Constructing Representations of Mental Maps

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Abstract

This short paper presents continued work on a design tool presented at CHI '97 [7] and further described in WP99-01 and [8, 9]. WayMaker is a tool for mapping the layouts and structural features of graphical virtual environments. The tool is based on principles of mental mapping familiar to urban designers and planners. Here we describe usage sessions with practitioners in these disciplines. The observations are influencing development of a new version of the prototype.

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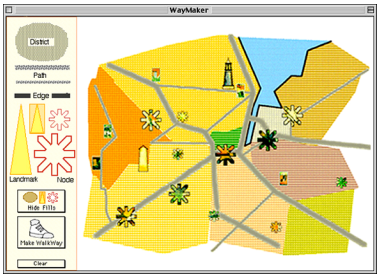
ABSTRACT
This short paper presents continued work on a design tool presented at CHI '97 [7] and further described in [8, 9]. WayMaker is a tool for mapping the layouts and structural features of graphical virtual environments. The tool is based on principles of mental mapping familiar to urban designers and planners. Here we describe usage sessions with practitioners in these disciplines. The observations are influencing development of a new version of the prototype.

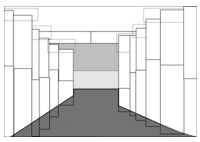
Keywords
Design tools, virtual worlds, urban design, navigation, spatial cognition, mental maps

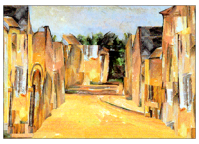
INTRODUCTION
Normally we read maps with the expectation that we will find in the world what we see on the map. What if we designed maps with the expectation that we will create in a world what we place on the map? That is the premise of WayMaker, a tool for designing the structure of virtual environments.

WayMaker is based on elements of the city image as defined by the urban planner, Kevin Lynch [3]. *Districts* are broad regions, such as neighborhoods; *edges* are boundaries between one region and the next; *paths* are the channels along which people move; *nodes* are foci to and from which people travel; and *landmarks* are punctuation points used for general orientation. WayMaker users manipulate and position representations of these elements to form a map.



The software then calculates and displays street-level scenes along user-designated "walkways." The initial PC-based prototype demonstrates this capability in 2D [8, 9].





However, WayMaker is intended as a tool that could be used with many different kinds of virtual environments. Depending on the genre and platform of choice, the elements and mapmaking capabilities could be implemented with a variety of image databases and virtual worlds. Of particular interest now are the affordances for constructing maps and the ways in which people think about the topological relationships among the elements. The current prototype enables us to focus on these issues.

This paper describes results of trials with a set of users well versed in the realms of landscape architecture, city and regional planning, and urban design. The goal of these sessions was to observe how these pertinently skilled users employed WayMaker's constructive capabilities. Many of the users' actions and comments are influencing a second version of the prototype, now being developed.

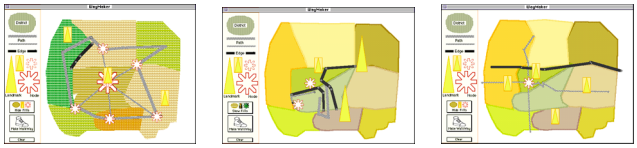
FINDINGS
The users were concerned with issues of representation, scale, and manipulability. Each person commented on the element symbols and on the images available for specifying illustrations of the elements in the street-level scenes. Users wanted more options and greater detail for these specifications, and more flexibility in applying them.

Many of the affordances that users wanted for construction and manipulation stemmed from their experience with other drawing and imaging tools. Among these were keyboard functionality to supplement the mouse, save and undo functions, object alignment, layering, and facilities for topographic mapping. Features like panning and zooming were among those requested for controlling view and scale, as was the capability of sizing elements (rather then merely selecting from available sizes).

Interestingly, there was an implicit notion of layering in the initial version of the prototype, but it was not under user control. Rather, it was an implementation strategy for keeping track of elements and the their specifications. (For example, a landmark, originally represented as a generic triangle, could become a specific tower, staircase, or the

like.) Furthermore there was a preferred sequence of moves, from the initial layer containing the element symbols, to the layer containing the specifications, to placing a walkway, to viewing the walkthrough. Users often stumbled through this process because of its complexity and the relatively crude stage of implementation. By adopting an object-oriented strategy for the new version, we are simplifying the implementation as well as the constructive process. Users can now designate and change element specifications at any time.

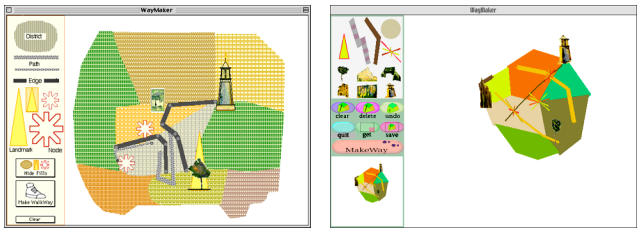
In spite of the difficulties, users managed to create some interesting designs:



Improving the representations and the construction process became the main goals for the new version of the prototype.

WAYMAKING THROUGH MAPMAKING

The construction screen has changed substantially from the first version, shown at the left, to the one we are currently developing, shown at the right.



Most notably, there is no longer a separate walkway construct (represented by the sneaker button at left); instead the street-level scenes are generated along the paths. This change simplifies the constructive process and better reflects Lynch's conceptualization of paths as a structural feature. Furthermore, a miniature copy of the user's map now reflects its construction at the lower left of the screen. This miniature is maintained in the street-level scenes, with a mark that proceeds along the paths as the software displays the corresponding series of scenes. This "you are here" map becomes a navigational aid, providing a conceptual link between users' constructions and the generated environment. Clear, delete, undo, save, get, and quit functions are now easily accessible, the elements are appropriately sizable and bendable, there is a fuller range of detail in specifications of images to represent the elements in the street scenes, and the specification process is consistent from element to element.

IMPLICATIONS AND FURTHER WORK

Graphical virtual environments are emerging as milieus with potential for broad use in learning, entertainment, and socializing [5, 10]. Interactions in these environments stem from text-based virtual environments in which participants exchange messages and create extensions to the domain by constructing characters, objects, and spaces. Constructive capabilites are particularly important in learning environments, where designed materials help learners focus their thinking on specific concepts, and affordances enable engaging and working with the concepts [1, 2, 6].

Text-based environments typically have an associated programming language that enables such interactions. However, this constructive component is not easily transferred to graphical domains. The tools for developing images tend to be complex, often requiring professional expertise in order to produce a satisfying result. We need to develop readily usable tools to support constructive interactions in graphical multiuser environments. WayMaker suggests a basis for designing the structural features of virtual environments. It is meant to complement facilities for designing other features, such as architectural and social aspects.

WayMaker is also a tool for learning research. Even in its prototypical form, the tool provides affordances for learners' investigations of topological relationships. Future work with the tool should include studies of this form of spatial reasoning, as well as implementations for 3D and multiuser platforms. Our immediate goal is to complete the aims for the PC-based prototypes, including development of sounds to further characterize the "flavors" of districts and nodes.

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