Web maps adaptation for smartphones

Klemen Kozmus Trajkovski, Katja Berkopec, Dušan Petrovič

University of Ljubljana, Faculty of Civil and Geodetic Engineering, Jamova 2, Ljubljana, Slovenia

Abstract. Digital maps were at the beginning of their usage intended for viewing on regular and big screens. Nowadays more and more users watch them on small screens, smartphones and tablets. We can indeed use the same maps on all platforms, but the user experience on small screens is limited due to the size of the screen and user requirements. A method of adaptation of a web map for smartphones is presented in the case of touristic map of Novo mesto, Slovenia.

Keywords. Interactive maps, web maps, smartphones

1.   Introduction

Development of computer, information and communication technologies enabled evolution, initially from printed maps to static digital maps and then from static digital maps to interactive digital maps, multimedia maps, 3D maps etc. Digital maps are usually made to be used on laptop or desktop displays, large screens and projectors. However, the number of sold smartphones increases constantly; according to numerous sources, i.e. Statista (2105), there were over 1.2 billion sold smartphones in 2014. More and more users tend to use maps on their smartphones. Maps are used for navigation, orientation, location based services etc.

At the beginning, the same maps had been used on smartphones and tablets as on the normal displays. But quite some problems with readability and user interaction occurred on small screen devices and adaption of maps for proper viewing and interaction on smartphone screens became necessary.

In our case the tourist map of the city Novo mesto was initially created as a static map. In the second stage, interactive content in the form of POIs for touristic map was added. Finally, interactive web map was customized for

viewing on small screens, from 4 to 10 inches, which are typical sizes for smartphones and tablets.

1.1. Concept of mobile cartography

According to Reichenbacher (2001), the key components of mobile cartography are information, context, user, visualization and technology. Figure 1 shows basic concept of mobile cartography.
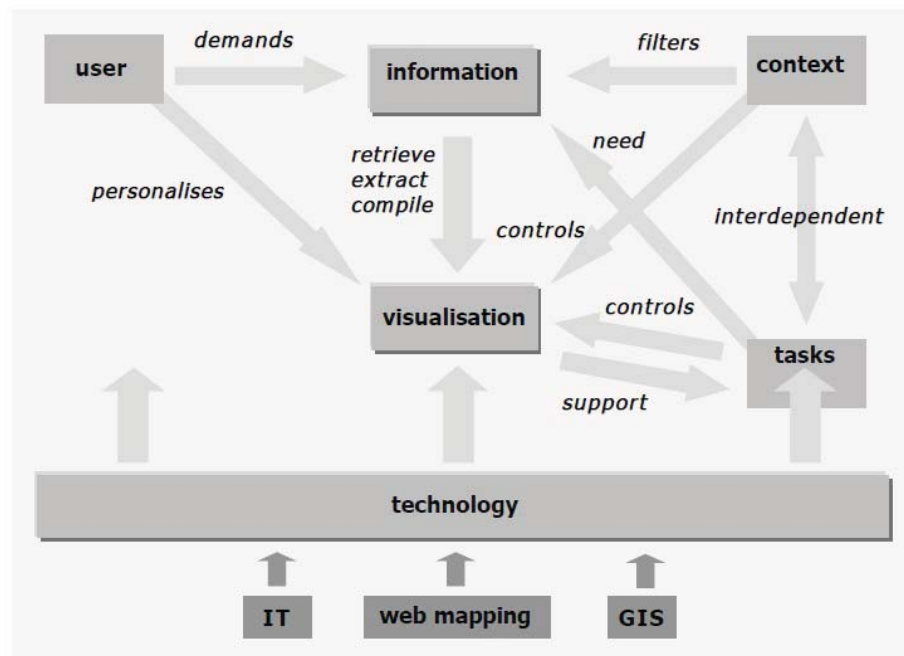

Figure 1. Conceptual framework of mobile cartography (Reichenbacher, 2001).

1.2. Demands for mobile cartography

The greatest problems for mobile cartography are characteristics and limitations of mobile devices: screen size, mobile data bandwidth and new types of data formats (KML, SVG, etc.). Recommended features for mobile cartography are therefore:

- mobile device with high resolution screen,
- use in direct sunlight and in the dark,
- location sensor (GPS, mobile network), and
- high bandwidth of mobile data transfer. (Reichenbacher 2001)

Icons on mobile maps have to be big enough for the touch with the thumb and there should be enough separating space between the icons.

