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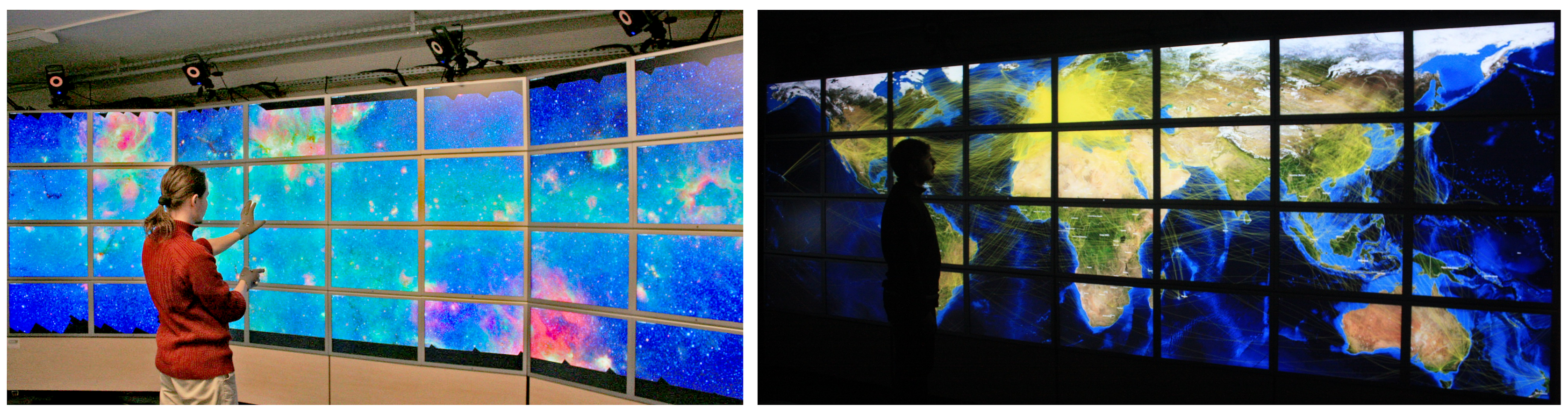
Rapid Development of User Interfaces on Cluster-Driven Wall Displays

ABSTRACT

Wall-sized displays have evolved from experimental, CRT monitor-based setups to sophisticated arrays of tiled projectors or LCD panels. The latter are often called *ultra-high-resolution* displays to emphasize their significantly higher display capacity compared to projector-based *very-high-resolution* displays. As an example, the setup depicted on the right uses 32+1 graphic processing units in 16+1 computers to display 131 megapixels on a 5.5m $\times$ 1.8m surface ($\simeq$ 100dpi). To make them interactive, wall-sized displays are coupled with advanced input devices, e.g., motion-tracking systems, wireless multitouch devices. These new environments pose new research challenges. From a *computer graphics perspective*: how to render complex graphics at high frame rates, taking advantage of the cluster's computing and rendering power. From a *human-computer interaction perspective*: how to design effective visualizations that take advantage of the specific characteristics of large, ultra-high-resolution surfaces. Finally, from a *software engineering perspective*: how to enable the rapid prototyping, development, testing and debugging of interactive applications running on clusters of computers, providing the right abstractions. Our research primarily focuses on the latter two research questions.



1 Multiscale Navigation

While pointing on wall displays has been studied extensively, higher-level, more complex tasks such as pan-zoom navigation have received little attention. It thus remains unclear which techniques are best suited to perform multi-scale navigation in these environments. Building upon empirical data gathered from studies of pan-and-zoom on desktop computers and studies of remote pointing, we identified three key factors for the design of mid-air pan-and-zoom techniques: uni- vs. bimanual interaction, linear vs. circular movements, and level of guidance to accomplish the gestures in mid-air. After an extensive phase of iterative design and pilot testing, we ran a controlled experiment aimed at better understanding the influence of these factors on task performance. Significant effects were obtained for all three factors: bimanual interaction, linear gestures and a high level of guidance resulted in significantly improved performance. Moreover, the interaction effects among some of the dimensions suggest possible combinations for more complex, real-world tasks.

2 Whole-Body Interaction

Wall display environments allow users to move in front of the display. Hand-held devices are mobile, but require users' visual attention, that should primarily be directed towards the wall display. We created BodyScape, a system detecting whole-body interaction. With BodyScape, users can use their body as an input device. A right-handed person uses the right hand to point towards on-screen targets and the left-hand to touch a specific body target, e.g. the elbow or shoulder, to manipulate the on-screen target. In this project, we investigate the most efficient body areas and body gestures, such as rubbing and tapping, for interaction.

3 Software Development

To support the prototyping of interaction techniques such as the ones above, we have developed various software toolkits, including jBricks, a Java toolkit for the development of post-WIMP applications executed on cluster-driven wall displays. jBricks extends and integrates a high-quality 2D graphics rendering engine and a versatile input management module into a coherent framework hiding low-level details from the developer. The goal of this framework is to ease the development, testing and debugging of interactive visualization applications, and rapid prototyping of novel interaction techniques.

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