Cartographic sign as a core of multimedia map prepared by non-cartographers in free map services

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Abstract: The fundamental importance of cartographic signs in traditional maps is unquestionable, although in the case of multimedia maps their key function is not so obvious. Our aim was to search the problem of cartographic signs as a core of multimedia maps prepared by non-cartographer in on-line Map Services. First, pre-established rules for multimedia map designers were prepared emphasizing the key role of the cartographic signs and habits of Web-users. The comparison of projects completed by a group of designers led us to the general conclusion that a cartographic sign should determine the design of a multimedia map in on-line Map Services. Despite the selection of five different map topics, one may list the general characteristics of the maps with a cartographic sign in the core.

Key words: cartographic sign, non-cartographer, legend on web-map, multimedia map, Map Services

1. Introduction

Our knowledge of the principles of cartographic design has been formalised in classic cartography textbooks (Dent, 1999; Robinson et al., 1995). A selection of these principles and a simplified method of their application have been provided in the practical guide to cartographic design for GIS users (Brewer, 2005, Krygier and Wood, 2011, Peterson, 2009). The significance of traditional rules of cartographic design shows also an additional value with respect to the dynamic development of online mapping with APIs (Application Programming Interface; Google Maps JavaScript API v3 – Documentation 2014), in particular when every web user has access to the creation of multimedia maps (Peterson, 2012). In this case a multimedia map means an on-line map with interactive integration of text, still images, animations, sound and video. When creating multimedia maps in on-line map services, one should refer to a compromise between the usage of traditional cartographic principles and the

habits of users of, for example, Google Maps API, OpenLayers and OpenStreetMap (Medynska-Gulij, 2012). The development of interface functionality allows to introduce advanced methods of geodata integration, the management and use of web services (Kowalski, 2012). The visualization of spatial information is connected with a change in the method of presenting point objects (Halik, 2012).

The largest number of maps are created by users of generally available map portals, with markers being elements most frequently added to public maps. A marker in the classic cartographic meaning is a sign on the map that conveys information about the location of a geographical object (Google Maps JavaScript API v3 – Documentation 2014).

Our task was to search the problem of cartographic signs as a core of multimedia maps in on-line map services. The fundamental importance of cartographic signs in traditional maps is unquestionable, although in the case of multimedia maps their key function is not so obvious. Simple tools enabling the addition of multimedia content to web maps of geographical objects are a strong temptation to limit the role of cartographic signs in the transfer of spatial information. For this reason, the objective of our research was to find answers to the following questions concerning the design of a multimedia map in free web-services: What is the role of a cartographic sign? Which multimedia are used to present geographical objects? How is information concentrated around a geographical phenomenon?

We have also considered the use of legend to strengthen the key role of a sign in an interactive web-map. According to cartographic principles, a legend contains all of the cartographic signs of the map. The appropriate placement of signs in the legend, together with a description of their meaning, enable understanding the subject of the map and help in the perception of geographical information (Slocum et al. 2009). In the case of an interactive multimedia web-map, we may pose the following questions: What signs and what information should the legend frame contain? In what way should the legend convey information about signs introduced by a web user?

2. Methodology

In order to reply to the abovementioned questions, we invited five MA geography students, majoring in geoinformation, from the Adam Mickiewicz University in Poznań. The selection of these participants for our research is connected with their knowledge of map services and their basic understanding of the principles of cartographic design. Of equal importance is the fact that the task was taken up by students particularly interested in Open Source Technology and Web Services. On the basis of the planned course of research, presented in Figure 1, we elaborated a task sheet: 'designing the operation of a multimedia map for a free web-service on the basis of cartographic signs'. The task sheet contained seven points with instructions addressed directly to the research user (Fig. 2).
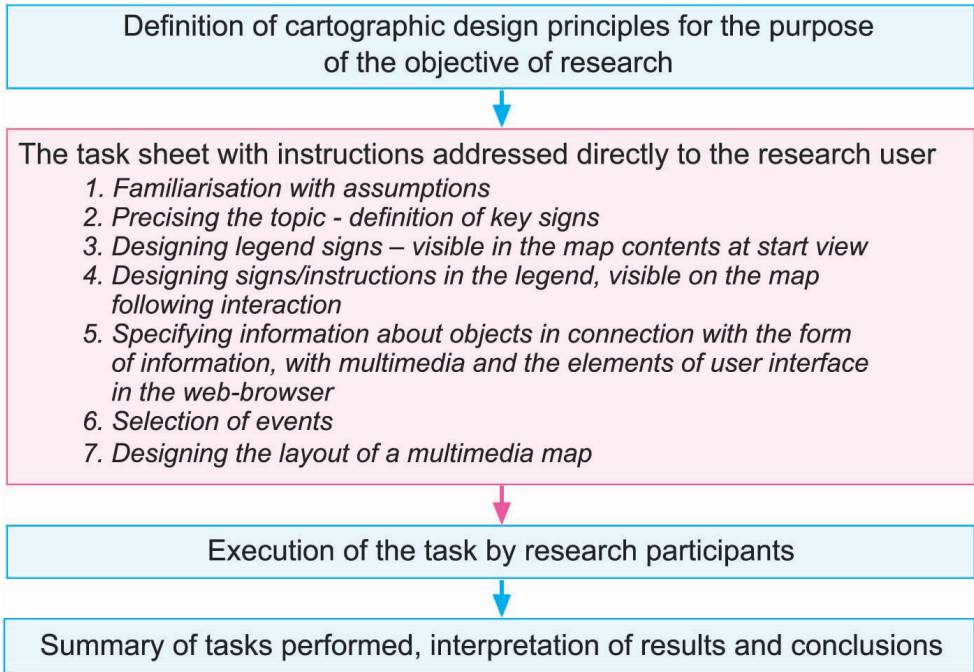
Fig. 1. The basis of the planned research

