adapts the on-screen content accordingly. An interest estimation algorithm based on the analysis of the users’ non-verbal behaviour, including the users’ position, their orientation and the social context, is proposed. A preliminary field study suggests that an adaptive public display may be more appealing than a control condition, where the same content is offered without any adaptation. We argue that behavioural-based measures are valuable data to inform and adapt a public display in a social-aware way, improving the users’ engagement.

Title:

Proxemic Peddler: A Public Advertising Display that Captures and Preserves the Attention of a Passerby

**Author:**

Miaosen Wang, Sebastian Boring, Saul Greenberg

**Abstract:**

Effective street peddlers monitor passersby, where they tune their message to capture and keep the passerby’s attention over the entire duration of the sales pitch. Similarly, advertising displays in today’s public environments can be more effective if they were able to tune their content in response to how passersby were at-tending them vs. just showing fixed content in a loop. Previously, others have prototyped displays that monitor and react to the pres-ence or absence of a person within a few proxemic (spatial) zones surrounding the screen, where these zones are used as an estimate of attention. However, the coarseness and discrete nature of these zones mean that they cannot respond to subtle changes in the us-er’s attention towards the display. In this paper, we contribute an extension to existing proxemic models. Our Peddler Framework captures (1) fine-grained continuous proxemic measures by (2) monitoring the passerby’s distance and orientation with respect to the display at all times. We use this information to infer (3) the passerby’s interest or digression of attention at any given time, and (4) their attentional state with respect to their short-term in-teraction history over time. Depending on this attentional state, we tune content to lead the passerby into a more attentive stage, ultimately resulting in a purchase. We also contribute a prototype of a public advertising display – called Proxemic Peddler – that demonstrates these extensions as applied to content from the Am-azon.com website.

Title:

Encouraging Spectacle to Create Self-Sustaining

Interactions at Public Displays

**Author:**

Ben Bedwell, Theresa Caruana

**Abstract:**

We present the first public trial of a novel mobile phone-public display application and discuss how key results from the trial can influence future designs of high visibility human-computer interactions. This paper describes how the design and deployment of the installation was engineered to utilise the single user’s interaction, both to attract participants and onlookers as well as to sustain a continuous flow of new participants. We present a series of significant ethnographic observations relating to the public’s interaction with the installation during its use then discuss how these features contributed to the success of the installation’s original aims and how observations of unexpected behaviour offer insight into design strategies that can be employed to foster the role of participant as a crucial aspect of the overall spectacle.

Title:

Evaluating Ambient Displays in the Wild: Highlighting

Social Aspects of Use in Public Settings

**Author:**

Jörn Messeter, Daryn Molenaar

**Abstract:**

A prominent issue for evaluating ambient displays has been the conflict between the relative intrusiveness of evaluation methods and the intention to keep the display at the periphery of the user’s attention. There is a general lack of research discussing the difficulties of evaluating ambient displays in the wild, and in particular social aspects of use has received little attention. This paper presents a case study of an ambient light display designed for a public setting. Based on results from a non-intrusive in situ evaluation, we argue that viewing ambient displays as features of a broader social setting may aid our understanding of issues regarding the evaluation of ambient displays in the wild.

Title:

**Exploring Limits and Opportunities for Public Displays in Dementia Care Centers**

**Author:**

Chiara Leonardi, Massimo Zancanaro

**Abstract:**

An initial investigation on the use of “encrypted” public displays as a way of interfacing an ambient intelligent infrastructure in dementia care centers is presented. Ambient intelligence promises new opportunities for daily human life that will be simplified by making people's environments supportive, flexible and adaptive. Yet, a crucial aspect of these technologies is the acceptability of user interfaces: the move of computing from a localized tool to a constant companion imposes to reconsider the relationship between humans and computers. We investigated the acceptability of public displays as a way of representing monitoring information with contextual inquiries and scenario-based design with the operators of three dementia care centers.

