A generalization framework for cartographic multi-representation on small display: Combining cognitive approach in building feature generation

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Introduction

Maps play a crucial role of providing spatial information for human activities such as planning, traveling, and economic actions. The increasing appearance of maps on portable devices like cell phones or PDAs have taken the diversity of maps to a different level. However, the owners of these devices--pedestrians-- are not facilitated well in wayfinding activities.

The primary reason is due to the size of display. In order to acquire the same amount of knowledge, a map user has to spend more cognitive efforts to integrate knowledge from several small maps (Dillemuth et al., 2007).

The second explanation is related to the difference between cartographic and cognitive mappings. Klippel et al. (2005) suggested that cartographic mapping derived from the most detailed spatial information. However, human cognitive mapping process started from weak conceptual spatial knowledge. In addition to the influence of size, maps on small displays with the same level of details make acquisition more difficult (Ishikawa et al., 2007)(Figure 1).

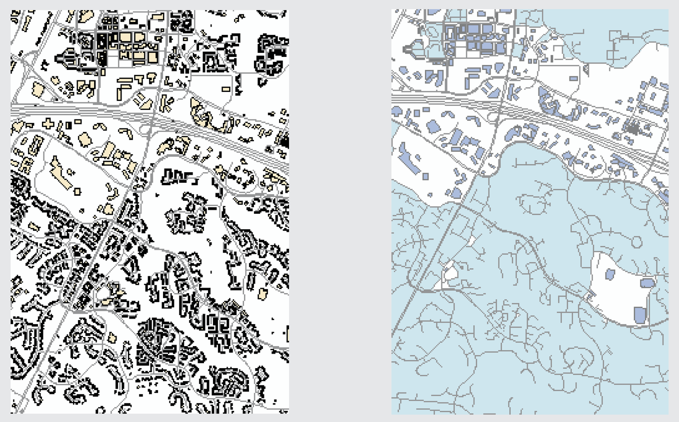


Fig. 1 Map representations of different levels of details on the same scale

To improve the facilitation for pedestrians using maps on small displays, the objectives of this study is to use building feature as a case to :

1) specify the generalization factors suitable for multiple scales;
2) suggest related operation of retaining buildings inter-relationship after generalation;
3) improve the readability of maps on small displays.

Methods

ScaleMaster (Brewer et al., 2007) provides an empirical example of producing multi-scale cartographic representations. When the level of details is required to be on a lower level as well as the size of display, geometric change is considered to be an important method to generalize data. Selected generalization operators are consisted of simplification, elimination, aggregation, collapse, alignment, and amalgamation.

Scales of 1:5,000, 1:7,000, 1:10,000, 1: 20, 000, 1: 25, 000, 1: 30, 000, 1: 50,000, 1:70, 000, and 1: 100, 000 were chosen as these scales were evaluated as ones require geometric changes. The building and road center-line features of Reston, VA collected at the scale of 1: 1,000 was used at the dataset. Implementation of operators was done in ArcMap 9.2. Single or multiple operators were applied to each scale to assess the acceptability of generalization. The Star approach was used in all generalization.

