POWERWALL: Int. Workshop on Interactive, Ultra-High-Resolution Displays

Chris Rooney
School of Science and Technology
Middlesex University
Hendon
London, NW4 4BT, England
c.rooney@mdx.ac.uk

Kasper Hornbæk
Department of Computer Science,
University of Copenhagen
Njalsgade 128, Build. 24, 5th floor,
DK-2300 Copenhagen, Denmark
kash@diku.dk

Alex Endert
Pacific Northwest National Laboratory
P.O. Box 999
Richland, WA 99352, USA
aendert@cs.vt.edu

Chris North
Dept of Computer Science
2202 Kraft Drive
Virginia Tech
Blacksburg, VA 24061-0106, USA
north@vt.edu

Jean-Daniel Fekete
INRIA Saclay - Île-de-France
Bat 650, Université Paris-Sud
F91405 ORSAY Cedex, France
Jean-Daniel.Fekete@inria.fr

Abstract
Ultra-high-resolution (Powerwall) displays offer a vast real estate for displaying data, but also present a new set of interaction issues. This workshop aims to bring together researchers and practitioners in the research area of Powerwall technologies. The workshop focuses on four key research questions: how do the interaction metaphors change as we move away from desktop interaction? How do we make the most of the visual resolution for data visualization? How can the physical size support collaborative work? And what are the lessons learnt from installing such displays?

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ACM Classification Keywords
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Introduction

It is not trivial to define when a set of tiled displays constitutes a Powerwall. Research can be considered relevant to this domain when the size and resolution of the display goes beyond that of the traditional desktop. Whilst such displays are often thought to be free-standing and wall-sized, they can just as easily be desktop mounted (e.g., the Bloomberg terminal). This creates a wide and varied research domain that encourages work in interaction, visualization, collaboration and hardware construction.

As much as 30 years ago, researchers were looking to large displays to support group meetings and presentations [1]. Over the past three decades, computers have become more powerful, monitors have become flatter, and the overall costs have been dramatically reduced. This makes Powerwall displays more popular than ever before and, as a result, they are installed in many research institutes across the world. Each institute has its own research focus, and the next step is to generate a community where research ideas can be shared and combined. This workshop aims to provide a forum where both academics and practitioners can meet, discuss, and collaborate on relevant topics.

Background

This section describes some of the recent work in the area of ultra-high-resolution, tiled displays. It has been split into four areas to tie-in with the workshop topics.

Construction

A Powerwall display is a large, ultra-high-resolution display that is constructed of a matrix of other displays, which may be either TFT monitors or projectors. It is important to differentiate between Powerwalls and displays that are just large, for example, the single projector display used in many lecture theatres. These single-projector displays rarely have a resolution higher than 1280x1024 pixels, and so present the same amount of information as on a standard desktop display. With Powerwall displays, users can view the display from a distance and see an overview of the data (context), but can also move to within arm's length and see data in great detail (focus). This technique of moving around the display is known as physical navigation [2], and can help users to better understand their data.

The first Powerwall display was installed at the University of Minnesota [3] in 1994. It was made of four rear-projection displays, providing a resolution of 7.8 million pixels (3200x2400 pixels). The largest Powerwall display, at the time of writing, is the Stallion display at the University of Texas [4], composed of 75x30-inch TFT displays offering a total resolution of 307 million pixels (38,400 x 8,000 pixels). Powerwall displays of this scale are typically driven by a cluster of computers. Specialist software is required to send the graphical output across the cluster. Off-the-shelf examples include Chromium [5] that sends the geometry to each node for rendering, and VRJugggler that runs an instance of the application on each node and synchronizes them across the network [6]. Two middleware technologies designed specifically for use with large, clustered displays are SAGE [7] that uses streaming to display multiple applications, and CGLX [8] that combines the advantages of Chromium and VRJuggler.

Not all Powerwalls are driven by a cluster. For example, the 32m pixel display at Virginia Tech and the 15m pixel Mural display at PNNL are both powered by a single node. Such displays are able to run software unmodified, but offer lower resolutions than clustered displays and can suffer from performance issues.

Interaction

Both software and hardware techniques have been proposed to aid with Powerwall interaction. There have been several devices that use pointing for selection [9]. This type of interaction is well supported for collaboration, and makes it possible for multiple users to interact simultaneously. Touch interfaces also support collaboration, and increasingly multi-touch interfaces are being overlaid on top of large displays [10]. The physical size of the display, however, can leave users prone to fatigue. Mobile devices such as tablets can be used as interaction devices, but the secondary screen can distract users' attention. It has been found that this issue can be addressed by adding physical widgets to the tablet's screen [11]. Finally, software techniques such as modifying the window management interface or providing a lens for selecting small targets has been found to speed up interaction [12].

Visualization

In the field of medical visualization, Powerwall displays have been used to render high-resolution, digitally scanned histology slides [13], where the high pixel count increases the volume of data that is rendered at any one time, and the context offered by the size of the display provides a spatial reference, aiding navigation through the visualization. The same principal can also be said for geographical data such as maps, where it has been found that the large display real estate increases performance for searching and route-tracing [14]. Rather than flooding the large display real estate with data, tools such as ForceSPIRE make use of *semantic interaction* to enable analysts to spatially cluster data [15]. Here the space is being used to mimic analysts' mental models, and support the sensemaking process.

Collaboration

Research on collaboration with Powerwall displays is related to that of tabletops [16], which suggests that partitioning the display space is crucial to efficient collaboration, and that distinct territories may be identified in the spatial layout of information. Physical movement, however, influences performance with large displays [2] and the relative distance among collaborators also influences their interaction [17]. Yet, most tabletop studies have participants sit down and stay put. A recent study found that during a collaborative sensemaking session in front of a multi-touch Powerwal display, the ability to physically navigate allowed users to fluidly shift between shared and personal spaces [10].

Workshop Goals

The workshop has two clear goals. The first is to provide a medium for researchers and practitioners in this field to share ideas, and disseminate cutting edge research. Currently, the community has to rely on disseminating solely through HCI or visualization conferences. What is lacking is opportunity for those involved in this growing field to get together. The aim is to make this the first in a series of annual workshops, which, as the discipline develops, may evolve into an independent symposium.

The second goal of the workshop is to create a plan of action for creating and maintaining an online resource that provides the details on hardware and software solutions for installing and using Powerwall displays. The aim is to make it easier to construct such displays, thus inviting more institutions to install their own.

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