Title:

Adaptive Navigation Support with Public Displays

**Author:**

Christian Kray, Gerd Kortuem, Antonio Kr¨uger

**Abstract:**

In this paper, we describe a public navigation system which uses adaptive displays as directional signs. The displays are mounted to walls where they provide passersbys with directional information. Each sign is an autonomous, wirelessly networked digital displays connected to a central server. The signs are position-aware and able to adapt their display content in accordance with their current position. Advantages of such a navigation system include improved flexibility, dynamic adaptation and ease of setup and maintenance.

Title:

Doodle Space: Painting on a Public Display by Cam phone

**Author:**

Yu Zhong, Xin Li, Mingming Fan , Yuanchun Shi

**Abstract:**

In this paper, we present a novel interactive application on public displays, Doodle Space, which allows multiple participants collaboratively painting 3D curve on a projected wall using personal camera phones. An image sequence based algorithm is used to estimate the movement parameters of cam-phones. Users’ camphone holding hand’s gesture is recognized and monitored in real time which allows users to control a virtual brush naturally by moving their phones in the air. A wireless transmission mechanism based on Bluetooth protocol is implemented to build movement parameters transmission channel between phones and server PC. A 3D drawing scheme is designed to construct 3D curve with movement parameters on the display. People could not only doodle but also manipulate their doodles by dragging, rotation and zoom which are indispensable for true drawing. User studies are applied to testify and improve doodle space’s feasibility and entertainment.

Title:

Math on a Sphere: Using Public Displays to Support

Children's Creativity and Computational Thinking on 3D

Surfaces

**Author:**

Sherry His, Michael Eisenberg

**Abstract:**

Math on a Sphere (MoS) is a newly developed Web-based environment that enables children to imagine, program, and share creative designs on a public spherical display, the "Science on a Sphere" system created by the National Oceanic and Atmospheric Administration (NOAA). The MoS software, similar in spirit to the Logo language, was installed at an exhibit located in the Lawrence Hall of Science at the University of California at Berkeley and at the Fiske Planetarium at University of Colorado, Boulder. Twenty-five children ages 8 to 13 in two cohorts tested the MoS software during a half-day workshop held at the Lawrence Hall. In addition to using the MoS software to create beautiful and original works of art, children also engaged in hands-on crafts and inquiry-based math activities to further promote learning of spherical geometry and computational thinking. MoS software workshop had a positive impact on children's engagement, but had mixed results about their understanding of geometry as evidenced by direct observations and results from pre/post-surveys, which are reported here.

Title:

Enhancing Interactive Public Displays with Social Networking Services

**Author:**

Simo Hosio, Hannu Kukka,

Marko Jurmu, Timo Ojala, Jukka Riekki

**Abstract:**

In this paper, we suggest utilizing modern social networking services for building versatile applications for interactive public displays. We demonstrate the functionality and potential of this approach by presenting a set of services deployed on top of a network of public displays, utilized in a longitudinal study in an authentic city setting. We further propose utilizing users’ personal online profiles for building personalized and appealing public social services, and suggest that this may enhance the attractiveness of interactive public displays. Results of this study indicate that using interactive public displays is inherently a social event, and that services supporting group use and sociality succeed in urban smart spaces.

Title:

Private Public Screens – Detached Multi-User Interaction

with Large Displays through Mobile Augmented Reality

**Author:**

Matthias Baldauf, Katrin Lasinger, and Peter Fröhlich

**Abstract:**

As everyday companions, smartphones are well-suited tools for controlling interactive applications on large public displays. To allow concurrent interaction by multiple users beyond traditional collaborative scenarios we introduce the idea of virtually augmented public screens for creating personalized views and thus literally enabling \private public screens". We present a fully functional research prototype in form of a Video Wall application and report on first experiences gathered from a comparative user study. The results show that the proposed personalized Augmented Reality approach, which allows each user to have a private view on the public display, is preferred over a purely competitive mode, where the public display is shared between the users. Further, our study shows that social activity indicators informing about the activities of other users are well appreciated.

