

THE DESCRIPTION AND COMPARATIVE ANALYSIS OF CHOSEN TOOLS AUTOMATIZING THE PROCESS OF CREATING INTERACTIVE MAPS OF SPATIAL OBJECTS

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Summary

Spatial data services play an increasing role in the exchange of information. The universal use of databases and digital cartographic resources has become possible thanks to the accessibility of computer tools and techniques, which until recently were reserved for small group of professional users.

The goal of the study is a characteristic and comparative analysis of some tools of automatizing the creation process of personalized, interactive digital maps. The chosen web applications offered by some web mapping services have been tested.

The analysis showed that the tested tools are relatively easy to use and do not require a specialist knowledge about geoinformatics. However their limited functionality means that only simple maps with numerous limitations can be created.

Keywords

map creator • generation of dynamic maps • Internet cartography

1. Introduction

Interactivity and functionality are characteristic features of modern websites and web applications. These attributes have become a designing standard. It is the result of development and availability of programming techniques and tools and expectation of users who want dynamic and interactive applications. The modern web projects are characterized not only by high quality graphics and spectacular way of presenting the content, but the designers also focus on their availability, usefulness, ergonomics and attention to detail. The use of geospatial services, including interactive maps made available by geo-data providers as part of various web services, becomes a standard.

The access to interactive maps in Internet is unrestricted. The geoinformation web services play an ever increasing role in the exchange of information [Król and Szomorowa 2015]. The visualisation of spatial data is becoming more and more sophisticated, dynamic and interactive. These changes include both the quality of available data (accuracy of representation, density of land cover, the speed and reliability of map

image generation) and graphic form of their presentation. The use of digital cartographic resources has also changed. The users expect interaction, want to add their own information to the map, want to participate in the process of creating and improving existing maps, and finally to have the chance to create their own thematic maps that they could share with others.

The maps using spatial information systems GIS fulfil an increasing number of functions, especially in modelling, analyses and presentation of natural environment phenomena with spatial reference [Król and Bedla 2013], in spatial planning [Salata and Król 2012, Hełdak et al. 2013], geomarketing [Roşu et al. 2013, Allo 2014], tourism and in many other areas [Prus and Budz 2014].

Using databases and digital cartographic resources have become possible thanks to full accessibility of computer tools and techniques, which until recently have been reserved for small group of professional users. The most popular mapping services provide open application programming interface (API). API is a set of procedures, protocols and tools enabling information exchange between computer software. The tools and geoinformation techniques that they provide are more or less difficult to use and very diverse.

Programming the advanced map functionalities requires specialist knowledge. Though APIs are usually accompanied by thorough technical and design documentation and a tutorial, many users choose uncomplicated solutions, such as web applications with graphical user interface (GUI), allowing for automatic creation of relatively simple maps.

The aim of the study is to characterize and comparatively analyse the chosen geoinformatic tools for automation the process of creating personalized, interactive digital maps.