Mobile maps are mostly used for location based services in the proximity of the user while in motion. GPS technology is mostly used for location and navigation. Single hand use of maps is preferable. (Kaasinen 2005)

Entering text on mobile devices can be time consuming so users prefer existing list of hits which, of course, needs to be regularly updated. The text font needs to be of proper size and simple so it can be read on a small screen. (Kaasinen 2005)

Interactivity is also an important feature of mobile maps. Interactive icons with hyperlinks prevent overfilling of the map; furthermore they can add multimedia content to the map and thus enriches the map. Graphic icons enable personalisation of the map.

2. Creating basic interactive web map of Novo mesto

2.1. Basic map data

The case map of Novo mesto is made in Gauß-Krüger (transverse cylindrical) cartographic projection. All the source data is provided by SMA (Surveying and Mapping Authorization) of Slovenia. Vector data was edited in ArcMap 10.1, map frame in AutoCad 2013, the map itself was created in OCAD 11 and icons in Photoshop editor. The details on the map consist with the scale of 1: 5000. The scale of the displayed map is of course variable. The resolution of the map is 600 dpi.

The map is touristic; the main purpose is to inform users of touristic sights and landmarks of Novo mesto, accommodation, cuisine, recreation and other features which a tourist in Novo mesto would be interested in.

2.2. Map creating procedure

Vector data from the national topographic database is in "shapefile" format. All the data was imported, edited, categorized and merged in ESRI ArcMap software. Edited data was exported in the shapefile format. Map frame was created in AutoCad and exported in vector form.

Topographic data was imported in OCAD 11 software where custom made cartographic symbols were assigned to vector data. The outcome of each topographic element was instantly tested on a smartphone.

Narrow streets in the downtown presented a problem because their true width in the scale was too narrow to include the names of the streets. So the streets had to be widened and as a consequence, displacements of buildings

were performed, done mostly with manual editing. Some of the problems and their solutions can be seen on Figure 2.
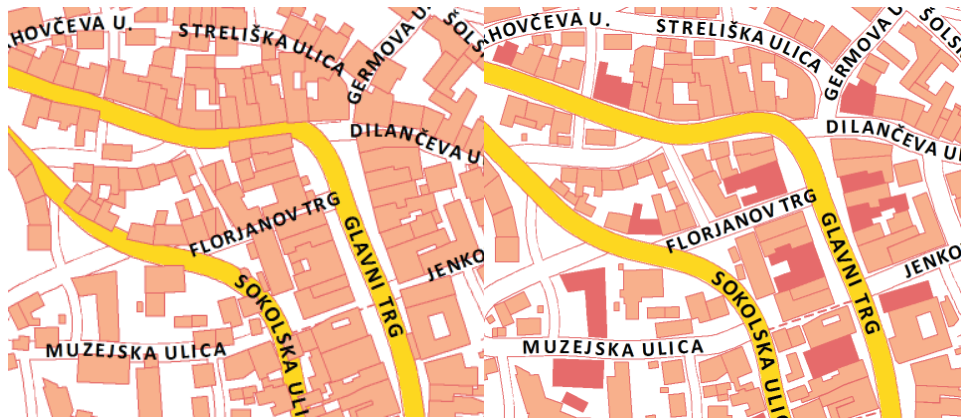

Figure 2. Problems with narrow streets (left) and the solution (right).

Missing or altered objects were added or edited according to ortophoto images.

A database was created in Ocad in order to make an interactive web map. The database consists of 27 datasets which are divided among 6 categories (landmarks and attractions, accommodation and restaurants, free time activities, sports, transportation and other). Suitable objects were manually appointed to corresponding datasets, labelled and if applicable, a hyperlink was added.

Creating icons was another special task. Ocad offers 2 options – marker can be a transparent circle or a graphic icon. In order to achieve associativity and overall clearness graphic icons were manually created, as depicted in Figure 3. Web icon frame (the same for each category) and a graphic were merged in Photoshop editor to form an icon shown in the map.
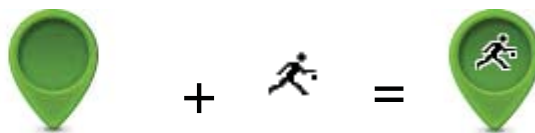

Figure 3. Creating web icons.