First of all, the students familiarised themselves with the assumptions for cartographic design adopted for the task. In order to make easier the definition of key cartographic signs, each participant specified the topic of his/her map in the second point. The third point concerned signs that were visible in the cartographic content window at the initial web-browser view following activation of the map page. At this point participants designed signs and, for the avoidance of doubt, wrote down their meanings. In turn, under point four the map-designer placed in the legend the necessary topical map information or signs that appeared only after interaction on the part of the web-browser user. The completion of a table under point 5 was to facilitate the coordination of the form of information about objects with the appropriate multimedia. Under the table there were placed the relevant examples, which could be utilised by the participant. Of considerable importance was the selection of the appropriate elements of user interface, which in this instance referred to an indication of a standard method for free web-services.

The reference to the intuitive interactive usage of maps in the web was made under Point 6, which concerned JavaScript user mouse events such as 'click'. The greatest degree of creativity was required from map-designers to perform the last point, i.e. drawing the map layout on the basis of data set forward in Points 1-6.

TASK: Designing the operation of a multimedia map for a web-service on the basis of cartographic signs

1. Familiarise yourself with the map design assumptions adopted for the task:
- *as simple as possible and intuitive reception of information by the user, i.e. in accordance with the habits of users of open map services;*
- *logical order of perception of multimedia object information;*
- *the cartographic sign as a "core" for navigation/interaction and the management of object information;*
- *the important role of the legend in the presentation and integration of signs concerning the topic of a map.*

2. Write down the topic of your map: _____

3. In the box/boxes below draw a schematic of a cartographic sign (or signs) for the key object of your map, which will be visible at "start view". Write down a definition for the map legend next to the sign

 4. In the box alongside draw schematics of the sign/information for the key object of your map placed in the legend, but visible on the map only after interaction

5. In the table write down information about the object according to: - forms of information - medium, - elements of user interface

forms of information *	medium **	elements of user interface ***

e.g. photographs, photograph galleries, tabels, addresses, graphs, charts, movies,...
** *e.g. text, audio, still images, animation, video, interactive,...*
*** *e.g. InfoWindow, NewWindow, Floating Window tooltip...*

6. Write events for your map: _____
 (e.g. onClick; onDblClick, onMouseUp, onMouseOut, onMouseOver,...)

7. On the basis of Points 1-6 draw the following: signs in the legend and on the map, and a schematic presenting the operation of the multimedia map in a web-browser view. Use the following designations: ⟶ direction of navigation, ◄----► legend-map, ☑ ⊞ checkbox

Fig. 2. The task sheet "Cartographic signs in designing the use of a multimedia map for a free web-service"

3. Results

A summary of the task performance by five participants as regards Points 2-6 is presented in Table 1. For their topics, participants usually chose point signs, and less frequently – lines. The students did not use the typical *red bubble google maps pointer*, but rather designed pictorial /iconic signatures that contained semantic information about the represented object. The legends of two maps contained signs that appear once the user clicks a key sign located in the window of cartographic content. For example, the map of historical forts shows the "Main Gate" sign after clicking the sign "Fort". The legends of four maps contain brief text instructions, two of which appeared next to signs appearing on the map following interaction. As regards the "Car Accidents" map, the sign "nearest Police Station" has been created in such a way as to include a brief instruction concerning the necessary user interaction in order to effect the appearance of the sign *'nearest Police Station" after clicking the selected "Car Accident'" sign on the map'*.

