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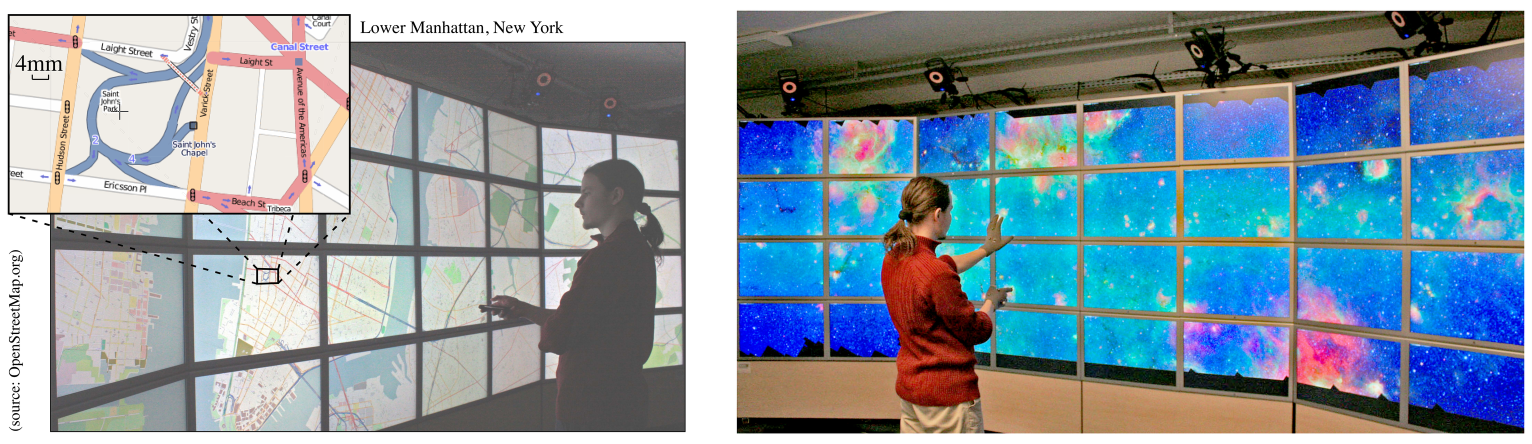
Interaction Techniques for Visualization Platforms

ABSTRACT

Visualization platforms are multi-modal environments for collaborative work on very large datasets. They are becoming widespread and yet lack adequate interaction techniques for everyday tasks such as remote pointing targets or application control. The WILD (Wall-sized Interaction with Large Datasets) platform is composed of a 32-screen wall displaying more than 130 million pixels, a motion capture system allowing sub-millimeter 3D tracking at 200 Hz, and a multi-touch interactive table. It provides a state-of-the-art example of such a platform for both HCI research and real use by partner research teams. This poster presents the current state of the HCI research conducted at *in | situ |* for pointing, multi-scale navigation, 3D manipulation and application control for the WILD platform.

1 Pointing at Distant, Small Targets

Ultra-high-resolution wall displays have proven useful for displaying large quantities of information, but lack appropriate interaction techniques to manipulate the data efficiently. We explored the limits of existing mode-less remote pointing techniques, originally designed for lower resolution displays, and showed that they do not support high-precision pointing on such walls. We then considered techniques that combine a coarse positioning mode to approach the area of the target with a precise pointing mode for acquiring the target. We compared both new and existing techniques through a controlled experiment, and found that techniques combining ray casting with relative positioning or angular movements enable the selection of targets as small as 4 millimeters while standing 2 meters away from the display.



Pointing very small targets and navigating into very-high resolution images

2 Multiscale Navigation in Very Large Datasets

Ultra-high-resolution wall-sized displays offer new opportunities for interacting with very large data sets. While pointing on this type of display 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.