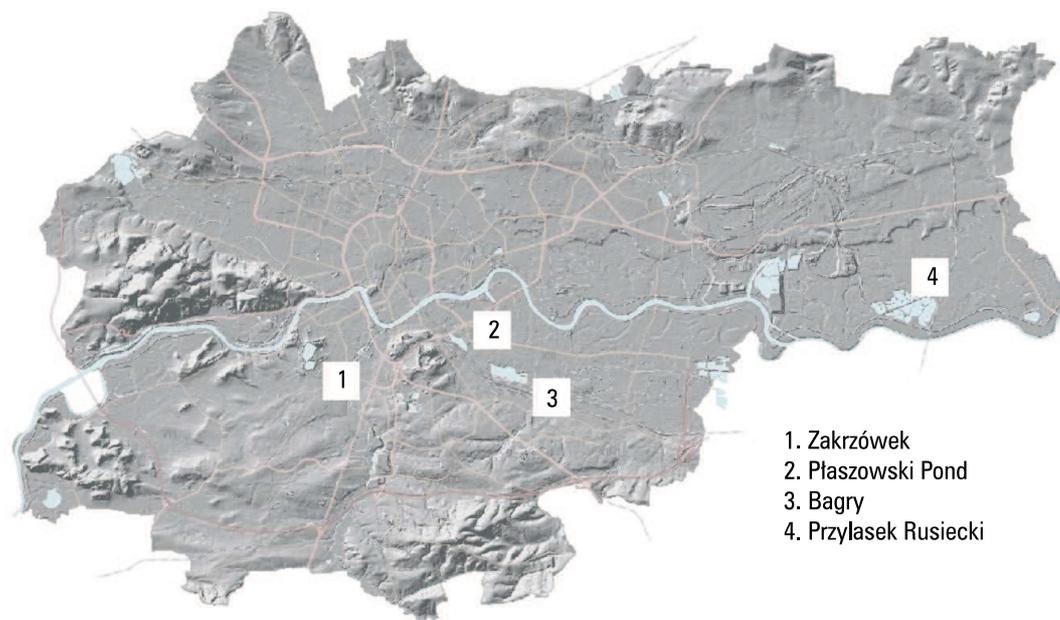
2. Material and methods

The paper analyses chosen web applications enabling automatic creation of interactive maps of spatial phenomena and requiring no specialist geoinformatics knowledge and the use of API and giving no access to source code. Only authorized tools and tools offered by mapping services were tested (Table 1), the ones that are one of the most popular on the “The top sites on the web, Reference, Maps” [Alexa 2015].

The applications were tested during the process of generating maps of chosen anthropogenic water reservoirs located within Kraków: Płaszowski pond (also called “Small Bagry”), Bagry, Przylasek Rusiecki and Zakrzówek (Figure 1). These reservoirs, created in post-mining pits, play a specific role in the city landscape, as they are recreational and tourist facilities, and though they are located in the area that is under strong industrial pressure, they retained their natural values (e.g. in the industrial district Płaszów). The natural environment transformed this way, that once was perceived negatively, have become a new attractive element of Kraków’s landscape [Pietrzyk-Sokulska 2010].

The analysed geoinformatics tools and techniques generate an address of the web resource embedded in a window “iframe” (embed map). Iframe is a floating frame or

inline frame, sometimes also called local or embedded frame. In this case, the frame created this way, embedded in the structure of HTML document, becomes a window displaying the map made available from the server of a service provider. All the operations on the map are performed on the side of server. The user must have only a web browser and he is performing the role of a “web service client”. The device supporting applications are created in client-server architecture called a thin client.



Source: Miejski System Informacji Przestrzennej (City System of Spatial Information 2015)

Fig. 1. Chosen water reservoirs of Kraków (scale 1 : 100 000)

Table 1. The list of tested digital mapping services

Web mapping service	Technique, HTTP(s), base map, core
Google Maps	Google Maps Embed API, Quick Start Build a Map https://developers.google.com/maps/documentation/embed/start My Maps https://www.google.pl/maps/d/splash?app=mp
Bing Maps	Customize embedded map http://www.bing.com/maps/embed/SnippetGenerator.aspx Simple map http://www.bing.com/maps/embed/Customize.aspx Bing Maps https://www.bing.com/maps/
OpenStreetMap	OpenStreetMap http://www.openstreetmap.org
MapQuest	Map Builder http://www.mapquest.com/tools/mapbuilder

Source: author's study

2. The characteristics of tested mapping services

The development of web services and the increase of Internet broadband capacity have contributed to the popularity of interactive forms of sharing geographic information. In the last a dozen or so years the share of spatial data in Internet resources has been growing, which is the result of the emergence of location-based services, such as Google Maps, Bing Maps and the like, and of computer tools giving users the chance to make their own thematic maps [Kowalski 2007].

One of the most popular web mapping services in Poland [Megapanel PBI/Gemius 2015] and in the world are Google Maps [Alexa 2015], and many other services, such as Bing, OpenStreetMap, MapBox or MapQuest.

The Google Maps service has revolutionized the way people perceive the information related to spatial character of objects. Launching in 2005 the extended programming interface API has marked the beginning of dynamic development of geospatial web [Halik 2011]. Google Maps provides numerous tools of creating thematic maps and integrating them with any hypertext document. The websites made by this method are called mashups. They combine thematic contents with a map base [Peterson 2015].

Microsoft Bing Maps is an alternative service and has analogous functions as Google Maps. Bing gives access to road maps, satellite and aerial images, 3D visualisations of buildings with the so-called bird's eye function, possibility to surf through virtual streets of cities ("Streetside" application), offers geo-coding, routing (marking out the route) and other functions useful in creating map applications.

