# Navigational Blocks: Tangible Navigation of Digital Information

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## ABSTRACT

Navigational Blocks provide a tangible user interface for applications such as information kiosks. Orientation, movement, and relative position of electronically and microprocessor augmented physical blocks support visitor querying, retrieving, understanding, navigation and exploration of an historical information database.

### Keywords

Tangible User Interface, Information Navigation, Database Query, Electromagnetic Haptic Feedback

## INTRODUCTION

A traditional kiosk interface, employing a touch screen display, requires visitors to navigate information using menus and buttons. These modalities involve learned patterns of interaction separate from one's direct experience of the real world [4] and in that way they often inhibit the very users for which information kiosks are intended—the young, inexperienced, or anxious.

A simpler play-like interface using physical blocks can enable a wider range of visitors to use the kiosk [3]. Tangible user interfaces invite users to manipulate the interface objects independently of their function as interface components [1]. The interface elements introduce and structure the information space for the user through their physical characteristics. Tactile manipulation and interaction offers visitors a rich, exciting, and explorative means to learn.

The Navigational Blocks take advantage of our understanding of physical objects to provide a means of navigation that encourages exploration and engagement with the information space. They provide visitors with a true direct manipulation experience using physical blocks to navigate a data space. This interface uses the visitor's actions in the physical world to control a computational environment, in this case a database of historical information.



## DESIGN CONCEPT

The Navigational Blocks grew from an earlier project that used a computer graphics (VRML) box with image mapped faces as hyperlinks to information. The box provided a three-dimensional virtual interface: a visitor could rotate the box to explore and touch a face to retrieve information. Users found the image box innovative and commented that interacting with the box was intuitive. However, they were dissatisfied by the speed of the VRML loading and found using a mouse to interact with the box difficult. We saw that physical objects could overcome these problems, facilitate interaction, and at the same time bridge the physical and virtual environments. Although the limited number of faces available on a cube represents a categorization challenge to the designer, more complex forms would represent a cognitive challenge to users.

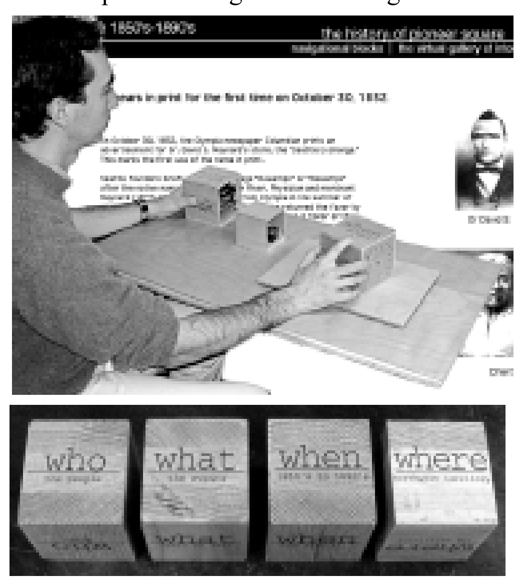


Figure 1a (top) A host Block (middle) receives information queries through infrared from the Block (right) on the active space and updates database display (background image). Figure 1b (bottom) Four Blocks support different query categories - who, what, when and where.

## INFORMATION STRUCTURE

As a case study, the blocks were used to provide an interface to a 'virtual museum.' The structure of the museum database echoes our physical experience, providing individual "exhibits" within categorical "rooms" of a thematic "gallery". In this way it builds on our everyday understanding of three-dimensional spatial relationships. Combining these physical descriptors with a physical interface produces a familiar metaphor for navigating an unfamiliar environment.

## INTERACTION AND NAVIGATION

As indicated, the Navigational Blocks (Figure 1a) were developed to support exploration and retrieval of historical information and stories related to the Pioneer Square district in downtown Seattle. The intended deployment consists of an information kiosk browsed by manipulating a set of Navigational Blocks. Each of four Blocks are designed to represent a major category or "gallery" of information: Who, What, Where and When (Figure 1b). Within these, subcategories or "rooms" cover topics such as 'the 1890s' (When), 'Seattle's founding fathers' (Who) and 'the Gold Rush' (What). Each room provides access to a number of exhibits, providing specialized information such as 'ships' (for the Gold Rush). Unlike a physical museum, however, each exhibit (database record) may be included in more than one room. The Blocks enable visitors to explore the Pioneer Square database, learning about their surroundings by responding to three visitor actions: placing a Block in the active space, sliding a Block in the active space, and combining Blocks.

Whether the display consists of an immersive 3D virtual environment or a standard computer monitor, it is always active. The Blocks are untethered but must be located within an "active area" in order to interact with the system. When no Blocks are detected the system displays an introduction screen. Picking up a Block, a visitor finds titles printed on each of its six faces. By placing the Block within the active area the user selects a "gallery" within the virtual museum, corresponding to the top face of the Block. Stories about people in Pioneer Square's history replace the title screen. Rotating the Block the visitor navigates among the six rooms of information; the top face selects a room. One face—with a unique graphical treatment—is the main face of the Block. Turning this face up displays information on a general topic. Placing two or more Blocks in the active space selects information that satisfies both query criteria.

The second type of interaction supports navigation within a room, to select an exhibit for closer examination. Each room has many exhibits and objects (records) for visitors to explore. By sliding a Block in the active space, the visitor can move through the information space. Imagine placing a Block with the title 'Who – the People' in the active space. Stories called up on the screen represent exhibits within the 'people' room. By sliding the Block back and forth in the active space you scroll through the stories (exhibits) associated with that room learning about the early settlers, for example, the first University of Washington graduate (a woman named Clara McCarty) and Chief Sealth (Seattle).

The third type of interaction supported by the Navigational Blocks involves haptic feedback regarding relationships between topics on the faces of the Blocks. Two Blocks placed side by side will either attract or repel one another. For example, the 'What – the Gold Rush' block repels the 'When – 1850's' Block because the Gold Rush didn't occur in the 1850's. If you rotate the 'When' Block so that '1890's' faces up, then the two Blocks attract each other (because the Gold Rush occurred in 1897). This haptic feedback reinforces user understanding of relationships among the data even without visual display.

## IMPLEMENTATION

A gravity-fed six-sided sensor inside each Block tells the onboard microcomputer (a red-dot cricket [2]) its orientation. The crickets can also read an adjacent Block's orientation so that it can control the polarity of electromagnets embedded in each block face to provide haptic feedback. The Block cricket transmits the orientation data via infrared to the host cricket, which passes it on to the desktop computer that houses the virtual museum. There an application program interprets these messages into queries to a backend database.

## FUTURE WORK

This interface was designed to help tourists explore information in a virtual museum. Currently only Boolean "and" queries are supported. We are investigating mapping spatial relationships to other Boolean operators. We are also exploring applications of the Navigational Blocks in areas of home automation controls and digital media management.

## CONCLUSION AND FEEDBACK

The Navigational Blocks project has been presented to professional, public, and peer groups, and the feedback has been overwhelmingly positive. A recent group of high school student visitors found the system intuitive and easy to use. We expect that this interface will prove a more exciting and accessible way for a wider section of the population to explore information.

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