Table 1. A summary of the task performance by five participants

Topics / Characteristics	Public Transport	Historical Churches	Cycle Trails	Car Accidents	Historical Forts
Signs in Legend Visible on Start View	— Bus/Tram Route ● Bus/Tram Stop	● Church	— Cycle Trail	● Car Accident	● Fort
Signs in Legend Visible on Map after Interaction	————	————	● Start ● Finish ● Position of Cyclist	● nearest Police Station	● Main Gate
Brief Instructions in Legend	"Click on bus stop or tram stop on the map to show Timetable"	————	"Current position of the cyclist on the route shown after placing the cursor over the profile"	"nearest Police Station" after clicking the selected "Car Accident'" sign on the map'	'Click above to show invisible marks, click on mark to get more information'
Multimedia	Text, Timetable, Photo	Text, Photo Gallery, Video, Rating	Text, Photo, Line graph	Text, Photo, Table	Text, Photo Gallery, Still images - old Maps
Elements of User Interface	Tooltip InfoWindow NewWindow	Tooltip InfoWindow	Tooltip Floating Window Graph Frame	Tooltip InfoWindow NewWindow	Tooltip InfoWindow NewWindow
Events	Click MouseOver MouseOut	Click MouseOver MouseOut	Click; onMove MouseOver MouseOut	Click MouseOver MouseOut	Click MouseOver MouseOut

All of the maps use text and photographs, or galleries of photographs, to convey object-related information. On two maps use was made of tables, while the bicycle routes map utilises a linear graph (terrain profile). Only the map-designer of historical church maps planned a video and interactive assessment by map users.

All participants of research utilised a common graphical user interface element "tooltip" (infotip) to show object names once a pointer is placed above the cartographic sign. However, four maps used an "InfoWindow" for the purpose of a multimedia presentation, this being connected with a sign in the form of *'a comic-book word balloon'*. Only one map-designer designed a "Floating Window", which is difficult

to display due to it being blocked by browser filters. In three cases, it was decided to depart from the map, i.e. making a multimedia presentation for objects in a "New Window".

Intuitive events were applied for interactive map usage: "onClick", "onMouseOver" and "on MouseOut". Only in one instance was an "onMove" event added to move the "Floating Window" by the user to any point in the map content window.

The graphical expression of the map concept, including the process of creating written assumptions under Points 2-6, appeared during the drawing of the map layout. Whereas the creation of the layout for the analogue map is relatively simple to make, drawing a comprehensive map layout in the web-browser window is definitely more complicated. Such a comprehensive layout should contain the key cartographic signs for the topic, with an indication of the action of multimedia according to events and the placement of the multimedia visualisation of information about objects.

Figure 3 shows a layout made for the topic "Historical Forts", where the key sign is "Main Fort". Only after juxtaposing the description of the map concept under Points 2-6 of the task with this layout is it possible to "grasp" the underlying concept of the multimedia map. Of particular significance is presenting the interconnection between the sign in the legend with the sign in the cartographic content window, and the role of the cartographic sign as a "core" for the multimedia information conveyed. The legend frame has also become a spot for a brief textual instruction concerning interaction on the map.
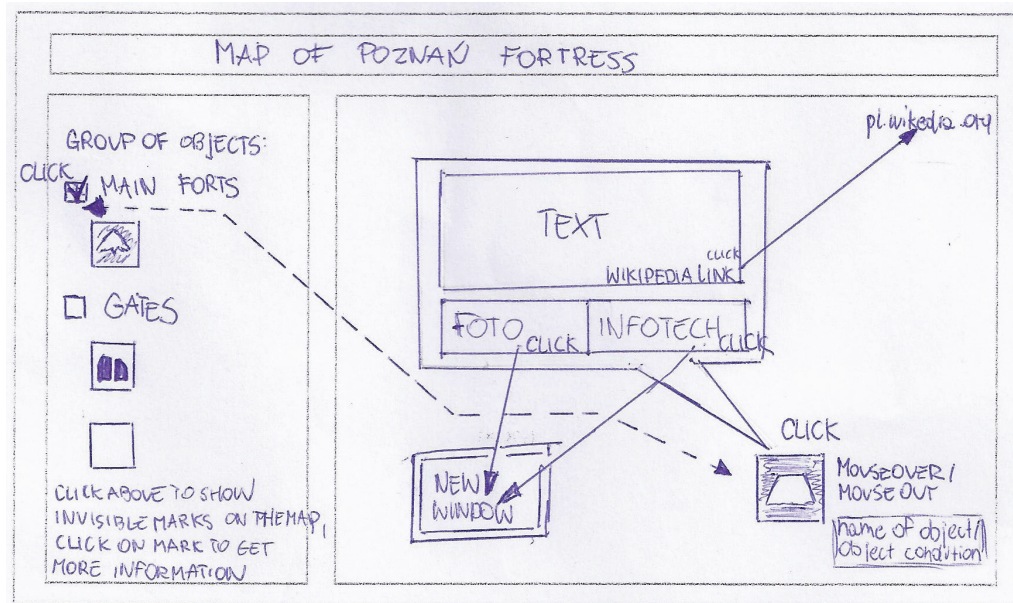