OpenStreetMap (OSM) is a mapping service also called The Free Wiki World Map. OSM is a global project aimed at creating public map of the world. Its distinctive feature is its open character. OSM maps can be edited by users from all around the world. The project databases are published under Open Data Commons, Open Database License (ODbL). The license gives rights to unrestricted distribution, modification and use of data, while granting other users the same rights.

MapQuest is one of three most popular mapping services in the world, listed in the "The top 500 sites on the web, Reference, Maps" [Alexa 2015]. It is the most popular in the USA. MapQuest platform is one of the first of services giving access to interactive maps in Internet.

3. Results and conclusions

My Maps – Google is a web application that enable creation, display, edition and managing of Google maps created for personal use (the application has replaced Google Maps Engine Lite). With the My Maps creator one can add POIs (points of interest, pushpins, markers), draw lines and shapes, measure distances and do other things. Markers can be differentiated through e.g. the choice of icons' shape, colour and letters' sequence, text description and multimedia materials. The map can be share as an URL (uniform resource locator) address, embed in any hypertext document or print.

My Maps application also has a Polish interface. Creating a map is relatively easy and does not require any source code interference. Editing maps is entirely done by

graphic interface, that is by a desktop environment. However free use of maps has its limitations. The map may consist maximally of 10 thematic layers. Ten thousand objects can be placed on one map, but only two thousand on one layer. Service provider also limits the number of attributes describing the placed objects, the size and types of imported files (e.g. size limit of imported keyhole markup language, KML, files).

Another web application with graphic service interface offered as part of Google Maps Embed API is “Quick Start Build a Map” (Google Developers). The software includes a tutorial on how to create maps. One can use the application free and with no quotas or request limits, but it requires registration. The application interface has a limited functionality, which is related to restrictions to number and possibilities of personalizing the objects placed on the map.

The application allows for sharing the map as an URL address, static or dynamic map or as a printout.

To make advanced maps with programming interface of Google Maps JavaScript API v3 there is no need to have a licence key (a unique sequence of numbers and letters, a token), whereas in automatically generated map (Quick Start Build a Map) the licence is required. It is somewhat inconvenient, because a user has to register, create an account to gain access to Google Developers service, and it is related with interference in the map's source code.

Another tested tool are authorized Bing map generators, available in two versions: basic and advanced. Both are in Polish and allow to create relatively simple maps in automatic way. To use generators there is no need to register or to have unique license key. Tools are simple but their functionality is limited. The alternative is to use an interface being an integral part of Bing Maps, which offers similar functionalities. The map generated by it and shared as an URL address is displayed properly in a web browser window. The inconveniences appear when the user tries to display the map in a iframe window, and they consist in showing correctly the placed objects.

The OpenStreetMap resources are created by users' community. To edit a map one has to register an account. To make a simple map as a resource embedded in iframe window there is no need to authorize the access and is a service's functionality with its limitations. By using the graphic interface of the service one can make an interactive map with one POI object, but placing line objects and shapes on the map is impossible. The user can decide in which form the map will be available: as an address of web resource, iframe map or a printout.

MapQuest mapping service offers an access to web application “Map Builder” designed for placing objects of various spatial character in relatively easy way. The application is intuitive and the map created by it – visually attractive. Among its advantages are wide range of icons to mark the points place on the map and tools for drawing spatial objects.

The examples of codes generated automatically by web applications of the tested mapping services are presented in Table 2. The presented code is responsible for displaying the interactive map in a defined and it consists of a base address of URL resources, and of the chosen map's attributes and their values, e.g. for

Bing Maps: cp=50.034131~19.990666; lvl=14; w=500&h=400; pp=Zalew%20Bagry~~50.032890~19.990709 – the attributes define adequately: latitude and longitude coordinates of the map's centre, the degree of approximation of the map's view, the size of map's display window in pixels, the character and localization of a marked POI. An average user does not have to understand the way of coding an URL address of web resource. In the studied cases it is a fragment of API generated code, which can be modified manually.