Title:

The Augmented Video Wall: Multi-user AR Interaction With Public Displays

**Author:**

Matthias Baldauf, Peter Fröhlich

**Abstract:**

The Augmented Video Wall is a compelling showcase application demonstrating a novel collocated interaction technique for public displays beyond traditional competitive or collaborative multi-user scenarios. By utilizing means of augmented reality on personal mobile devices and applying animated video overlays accurately superimposed upon the public display, we create the illusion of literally private views to a shared public display. Besides this concurrent viewing mode, the demonstrator features a competitive mode and a concurrent mode enhanced with social features to highlight the characteristics of this novel display interaction techniques. During a first preliminary study, the Augmented Video Wall attracted lots of visitors and created highly entertaining experiences for groups.

Title:

Virtual Prototyping Using Miniature Model and Visualization for Interactive Public Displays

**Author:**

Yasuto Nakanishi

**Abstract:**

In the development of augmented spaces, it is often difficult to perform frequent prototyping and testing. A range of related problems arise, especially when the cost of operation is high or when it is difficult to implement simulation in advance within the installation space. To address these problems, the authors created an integrated environment for iteration-based development of augmented spaces that allows interactive system developers to create systems using iterative virtual simulation and trial-and-error. With this system, hybrid prototyping using both virtual and miniature simulation can be performed. This paper introduces virtual simulation based on visualization. The authors studied four prototyping and deployment processes for two interactive public displays using both methods in order to clarify their characteristics, and the respective merits and demerits were discussed. Based on the results, a prototyping strategy for interactive public displays was proposed. Basic software operations and ideal positioning of input and output devices were investigated within virtual space, problems arising from differences between virtual and real space were clarified within miniature model space, and the addition of features to the code and related adjustment were iterated within both spaces.

Title:

FizzyVis: Designing for Playful Information Browsing

on a Multitouch Public Display

**Author:**

Céline Coutrix1, Kai Kuikkaniemi1, Esko Kurvinen1,

Giulio Jacucci12, Ivan Avdouevski1, Riikka Mäkelä3

**Abstract:**

Multitouch screens are being increasingly deployed in public settings. In order to provide useful information to users in an attractive way, playfulness of the interaction is a relevant characteristic. In this paper, our contribution is FizzyVis, a walkup- and-use interface that displays information through bubbles reacting to touches, and its design goals. The interface following a “ball pool” metaphor presents three types of bubbles animated and linked to each other by gravitation and magnetism: content bubbles, browsing bubbles and map bubbles. FizzyVis supports playful use through catching curiosity, projecting users in a playful state of mind, enabling easy and explorative information browsing, enticing playful gesturing and collective play, and rewarding finish. FizzyVis is evaluated regarding these design goals in a field study at a music festival over several days. The UI was useful to find information and playful. We detail the use of the installation to uncover generic lessons to be learned and explore further potential of FizzyVis.

Title:

Sharing Multimedia Content with Interactive Public

Displays: A Case Study

**Author:**

Elizabeth F. Churchill, Les Nelson, Laurent Denoue, Jonathan Helfman, Paul Murphy

**Abstract:**

Plasma Posters are large screen, digital, interactive posterboards situated in public spaces, designed to facilitate informal content sharing within teams, groups, organizations and communities. While interest in interactive community poster boards has grown recently, few successful examples have been reported. In this paper we describe an ongoing installation of Plasma Posters within our organization, and report qualitative and quantitative data from 20 months of use showing the Posters have become an integral part of information sharing, complementing email and Web-based sharing. Success factors include our design process, the reliability and flexibility of the technology and the social setting of our organization. We briefly describe three external installations of the Plasma Poster Network in public places. We then reflect on content posting as “information staging” and the ways in which the public space itself becomes part of the “interface” to content.

Title:

Measuring Environments for Public Displays: A Space Syntax Approach

**Author:**

**Sheep Dalton, Paul Marshall, Ruth Conroy Dalton**

**Abstract:**

This paper reports on an on-going project, which is investigating the role that location plays in the visibility of information presented on a public display. Spatial measures are presented, derived from the architectural theory of Space Syntax. These are shown to relate to the memorability of words and images presented on different displays. Results show a complex pattern of interactions between the size and shape of spaces in which displays are situated and the memorability of different types of representations depicted. This approach offers a new way to consider the role of space in guiding and constraining interaction in real settings: a growing concern within HCI and Ubicomp.

