

Urban Visualization: User Centered Mapping

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1 Introduction

The complexity of contemporary urban environments demands new mapping techniques that combine information and urban geometry in a manner that responds to our cognitive processes. Working directly with cognitive scientists, computer scientists, and architects, the Urban Visualization Group at UNC Charlotte has been investigating new ways to visualize the city as it relates to our mental representations. Our research has investigated theories of urban legibility and summarized possible conceptual approaches to urban form. Through cognitive experiments involving 80 subjects, we have developed semantic and mental depictions (from sketch maps) from which we were able to infer perceptions of the city. Based on this research, we developed a set of design principles that can serve as the basis for feasible alternatives of urban visualization. We have selected user-centered mapping as the next focus of our work.

2 Urban Legibility

Although people interpret the urban environment differently, all people understand the city through its physical elements. The concept of urban legibility recognizes that people intuitively categorize a city's physical elements. Our research on urban legibility covers both historical and modern examples. These ideas can serve as the basis to generate new methods of visualizing the city by developing diagrammatic processes that can be applied to a computer-based urban visualization [1].

3 Human Studies

Navigation of the city is dependent on our cognitive map and it was therefore relevant to explore methods to understand how people perceive the environment. One of us conducted a series of cognitive studies that used semantic analysis to organize subjects' descriptions of the city. A follow-up study used subject's self-drawn sketch maps of the city to understand the graphic image of the city.

4 Cognitive Principles

Based on our work with human subjects, we abstracted the following cognitive principles:

1. People mentally organize elements of the city in a hierarchy; an urban visualization needs to seamlessly adjust to various levels of spatial understanding and abstraction.
2. People organize elements of the city based upon spatial and non-spatial attributes; a visualization must not only take into account geometrical properties but also use and function.
3. People view elements of the city in multiple forms (text, symbols, structure); the urban visualization needs to offer modifiable configurations and representations of elements.
4. People use landmarks as way finding devices; the visualization needs to integrate salient features to lessen their cognitive workload.
5. People recognize elements of the city in context; the visualization needs to reflect spatial proximity of elements.
6. People often experience disorientation due to the abundance of information on the map; the visualization should display only information necessary for the user's task.

5 User Centered Mapping

Although our research suggests that the combination of graphic, text and geometric information can take many paths, the first avenue of research should aim at combining some individualize input with a more generalized description of the city. Rather than one map of the city, we imagine a meta map that can adapt to the position and intentions of each user [Figure 1].

LineDrive[2] is an application that simulates hand-drawn routes by distorting road lengths and angles based on their importance to the user's understanding of the street layouts. Although LineDrive is intuitive, the shortcoming of this application is that users can lose their sense of the larger context of the city; once off the mapped line, it is easy to get lost. The intention of our current research is to apply principles of cognitive mapping to two dimension networks rather than to one-dimensional lines. We will begin with the principles from LineDrive, but we will apply them to the network of lines that form a street map. Each example of a map is calibrated to the user's position and intention; there are potentially very large sets of distinct maps based on this method.

There are two main issues in formulating the graphic responses to a user centered mapping. One is the need for selective level of detail. Our working premise is important variables are the scale of the relative links in the trip and the distance away from any link. We plan to use an analysis of these two factors as a test for paring down the numbers of roads to display. The other important issue is the parametric relationship of any link to the other links in the road network. We anticipate using inverse kinematics to organize the network in such a way that it can adapt to the specifics of new trip routing.



Figure 1: Normative street map (left) and user centered map with reconfigured street pattern based on route information (right).

Notes

- [1] WESSEL et al. 2008. Urban Visualization: Urban Design and Computer Visualization. In *Proceedings of CAADRIA 2008*, CAADRIA Press, Thailand, Annual Conference Series, 409-416.
- [2] AGRAWALA, M. and STOLTE, C. 2001. Rendering Effective Route Maps: Improving Usability Through Generalization. In *Proceedings of ACM SIGGRAPH 2001*, ACM Press/ACM SIGGRAPH, New York. Computer Graphics Proceedings, Annual Conference Series, ACM, 241-249.