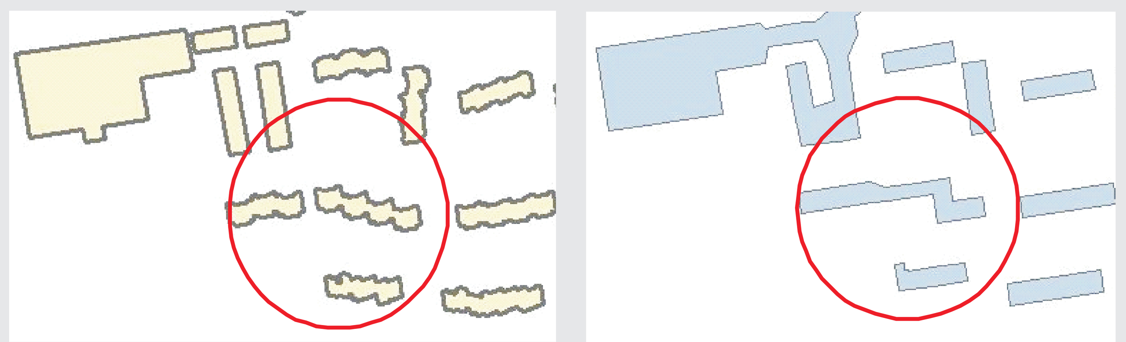
Results

Simplification

This step was done on the scale of 1: 5,000 using simplify polygon in ArcTool

Elimination

This step was done on the scale of 1: 10, 000 using simplify polygon in ArcTool



Aggregation

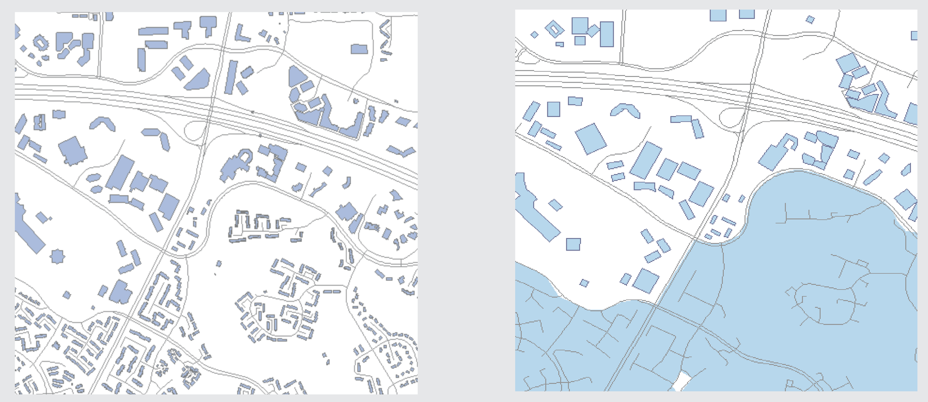
This step was done on the scale of 1:20 ,000 using aggregation in ArcTool

Collapse 1

This step was done on the scale of 1: 25,000 using simplify polygon in ArcTool, in which building with area smaller than threshold were converted to points

Collapse 2

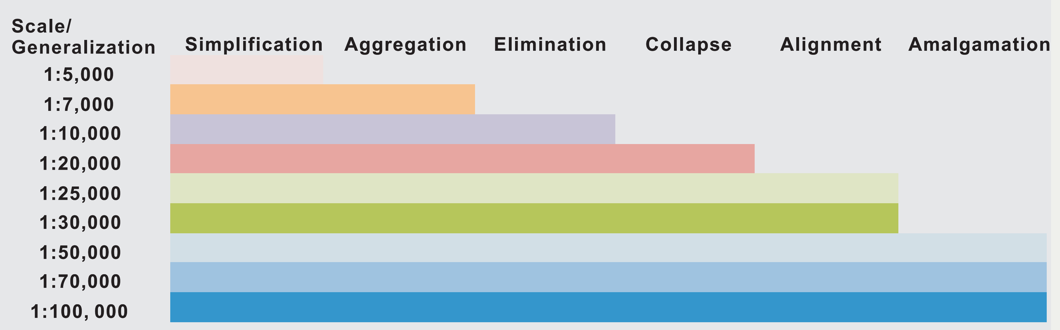
This step was done on the scale of 1: 25,000 using simplify polygon in ArcTool. Points converted from polygons were aligned with road center lines in Representation Tool.



Amalgamation

This step was done on the scale of 1: 70,000 using multiple operators in ArcTool. Major roads were converted to polygons to represent district. Building density determined to fill or not fill polygon.

The Framework



Each bar represents generalization suggested for a scale, the darker color in a bar indicates a larger threshold of generalization on that scale.

Conclusion and future work

The goal of this study is to transform cartographic data to presentation at multiple scales by integrating cognitive perspective with geometry changes. As the framework of generalization has been suggested, more empirical evaluation is still necessary to assess the effectiveness of generalization on small displays for a specific purpose– wayfinding, which is currently being conducted.

Acknowledgement

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