3. Adaptation of the map for smartphones

Ocad export module can create zoom levels from the same origin map. This usually works without problems on regular size screens, but not on small screens.

3.1. Problematic default web map

Even if different origin maps are used for zoom level, the icons are shown at each zoom level by default settings, as can be seen on Figure 4. The map is useless in such output.
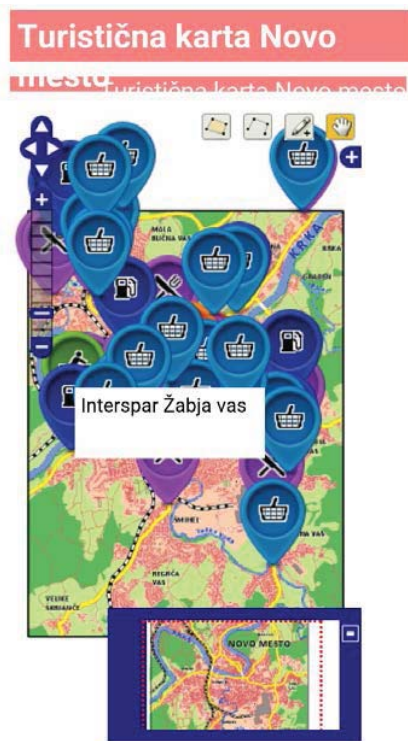

Figure 4. Problems with the mobile map in the default view.

The map required some tweaking in order to be usable on smartphones.

3.2. Customizing the map

A separate map was made for each zoom level. 7 levels of view are possible with each level with a different LoD (Level of Detail). Zoom levels and LoDs can be seen on Figures from 5 to 8 and on Figures 10 and 11.

The default view, shown in Figure 5, includes names of the city, city quarters and all water streams.

Figure 5. Default view of the map.

The zoom-out level (Figure 6) features only names of the city and the main river. There's also the 2nd zoom-out level which is similar to the 1st one, only made even smaller.
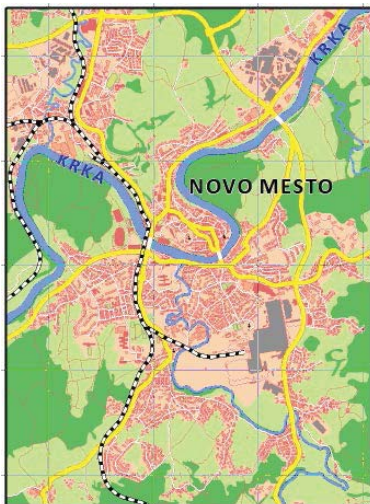

Figure 6. Zoom-out level.

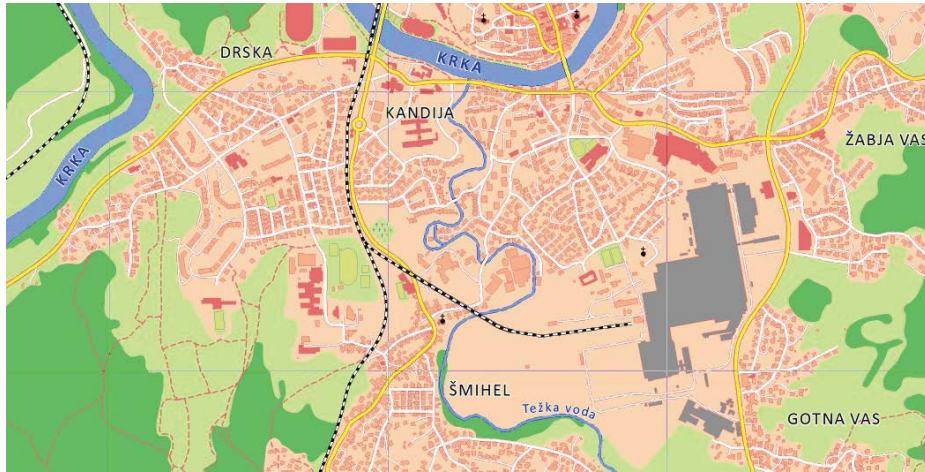The 1ˢᵗ zoom-in adds some topographic symbols to the default view, see Figure 7.