Title:

An Advanced Bidding Agent for Advertisement

Selection on Public Displays

**Author:**

Alex Rogers1, Esther David2, Terry R. Payne1 and Nicholas R. Jennings1

**Abstract:**

In this paper we present an advanced bidding agent that participates in first-price sealed bid auctions to allocate advertising space on BluScreen – an experimental public advertisement system that detects users through the presence of their Bluetooth enabled devices. Our bidding agent is able to build probabilistic models of both the behaviour of users who view the adverts, and the auctions that it participates within. It then uses these models to maximise the exposure that its adverts receive. We evaluate the effectiveness of this bidding agent through simulation against a range of alternative selection mechanisms including a simple bidding strategy, random allocation, and a centralised optimal allocation with perfect foresight. Our bidding agent significantly outperforms both the simple bidding strategy and the random allocation, and in a mixed population of agents it is able to expose its adverts to 25% more users than the simple bidding strategy. Moreover, its performance is within 7.5% of that of the centralised optimal allocation despite the highly uncertain environment in which it must operate.

Title:

Gaze-Based Interaction with Public Displays

Using Off-the-Shelf Components

**Author:**

Javier San Agustin, **John Paulin Hansen, Martin Tall**

**Abstract:**

**Eye gaze can be used to interact with high-density information presented on large displays. We have built a system employing off-the-shelf hardware components and open-source gaze tracking software that enables users to interact with an interface displayed on a 55” screen using their eye movements. The system works at a viewing distance of 1 to 1.5 meters and requires a 30 second calibration procedure for every user. We demonstrate how it can be used to navigate a digital bulletin board display with several notes on top of each other. There are some technical challenges detecting the eyes when people are wearing glasses and when external light sources are present.**

Title:

Extending Large-Scale Event Participation with

User-Created Mobile Media on a Public Display

**Author:**

Peter Peltonena, Antti Salovaaraa, Giulio Jacuccia, Tommi Ilmonena,

Carmelo Arditob, Petri Saarikkoa, Vikram Batraa

**Abstract:**

Most large public displays have been used for providing information to passers-by with the primary purpose of acting as one-way information channels to individual users. We have developed a large public display to which users can send their own media content using mobile devices. The display supports multi-touch interaction, thus enabling collaborative use of the display. This display called CityWall was set up in a city center with the goal of showing information of events happening in the city. We observed two user groups who used mobile phones with upload capability during two large-scale events happening in the city. Our findings are that this kind of combined use of personal mobile devices and a large public display as a publishing forum, used collaboratively with other users, creates a unique setting that extends the group’s feeling of participation in the events. We substantiate this claim with examples from user data.

Title:

Multi-user mobile applications and a public display: novel ways for social interaction

**Author:**

Leikas, J. ; VTT Tech. Res. Centre of Finland, Tampere ; Stromberg, H. ; Ikonen, V. ; Suomela, R.

**Abstract:**

In this paper we introduce prerequisites for the empowerment of social interaction when using a multi-user mobile service. The paper is based on a case study of user experiences of a multiplayer mobile game where the players attend the game via their mobile phones whilst their activity is materialized on a common public display. Based on the results of user evaluation we introduce three enabling factors for social interaction in a multiplayer game: context, communication and identification. User aspects to these factors as well as perspectives to other types of services are presented

Title:

Using Public Displays to Stimulate Passive Engagement,

Active Engagement, and Discovery in Public Spaces

**Author:**

Nemanja Memarovic\*, Marc Langheinrich\*, Florian Alt†,

Ivan Elhart\*, Simo Hosio‡, Elisa Rubegni\*

**Abstract:**

In their influential book “Public space” Carr et al. describe essential human needs that public spaces fulfill: (1) passive engagement with the environment, where we observe what others are doing; (2) active engagement through intellectual challenges posed by the space, or through engagement with the people in it; and (3) excitement of novel discoveries within the space. An often underused resource in public spaces – public displays – can be used to stimulate these needs. In this paper we argue for a new research direction that explores how public displays can stimulate such essential needs in public spaces. We describe and conceptualize related processes that occur around public displays, based on indepth observations of people interacting with a publicly fielded display application in a city center. Our conceptualization is meant to lay the foundations for designing engaging public display systems that stimulate PACD, and for supporting the analysis of existing deployments.