Table 2. The examples of iframe embedded maps

Google Maps Embed API
<code><iframe width="600" height="450" frameborder="0" style="border:0" src="https://www.google.com/maps/embed/v1/place?q=Bagry%2C%20Krak%C3%B3w%2C%20Polska&key=AIzaSyACfR_IWOH-wO8QDU5S_bmGsO04TF7lChI"></iframe></code>
My Maps Google
<code><iframe src="https://www.google.pl/maps/d/embed?mid=zVNCTdK_ucaY.kRR73BuAGl48" width="640" height="480"></iframe></code>
Bing Maps Customize embedded map
<code><iframe width="500" height="400" frameborder="0" src="http://www.bing.com/maps/embed/viewer.aspx?v=3&cp=50.036837~19.982706&lvl=14&w=500&h=400&sty=r&typ=d&pp=Zalew%20Bagry~Zalew%20Bagry~50.032890~19.990709 Staw%20P%26%23322%3Baszowski~Staw%20P%26%23322%3Baszowski~50.040619~19.970425&ps=&dir=0&mkt=pl-pl&form=BMEMJS"></iframe></code>
OpenStreetMap
<code><iframe width="425" height="350" frameborder="0" scrolling="no" marginheight="0" marginwidth="0" src="http://www.openstreetmap.org/export/embed.html?bbox=19.97241497039795%2C50.02483619946564%2C20.00528812408447%2C50.04021846455244&layer=mapnik&marker=50.032527947916144%2C19.98885154724121" style="border: 1px solid black"></iframe></code>
MapQuest map builder
<code><iframe width="350" height="310" frameborder="0" scrolling="no" marginheight="0" marginwidth="0" src="http://www.mapquest.com/embed?icid=mqdist_mb_tools&c=xfTp&maptype=map&zm=13&cr=50.0372827045004,19.981071240849467&projection=sm&showScale=false"></iframe></code>

Source: author's study

Though the attributes of the embedded maps are saved in different ways, the tested tools are comparable and they generate maps of similar parameters. Among functionalities of these maps are: the option of exploring the surface of the globe by selecting and dragging a map's area (by means of a computer mouse or map's interface), of changing the zoom and placing a point or – as it was in tested applications – line object or shape on the map. The above-mentioned functionalities are typical of maps generated automatically, without interference in the source code. On the other hand, they are usually limited as to the number of placed objects.

All tested code generators can be used without the need to register, create an account and obtain licence key (with the exception of Google Maps Quick Start Build a Map), however additional functionalities, such as the option to save and re-edit the project, are available only after the registration.

In the subjective assessment, on the basis of tests, the tools which have been found the easiest to use and proved most functional – the ones by which maps can be made with the largest number of functionalities in the easiest way – are those provided by Google Maps (My Maps) and MapQuest (MapBuilder) services, characterized in Table 3.

Table 3. The characteristics of chosen parameters of tested map tools

	Requires registration	Requires access key	Map as a link	Possibility of placing many points	Interface in Polish	Static map option	Adding graphics or films
Google Maps Quick Start Build a Map	+	+	+	-	-	-	-
My Maps Google	+	-	+	+	+	+	+
Bing Maps Customize embedded map	-	-	-	+	+	+	-
Bing Maps Simple map	-	-	-	-	+	+	-
Bing Maps	-	-	+	+	+	+	+
OpenStreetMap	-	-	+	-	+	+	-
MapQuest Map Builder	-	-	+	+	+	+	-

Source: author's study

4. Summary

Tests and the characteristics of the chosen geoinformatics tools show that the access to the cartographic resources is not restricted only to advanced users. The providers of geodata offer different, more or less sophisticated tools, with which users can make their own maps. Making a map by a generator is usually intuitive and relatively simple. Moreover the users can choose from many applications, both made by firms and private users, that are available in Internet.

Though the tested tools are relatively easy to use, they may be insufficient for some designers. Making advanced maps requires the programming interface API and usually some knowledge about geoinformatics.

There are more and more personalized thematic maps, related not only to professional activity, but also with users' interests. This applies to tourist, landscape maps and all those maps by means of which geospatial information can be shared in Internet.

All the tested tools are web applications. To use them one has to have web browser and Internet access. The greatest advantage of map generators is that they are easy to use and offer the tools to making interactive map with defined values in a short time. The map created this way consists of a few lines of code and can be a component of any hypertext document. The relatively simple use of application is related to limited scope of functionality. The tested generator are good for creating simple maps, showing chosen points, object or marking out the route. Moreover the technique of embedding web resource in iframe is one of the least complicated forms of implementing map in a website structure. For all these reasons map generators provided by mapping services are often called basic and are addressed to users with no knowledge on geoinformatics, not interested in programming advanced map functionalities – to people such as editorial non-technical staff of various websites, bloggers and amateur users.

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