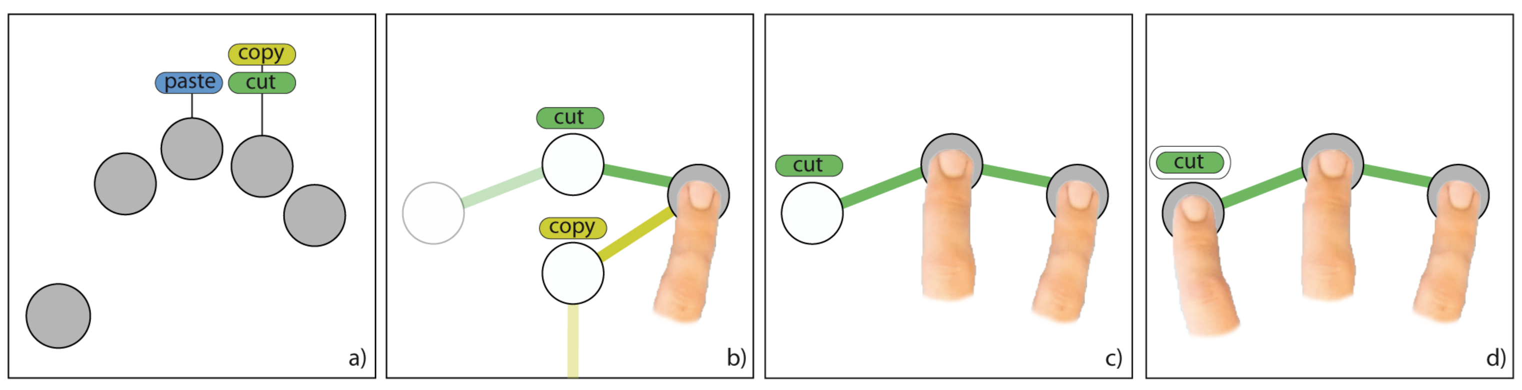
3 3D Manipulation of Virtual Objects

Understanding 3-dimensional structures is a key matter for some of our scientific partners, such as biochemists studying how the structure of molecules allows chemical reactions involved in RNA transcription, or neuro physicists exploring variability in the brain morphology to help in diagnosis of cerebral diseases. We build and evaluate interaction techniques allowing users to perform the very basic tasks involved in such activities: navigating 3D scenes, moving and rotating objects, and selecting regions of interest. We make use of the equipment of the room, such as the motion-tracking system and the multi-touch table, but our goal is also to make an opportunistic use of the resources users bring inside the WILD room, such as laptops, mobile phones and domain-specific devices (e.g. a 3D-printed brain model). We also investigate the generalization of common 2D manipulation techniques into 3D. For example, a two-finger pinch gesture on a touch-sensitive surface can be used to simultaneously translate, rotate and resize a virtual object. This enables translations in the plane defined by that surface and rotations around the surface normal. That gesture could also be realized by free-hand gestures, using one hand to define the surface and the other to perform the gesture. This configuration does not require an actual surface, thus it is possible to complement the technique so that it allows translations in the direction of the surface normal.

Simultaneous 3D manipulation with an interactive table and tracked gestures

4 Application Control via Multi-Finger Gestures

Despite the success of multi-touch screens, interaction with this kind of devices remains limited to a few gestures performed with one or two fingers. Enhancing these interactions with large vocabularies of multi-finger gestures would allow expert users to reach a higher level of expressiveness and efficiency. This approach has been inspired by the common use of multiple fingers in expert practices like music or stenotypy. But it creates two problems we address in this project: the design of large multi-finger gestures vocabularies, and their learning by novice users. Firstly, we proposed some guidelines for gestures design, informed by mechanical studies of the hand, aiming at the limitation of required effort. Then, we ran a study demonstrating the efficiency of these gestures for expert users. Finally, we created *Arpege*, an interactive step-by-step learning, that allows novice users to do three times less errors than an usual static learning system.



Learning mechanism for multi-finger gestures vocabulary

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