Fig. 3. The layout made for the topic "Historical Forts"

The layout for the topic "Cycle Trails" has been constructed for a linear sign – the bicycle route, which has been connected with point signs presenting the beginning and end of the route (Fig. 4). The legend also contains a sign presenting the position of the cyclist (yellow arrow), even though this is not present at "start view". The concept of the map "Cycle Trails – Puszcza Zielonka" has been coded in HTML using GoogleMaps API, and for this reason in Figure 5 one can compare the layout with the map view in the web-browser. The yellow arrow appeared only after interaction in accordance with the instruction given in the legend: "*Current position of the cyclist on the route shown after placing the cursor over the profile*". The inclusion in the legend of a yellow arrow and textual instruction makes it easier for the user to utilise this key element of visualisation for the topic of the interactive map: location of the cyclist's position on the topographical map and reading the height, in metres, on the profile, and the distance from the beginning of the route in kilometres.

4. Conclusions

The comparison of the task sheets completed by the participants with the layouts drawn thereby leads us to the general conclusion that a cartographic sign should determine the design of a multimedia map in on-line Map Services. Despite the selection of five different map topics prepared by non-cartographers, one may list the following general characteristics of maps with a cartographic sign in the core:

a) the cartographic sign focuses multimedia navigation;
b) it is advantageous to use graphical or iconic signs.

Moreover, the following common features/ advantages were observed:
– the placement of object names in tooltips near cartographic signs;
– the necessity of focusing interaction on the cartographic sign;
– maintaining eye contact between the sign and cartographic content by placing multimedia in the InfoWindow;
– avoiding a departure from the window with cartographic content (avoiding the usage of NewWindows);
– the placement of signs that are visible at "start view" in the legend frame.