Figure 7. 1ˢᵗ zoom-in level.

The 2ⁿᵈ zoom-in includes names of the main streets, as can be seen on Figure 8.
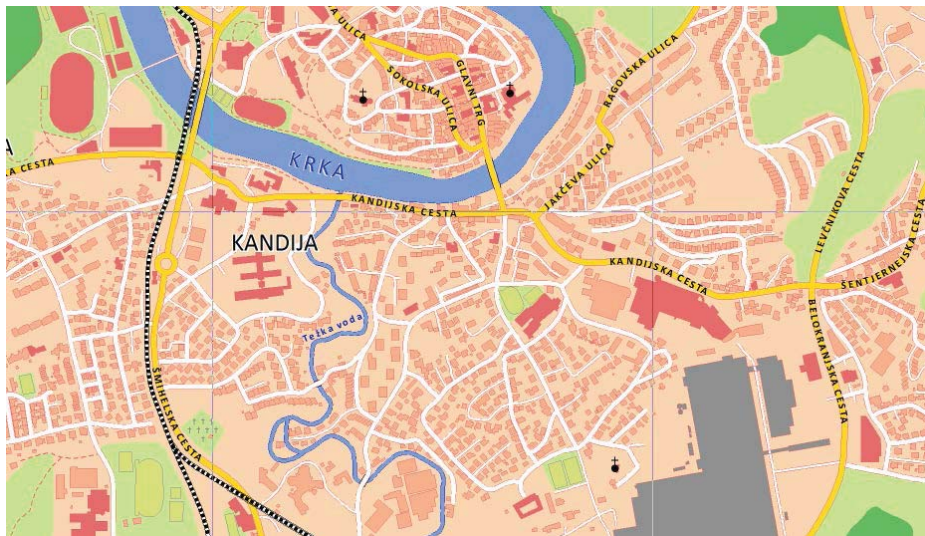

Figure 8. 2ⁿᵈ zoom-in level.

The next zoom-in level can be seen on Figure 11. Names of all the streets are shown. Only the final zoom-in features POI icons, see Figure 10. A tap on an icon opens a popup window with text description. Some info windows include hyperlinks as example on Figure 9.

Figure 9. POI popup window with description and hyperlink.

3.3. Testing the map

The map was tested:

- on different operating systems for mobile devices (android, iOS),
- on different screen sizes,
- on different browsers, and
- for the suitability of map elements.

Map elements were evaluated by different groups of people, young (around 10 years) and middle aged (around 50). Icons were correctly recognized and street names could be read by all participants.

The map is shown correctly on all operating systems and all browsers on mobile devices. Figure 10 shows a screenshot of iPad 4 (iOS, Safari browser, 9.7 inch, 1536 x 2048 pixels) while Figure 11 shows a screenshot of LG G3 (Android, Chrome browser, 5.5 inch, 1440 x 2560 pixels).
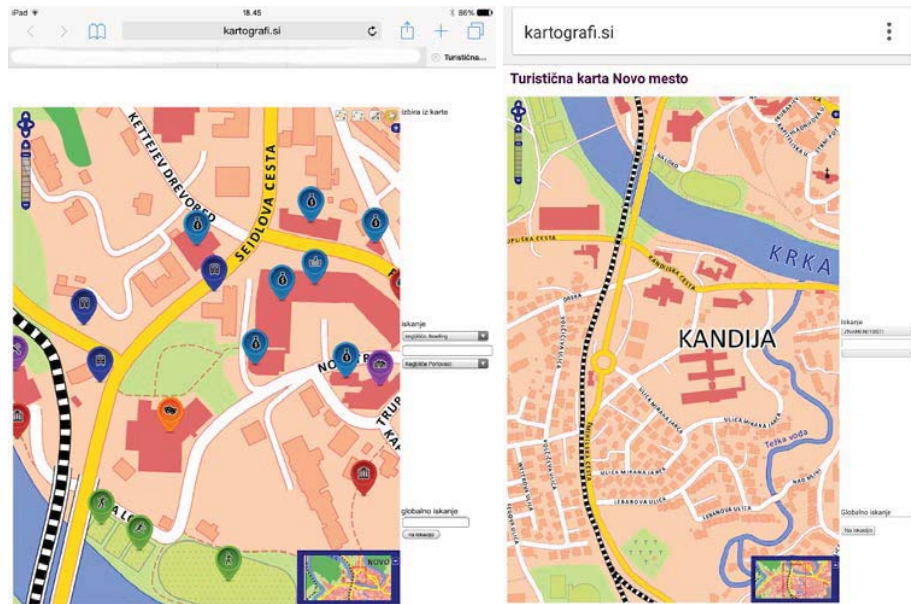
Figure 10. Map on iPad 4.