Title:

Large-Scale Displays for Public Spaces—Constellation of Departure:

Presenting the Impression of Airplanes Taking Off above an Airport

Departure Lounge

**Author:**

YASUHIRO SUZUKI, RCAST, The University of Tokyo, Japan

SHINYA NISHIZAKA, YUSUKE TORIGOE, ATSUSHI IZUMIHARA,

ATSUSHI HIYAMA, KUNIHIRO NISHIMURA, TOMOHIRO TANIKAWA

and MICHITAKA HIROSE, The University of Tokyo, Japan

**Abstract:**

The use of large visual displays in public spaces such as large buildings has become increasingly popular. Public art can make use of the characteristics and context of the site. However, it is difficult to install new displays in existing buildings because of the large, rigid hardware associated with such displays. In this article, we describe a robust, lightweight, low-profile, and fully restorable display system that can be easily and quickly installed for use in existing public buildings. We considerably reduced the number of physical components and the system weight with our proposed method, which can be optimized for any planned content. We describe the technical design and implementation of the display system and discuss some of its applications for public audiences. We then report a three-month field trial that we conducted at an airport terminal building.We discuss the advantages and effectiveness of this system in light of the field trial results.

Title:

Visual Highlighting on Public Displays

**Author:**

Morin Ostkamp, Gernot Bauer, Christian Kray

**Abstract:**

Public displays are often used to broadcast large amounts of information to people who pass by the displays. Flight departure boards, stock market displays and information systems at large conferences are examples for this kind of pervasive displays. While such displays serve a large number of users, one key disadvantage for individual users results from the difficulty to pinpoint which of the many items shown is relevant to them. This paper introduces a novel method to address this problem through visual highlighting and compares it to existing approaches. In doing so, we propose a set of criteria, that can also be used by designers of public display systems to select the most well suited approach for a given application scenario. In addition, these criteria can contribute towards ensuring the comparability of future studies in public display systems.

Title:

Towards Multi-Application Public Interactive Displays

**Author:**

Tomas Lindén, Tommi Heikkinen, Vassilis Kostakos, Denzil Ferreira, Timo Ojala

**Abstract:**

Public displays are becoming a common sight in the urban landscape and they are increasingly being equipped with interaction components such as touch screens. In addition, the Web and its set of enabling technologies are attractive for realizing applications for public displays. We argue that to develop multi-application public displays, then services generally need to be easy to develop, robust, and be easy to deploy and maintain. In this position paper we present a virtual machine-based Web application platform, for decentralized deployment of interactive services on heterogeneous public displays, which satisfies the aforementioned requirements. We also report on some usage experiences of utilizing the platform in a network of large public displays, which we have deployed in a mid-size city.

Title:

Chained Displays: Configurations of Public Displays Can Be Used to Influence Actor-, Audience-, and Passer-By Behavior

**Author:**

Maurice ten Koppel Gilles Bailly Jörg Müller Robert Walter

**Abstract:**

Most interactive public displays currently rely on flat screens. This form of factor impacts how users (1) notice the public display (2) develops motivation and (3) (socially) interact with the public display. In this paper, we present Chained Displays, a combination of several screens to create different form factors for interactive public displays. We also present a design space based on two complementary concepts, Focus and Nimbus, to describe and compare chained display configurations. Finally, we performed a field study comparing three chained displays: Flat, Concave, and Hexagonal. Results show that Flat triggers the strongest honeypot effect, Hexagonal causes low social learning, and Concave triggers the smallest amount of simultaneously interacting users among other findings.