The following observations, resulting from the analysis of the tasks performed by the research participants, which do not directly concern the key role of a cartographic sign, are significant:
– the placement of brief instructions how to reach key information concerning the topic of the map in the legend frame;
– the usage of intuitive, simple events (Click, MouseOver and MouseOut);
– the placement of novelties/trends from Social Networking Websites on maps, e.g. rating according to popular "I like it";
– the usage of photographs and photograph galleries that are simple to process and visually attractive.
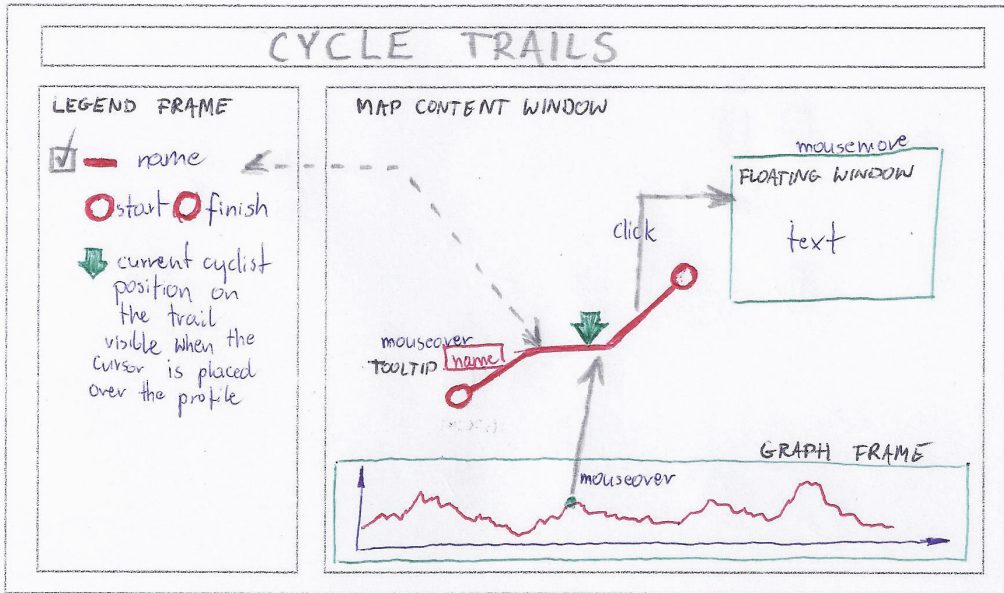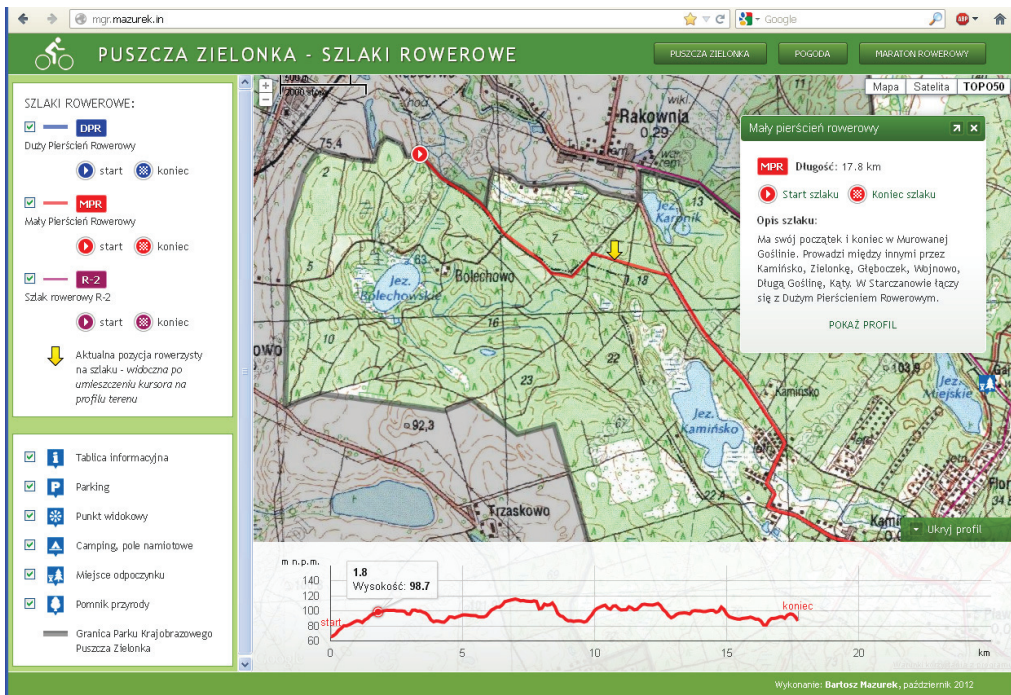
Fig. 4. The layout for the topic "Cycle Trails"

Fig. 5. The map view "Cycle Trails – Puszcza Zielonka" in the web-browser

All of the above conclusions may be considered as guidelines for designing multimedia maps in on-line Map Services. The method of adapting and making formal principles of cartographic design for dynamically developing technologies in free web-services remains a matter of discussion. The inclusion of web map-designers in determining the current state of open map design, proposed in the present research, may turn out to be helpful in understanding the web creation of cartographic principles.

Acknowledgments

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Znak kartograficzny jako spoiwo multimedialnej mapy opracowanej przez nie-kartografa w serwisach mapowych

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Streszczenie

Fundamentalne znaczenie znaków kartograficznych na tradycyjnej mapie nie budzi wątpliwości, jednak w przypadku multimedialnej mapy ich kluczowa funkcja nie jest już tak oczywista. W tych badaniach podjęto problem znaczenia znaku kartograficznego jako spoiwa mapy multimedialnej opracowanej przez nie-kartografa w darmowych serwisach mapowych. Zadaniem dla projektujących mapy stało się opracowanie mapy multimedialnej według ustalonych wstępnie zasad, w której kluczową rolę odgrywały znaki kartograficzne oraz przyzwyczajenia użytkowników Internetu. Porównanie wypełnionych arkuszy zadań przez uczestników badań skłania do wyciągnięcia generalnego wniosku, że znak kartograficzny powinien determinować projektowanie multimedialnej mapy w serwisach mapowych on-line. Pomimo opracowania pięciu różnych tematów map, można wymienić ogólne charakterystyki map, w których znak kartograficzny jest spoiwem.