Figure 11. Map on LG G3.

The map can be used on even smaller screens, i.e. iPhone 5s (4 inch, 640 x 1136 pixels). Street names can be easily read and the map works flawlessly.

The map can also be used for location based services. The map was geolocated with Custom Maps application. Figure 12 shows the map in the Custom Maps with position marker visible in the bottom left part of the screen.

Figure 12. Map in the Custom Maps application.

Ocad software supports export to GeoTIFF. Geolocated TIFF can be opened and used with GPS position in various apps, i.e. PDF Maps. Figure 13 depicts current position (blue circle) of a user on the map.

Figure 13. Map with current GPS position in the PDF Maps application.

4.   Conclusion

OCAD 11 software is easy to use and very handy for making web maps. However, default web maps are optimized for viewing and interacting on regular computer screens. Luckily, OCAD made web maps can be altered for different purposes. The POI menu can be customized using CSS, i.e. web map of Žirovnica as seen in Figure 14. User can choose which icons are visible.
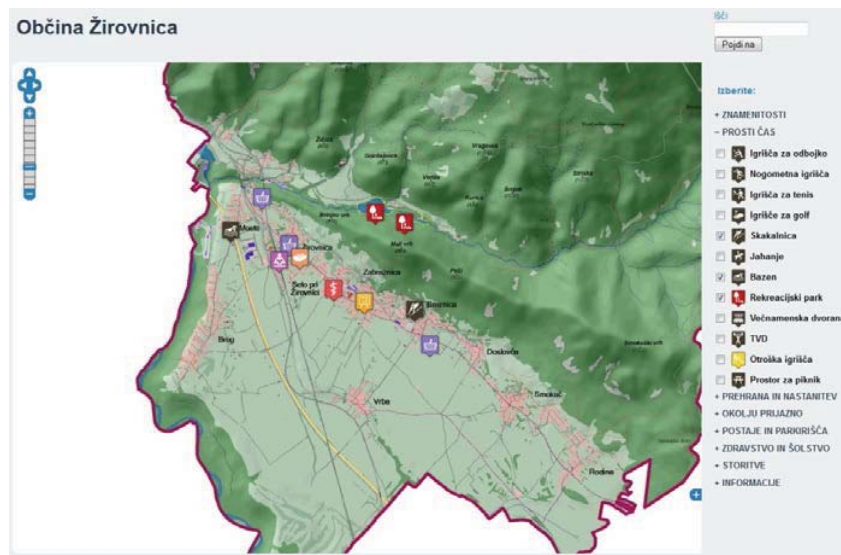
Figure 14. Map menu customization (http://kkfdz.fgg.uni-lj.si/izdelki-diplome/zirovnica/).

Customization of a map for smartphones requires a deeper approach as many aspects need to be addressed. Screen size is the main factor. Content differs by the zoom level, street names have to be big enough so they can be read even on the smallest screens. Icons should be associative and large enough, but for that reason they can be only shown in the detailed view in large zoom.

The mobile map of Novo mesto is user friendly. Zoom-in can be achieved by double tap, pinch to zoom or by tapping on the plus icon or slider in the top left part of the screen. User can pan the map by the buttons on the top left side of the map or by swiping the screen in any direction.

The map works in any mobile environment: on any screen size, in any browser in any operating system. The map can be used to display current location of a user using GPS positioning.

The final product is an example of customizing a web map for use with smartphones by complying all characteristics and limitations of mobile devices. However, there's still room for improvement. For one, web map style could be programmed so only selected icons would be visible.

The map is available at http://kkfdz.fgg.uni-lj.si/izdelki-diplome/novomesto/. It can well be used on regular size displays; however, it is optimized for use with mobile devices.

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