Title:

Designing Application Stores for Public Display Networks

**Author:**

Sarah Clinch1, Nigel Davies1, Thomas Kubitza1;3, Albrecht Schmidt2

**Abstract:**

Current public display systems are often ignored by passersby. We believe that increasing the level of engagement requires substantial innovation for the content shown { and that this in turn requires opening up displays to new forms of applications and content from a wide variety of sources. In this paper we consider the design of \application stores" that are intended to facilitate the introduction of these new forms of content in future display networks.

Title:

The Interacting Places Framework –

Conceptualizing Public Display Applications that Promote

Community Interaction and Place Awareness

**Author:**

Nemanja Memarovic

Marc Langheinrich

Florian Alt

**Abstract:**

The proliferation of public displays, along with ubiquitous wireless communication and sensing technology, has made it possible to create a novel public communication medium: open networked pervasive displays would allow citizens to provide their own content, appropriate close-by displays, and increase their own awareness of a display’s surroundings and its local communities. We envision that such displays can create interacting places, i.e., public spaces that promote community interaction and place awareness. In this paper we describe our Interacting Places Framework (IPF), a conceptual framework for designing applications in this novel research space that we developed based on four distinct public display studies. Our IPF focuses on 4 elements: 1) content providers, i.e., entities that will supply content; 2) content viewers, i.e., people who are addressed by the content; 3) communication channels that deliver the content and range from inclusive, i.e., open-for-everyone, to exclusive, i.e., closed-group channels; and 4) an awareness diffusion layer that describes how community awareness building happens both explicitly, i.e., through content tailored towards a specific audience, and implicitly, by observing output for other people.

Title:

An Investigation on Acceptance and Rejection of Public Displays in a Knowledge Company

**Author:**

Eleonora Mencarini, Leonardo Giusti, Massimo Zancanaro

**Abstract:**

**A field study on the dynamics of acceptance and rejection of public displays in a knowledge work environment is presented. This study has been conducted on the premises of a research center that employs more than 400 people. We report the motivations for the deployment of a public display infrastructure by the Communication Office, and present the results of the field study conducted 18 months after the initial installations. The results showed that there were several limitations for addressing the information needs of employees through the public displays. The main reasons being they were not properly situated in the everyday lifecycle of the institute, and the visual layout was somehow confusing and often ineffective. However, one of the main design goals was the address the need to propose a new corporate identity after a recent company restructuring. This was communicated more effectively even if not generally accepted. Starting from these results, we proposed two main design strategies to make the deployment of public display systems more effective in terms of perceived usefulness and acceptance: (1) seamless integration of the public display into the everyday life of the community and (2) active involvement of the members of the community in the creation and diffusion of content.**

Title:

Design, Implementation and Evaluation of a Novel Public Display for Pedestrian Navigation: The Rotating Compass

**Author:**

Enrico Rukzio, Michael Müller, Robert Hardy

**Abstract:**

Important drawbacks of map-based navigation applications for mobile phones are their small screen size and that users have to associate the information provided by the mobile phone with the real word. Therefore, we designed, implemented and evaluated the Rotating Compass – a novel public display for pedestrian navigation. Here, a floor display continuously shows different directions (in a clockwise order) and the mobile phone informs the user when their desired direction is indicated. To inform the user, the mobile phone vibrates in synchronization with the indicated direction. We report an outdoor study that compares a conventional paper map, a navigation application running on a mobile device, navigation information provided by a public display, and the Rotating Compass. The results provide clear evidence of the advantages of the new interaction technique when considering task completion time, context switches, disorientation events, usability satisfaction, workload and multi-user support.

Title:

Public Display Advertising Based on Bluetooth Device Presence

**Author:**

Matthew Sharifi, Terry Payne, Esther David

**Abstract:**

Public electronic displays can be used as an advertising medium when space is a scarce resource, and it is desirable to expose many advertisements to as wide an audience as possible. Although the efficiency of such advertising systems can be improved if the display is aware of the identity and interests of the audience, this knowledge is difficult to acquire when users are not actively interacting with the display. To this end, we present BluScreen, an intelligent public display, which selects and displays adverts in response to users detected in the audience. Here, users are identified and their advert viewing history tracked, by detecting any Bluetooth-enabled devices they are carrying, such as phones and PDAs.

