Cartographic symbolization for high-resolution displays

by **Agnieszka Mańk**

The design guidelines for maps on screens constrain the symbol sizes due to the screen resolution limitations. However, high-resolution screens have become increasingly popular and rethinking the map design for screens may be necessary.

Background

Screen resolution and pixel density are factors that seem to have a major influence on map design for screens. These factors constrain symbol size and complexity, as well as the amount of content presented. Several researchers call for simplified web map design because of lower screen resolution in comparison to the resolution of print [1,2]. Previous works on minimal symbol sizes for screens were conducted when high-resolution screns were not yet available [3].

Methodology

To investigate, if indeed currently available high-resolution screens create new rendering opportunities, first the related scientific work was reviewed on topics such as visual acuity, visual display resolution, visual variables, and design guidelines for maps on screens.

A study for a computer screen and a phone screen was designed to test legibility of point and line symbols. The influence of screen resolution was approximated using raster images in varying resolutions.

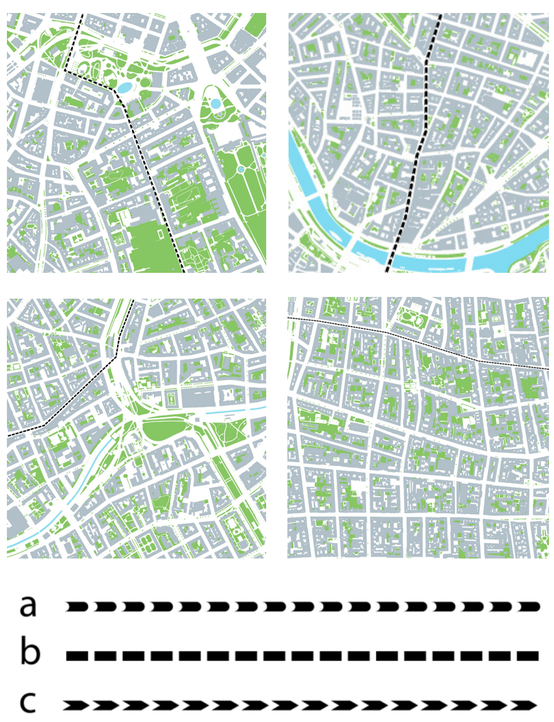

Fig. 1 Example images used in a survey to study line symbols legibility it different resolutions

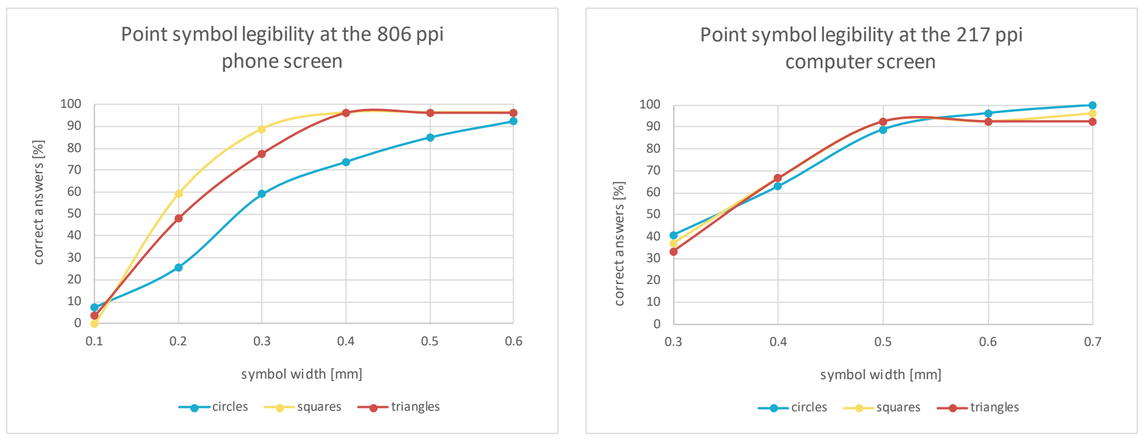

Fig. 2 Legibility of isolated point symbols on a high-resolution phone screen (left) and high-resolution computer screen (right)

Survey tasks included:

- point symbols isolated
- point symbols in the map context
- line symbols isolated
- line symbols in the line context

In every above-mentioned part of the survey participants had to recognize the shapes (circles, squares and triangles) or had to match the line pattern with the enlarged correesponding sample (Fig. 1). The smallest tested symbols were limited by the resolution.

An additional task with line symbols attempted to measure the difference in time taken to perform a visual task in different resoltuitons.

Additionally, the participants were asked about their age, sex, subjectifve asessment of vision quality and about their professional background.

The experiment results

At least 90% correct answer threshold was met on the computer screen by the 0.6 mm wide circle, 0.5 mm wide square or 0.5 mm wide triangle. For a phone screen 90% legibility threshold was met by the 0.6 mm wide circle, 0.4 mm wide square or 0.4 mm wide triangle (Fig. 2). The study has shown that the smallest legible symbols have different sizes at different resolutions.

The experiment results did not completely confirm the previous studies, as some of them state that minimum sizes for a circle and square are smaller than for a triangle [4,5]. Also, on an 806 ppi phone screen symbols must be larger then previously suggested [5], when sizes are expressed in pixels.

Furthermore, the experiment was concerned with determining if a symbol would have better legibility if rendered at a higher resolution. This study has found no such correlation, as the differences in results were very small and statistically insignificant.

Part of the experiment was testing line legibility, while the shape differentiation was inspired by circle, square and triangle. The results show that square cap line has much better legibility than the other two.

The proposed line symbolization test shows, that the line with a square cap has a much higher legibility rate than the triangle or rounded cap. More than 90% of participants could read the square cap correctly, even when the pattern was only 0.2 mm wide.

The designed study failed to show significant differences in legibility of the same size symbols in at different resolutions. The difference in time taken to do the task at different resolutions also did not bring statistically significant results.

Conclusions

The study results established minimum sizes of point symbols on tested visual displays and in an example of line symbols. Those sizes are smaller for a phone screen due to both higher resolution and longer viewing distance. The differences between individual results of study participants show, that only some can benefit from high-resolution cartographic visualizations.

Thesis Conducted at

Research Division Cartography
Department of Geodesy and Geoinformation
Technische Universität Wien

TECHNISCHE UNIVERSITÄT WIEN

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Year

2019

Keywords

cartographic rendering, web mapping, screen resolution

References

[1] Lobben, A. K. and Patton, D. K. (2003) 'Design Guidelines for Digital Atlases', *Cartographic Perspectives*, 0(44), pp. 51–62.

[2] Jenny, B., Jenny, H. and Räber, S. (2008) 'Map design for the Internet', in Peterson, M. P. (ed.) *International Perspectives on Maps and the Internet*. Berlin, Heidelberg: Springer Berlin Heidelberg, pp. 31–48.

[3] Malić, B. (1998) *Physiologische und technische Aspekte kartographischer Bildschirmvisualisierung*. Ph.D.Thesis, Universität Bonn.

[4] Rytz, A. et al. (1980) *Kartographische Generalisierung: Topographische Karten*. na (Kartographische Schriftenreihe).

[5] Neudeck, S. (2001) *Zur Gestaltung topografischer Karten für die Bildschirmvisualisierung.* Ph.D.Thesis, Universität der Bundeswehr München.

This master thesis was created within the Cartography M.Sc. programme – proudly co-funded by the Erasmus+ Programme of the European Union.

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