

Charting New Ground: Modeling User Behavior in Interactive Visualization

David C. Wilson, Heather Richter Lipford, Erin Carroll, Pamela Karr Wisniewski, Nadia Najjar

Department of Software and Information Systems
University of North Carolina at Charlotte

BACKGROUND

- Recent developments have brought a revolution in widespread online access to geographic data and integration tools, particularly for map-based interfaces.
- Building the most effective interaction tools to support user-centered geovisualization faces a significant challenge: "To date, virtually nothing is known about the usability of geospatial technologies."

GOALS

- Develop and formalize usability design guidelines for typical end users dealing with different task goals in interactive mapping environments
- Apply such usability design guidelines in order to personalize interactive mapping environments for better support of particular users dealing with specific tasks

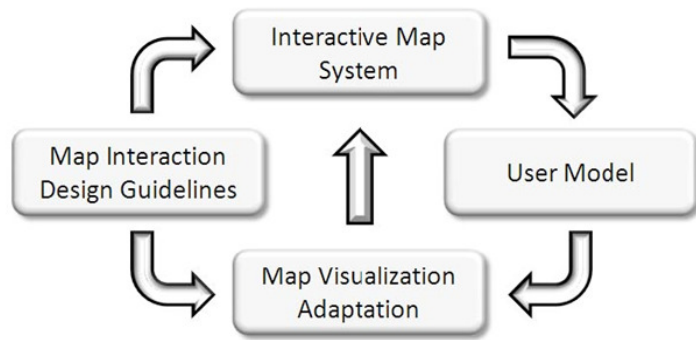


Figure 3. PerMUse architecture

Methodology

Overview

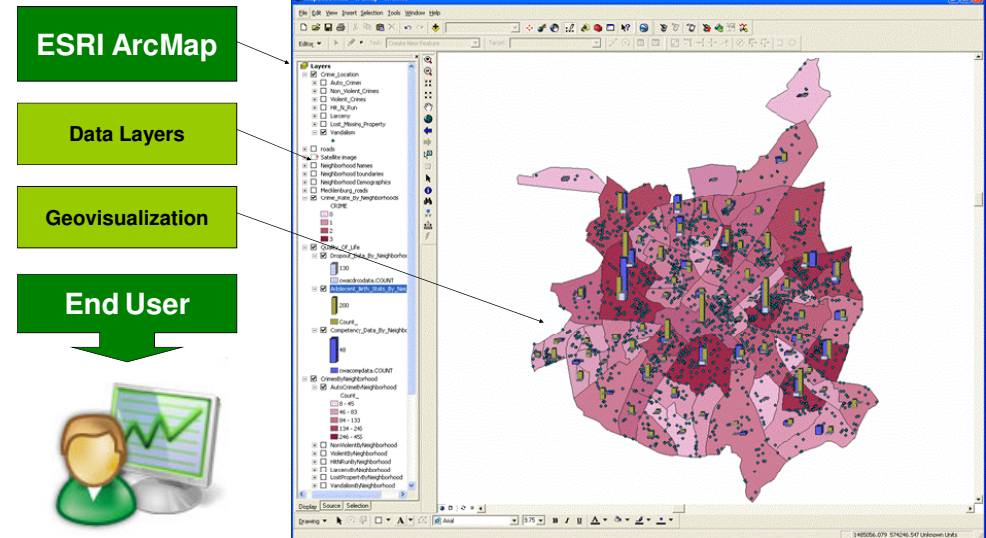
- Exploratory, observational studies of users performing a variety of map-based tasks
- Our user studies utilize standard HCI techniques, such as *think-aloud* methodology along with qualitative analysis
- Subjects complete various tasks using different mapping interfaces (Google Earth and ArcMap)

Pilot Studies

- Google Earth Pilot Study:** Participants performed various Geocaching tasks using Google Earth
- ArcMap Pilot Study:** Participants analyzed crime data and answered tasks related to neighborhood demographics, quality of life, and other city-related characteristics using ESRI's ArcMap

User Goal	Operation		User Type	Action	Data Type	Active Data Result
Explore	Select	Trace	Mapping Expert	Zoom	Region	Layers
Analyze	Identify	Compare	Mapping Novice	Pan	Point	Features
Synthesize	Locate	Correlate	Domain Expert	Select	Line	Scale
Present	Search	Categorize	Domain Novice	Alter		
	Recognize	Position				

Table 1. Potential dimensions for map interaction framework.



RESULTS

- Participants were very detailed in performing the navigation tasks
- Participants spent very little time on the actual analysis task. They generally scanned the campus very quickly
- They spent much time zooming in and out of the map
- Users who utilized the mouse wheel zoomed in and out much more frequently. However, this did not lead them to complete their tasks any faster
- There was a very distinct difference between the two experts and the two novices.
 - Experts utilized more functionality and came up with clear strategies for performing our tasks. The experts were more methodical, and explored a greater amount of the data and relationships in our visualization.
 - Novices often arrived at a decision more quickly, based more on visual patterns and expected or pre-conceived data relationships.

User Task	User Type	Data Type	Interaction
Search	Mapping Novice	Geographic Region	Zoom until labels readable; Pan map; Click and drag to zoom in; or use zoom in tool multiple times
Search	Mapping Expert	Geographic Region	Open attribute table for regions; Sort name by ascending or descending; Scroll to locate region name; Highlight region name row; Close or hide attribute table; Right click on layer label; Click on "Zoom to Selected Boundary";

Table 2. Map interaction framework description for example 'search' task.

CONCLUSION

- Our pilot behavioral user studies have helped to identify, ground and better understand the basic theoretical foundations of geospatial user interaction.
- By exploring how individuals interact with map interfaces, we can develop design practices that support mapping application users and the tasks they need to perform.
- We will continue to refine and expand our interaction model and identify the patterns of interaction sequences that accomplish and support geovisualization user operations.