Title:

Large Public Display Boards: A Case Study of an OR Board and Design Implications

**Author:**

Caterina E.M. Lasome M.S.N., M.B.A., R.N.\*, Yan Xiao Ph.D.'

**Abstract:**

A compelling reason for studying artifacts in collaborative work is to inform design. We present a case study of a public display board (12ft by 4ft) in a Level-I trauma center operating room (OR) unit. The board has evolved into a sophisticated coordination tool for clinicians and supporting personnel. This paper draws on study findings about how the OR board is used and organizes the findings into three areas: (1) visual and physical properties of the board that are exploited for collaboration, (2) purposes the board was configured to serve, and (3) types of physical and perceptual interaction with the board. Findings and implications related to layout, size, flexibility, task management, problem solving, resourcing, shared awareness, and communication are discussed in an effort to propose guidelines to facilitate the design of electronic, computer driven display boards in the OR environment.

Title:

PuReWidgets: A Programming Toolkit for Interactive Public Display Applications

**Author:**

**Jorge C. S. Cardoso, Rui José**

**Abstract:**

Interaction is repeatedly pointed out as a key enabling element towards more engaging and valuable public displays. Still, most digital public displays today do not support any interactive features. We argue that this is mainly due to the lack of efficient and clear abstractions that developers can use to incorporate interactivity into their applications. As a consequence, interaction represents a major overhead for developers, and users are faced with inconsistent interaction models across different displays. This paper describes the results of a study on interaction widgets for generalized interaction with public displays. We present PuReWidgets, a toolkit that supports multiple interaction mechanisms, automatically generated graphical interfaces, asynchronous events and concurrent interaction. This is an early effort towards the creation of a programming toolkit that developers can incorporate into their public display applications to support the interaction process across multiple display systems without considering the specifics of what interaction modality will be used on each particular display.

Title:

Highly Integratable Large-Scale Displays for Public Spaces

**Author:**

Munehiko Sato1, Yasuhiro Suzuki2, Shinya Nishizaka3, Yusuke Torigoe3, Atsushi Izumihara3, Atsushi Hiyama4, Kunihiro Nishimura3, Tomohiro Tanikawa3, Michitaka Hirose3

**Abstract:**

The use of large visual displays in public space has become increasingly popular. However, it is still difficult to install new displays in already existing buildings because of the large and rigid hardware associated with such displays. In this paper, we describe a highly integratable, easily and quickly installable, and lightweight display system for use in existing public buildings. We describe the technical design and implementation of the display system and describe an application of the display for public audiences.

Title:

IM Here: Public Instant Messaging on Large, Shared Displays for Workgroup Interactions

**Author:**

Elaine M. Huang, Daniel M. Russell, Alison E. Sue

**Abstract:**

**Instant messaging (IM) in the workplace has proven to be a valuable tool for facilitating informal communication. Its benefits, however, are generally limited to times when users are in front of their computers. Because so much work takes place while people are mobile within their workplace, we sought to extend the benefits of IM beyond people’s personal machines and into publicly accessible groupware. We first conducted a study of large display groupware applications (LDGAs) to understand the affordances that large displays offer for groupware, and the factors surrounding their adoption. We developed the IM Here system for shared IM on large displays using the lessons learned from the study. In this paper, we present the findings of our LDGA study, the design of IM Here and the preliminary results of our evaluation of IM as a public resource for workgroups.**

Title:

Creating and sharing multi-media packages using large situated public displays and mobile phones

**Author:**

Andrew Maunder, Gary Marsden, Richard Harper

**Abstract:**

**This paper will describe a novel interaction technique that allows mobile phone users to create and share contextualized media packages between their personal, Bluetooth enabled camera phones, and situated public displays. Unlike other solutions to this problem, the one presented in this paper does not require any specialist software or hardware on the user’s handset. We believe this technique has the potential to revolutionise how people donate and retrieve digital medial files without incurring any direct cost.**