BADANIA FIZJOGRAFICZNE
R. XIII – SERIA A – GEOGRAFIA FIZYCZNA (A73)

DOI 10.14746/bfg.2022.13.9 str. 155–166

MULTIMEDIA-CARTOGRAPHIC INTERNET SERVICE OF THE CULTURAL HERITAGE ON THE "PUSZCZA BUKOWA" AREA

BŁAŻEJ OSTROWSKI

Adam Mickiewicz University, Poznań, Poland; Faculty of Geographical and Geological Sciences
10, B. Krygowskiego St., 61-680 Poznań

Abstract: The main objective of this research was to design a multimedia website with a collection of thematic maps to show the values of cultural heritage sites in the "Puszcza Bukowa" Forest (Szczecin Landscape Park "Beech Forrest") for public and expert users. In the research, the cartographic method was used together with User Centred Design, geo-information operations on BDOT10k data, and JavaScript programming using the Leaflet library. In addition to the chamber work, field research was carried out in several cartographic and geo-information applications to obtain materials for multimedia. The research process consisted of four stages: conceptual, preparatory, execution and publication of the completed service. The result of the research became a multimedia-cartographic web service, an indication that a properly designed and coded collection of spatial information can significantly affect the dissemination of cultural knowledge in protected areas.

Keywords: multimedia cartography, web application, Puszcza Bukowa, online map, leaflet, cultural heritage, mapping methods, BDOT10k, GeoJson, User Centred Design, protected area

INTRODUCTION

Online maps are a common source of information about the objects of geographic space in many dimensions related to the general accessibility, interactive communication between the user and the map and the effectiveness of multimedia cartographic visualizations (Medyńska-Gulij 2021). A specific example of the use of such services is the popularization of knowledge of spatial interrelationships and thematic data resources dedicated to protected areas. Appropriately designed web maps with multimedia in the form of desktop or mobile applications enable comprehensive presentation of cultural heritage in protected areas.

The resource comprising cultural heritage includes immovable and movable things along with related historical phenomena, cultural values recognized as the basis of legal protection for the benefit of a particular society and its development. Cultural heritage has a very important function in conveying information also objects of natural importance on a national and regional scale. Because of the understood and accepted historical, patriotic, scientific values of importance for the identity and continuity of social and cultural development, commemoration of historical events, cultivation of the beauty of the region and the state (Pruszyński 2001). In a broad

sense, documentation of actual natural heritage sites can prove invaluable when it is necessary to restore, for example, areas subjected to a natural disaster (Wabinski, Moscicka 2019; Qianli, Qingping 2020).

The basis for the development of a thematic service needs a reliable reference, so the most appropriate are official databases. Currently, the most up-to-date and available source of topographic data for Poland is the Topographic Objects Database (BDOT10k). The database contains 9 categories of topographic object classes, which make it possible to obtain data that can then serve as essential cartographic content elements for a given web map (Izdebski 2020).

Additional map libraries are used to design web sites to provide a variety of functionalities including geolocation, layer panel, etc. One of them is the Leaflet library. It is noteworthy that nowadays a map service designer can use the Application Programming Interface in worldwide map platforms to add custom maps. In such multimedia cartographic representations with multimedia, cartographic characters play a key role (Medyńska-Gulij 2014). Among the key problems in achieving efficiency is the search for ways to communicate more easily with the user of map applications through the appropriate arrangement of service components. First of all, the work focuses on specialized map design using software tools along with appropriate graphic programs (Horbiński, Cybulski, Medyńska-Gulij 2020).

The most popular are map services with multimedia, and the design of the service involves the layout of the site, including the opening of the service, buttons and navigation directions (Medyńska-Gulij 2021). High efficiency of a cartographic product can be achieved by using User Centred Design (UCD) (Kramers 2008). In the cartographic method of research, it is important to choose an appropriate mapping method to present spatial phenomena that allow the viewer to interpret them correctly (Żyszkowska et al. 2012). To this end, one of the best methods for creating an online map is, among others, the signature method as a graphic presentation of spatial objects and their status on a map or other form of cartographic presentation (Koch 2007). Cartographic signs can indicate the location and attributes of linear or surface objects of points according to their symbolic, pictorial, letter features (Medyńska-Gulij 2015). In turn, for the development of a correct cartographic product, it is necessary to apply the principles of map design, of which in this research the key ones became: the appropriate arrangement of map components, among others, the window of information about the selected object on the map. Application of the principle of graphic reinforcement of thematic content elements, which meant designing signatures that stand out visually from the map (Medyńska-Gulij 2021).

RESEARCH OBJECTIVE

The main objective of the present research was to design a multimedia website with a collection of thematic maps for showing the values of cultural heritage sites of the Beech Forest in a public and profiled user context. The second complementary objective became the design of maps in an effective and functional way according to the principles of UCD using the Leaflet library and the resource taken from BDOT10k.

RESEARCH AREA

The area of research in this study became the "Puszcza Bukowa" (Szczecin Landscape Park "Beech Forrest") (Fig. 1). It is a forest complex located in the southeastern part of the capital of the West Pomeranian Voivodeship (województwo zachodniopomorskie) (Domian i Kędra 2010). In the area of the Beech Forest, there are many reserves like a landscape park, such as the Szczecin Landscape Park "Beech Forest", established in 1981, and the Forest Promotional Complex "Szczecin Forest", established in 1996. The area is characterized by a specific dominance of deciduous forests, especially beech forests resulting from the presence of fertile fresh and moist habitats here. Alder forests, riparian forests, oak forests and pine forests and oak-hornbeam forests can also be found. The highest point of the Beech Forest is Bukowiec 149 m above sea level. Characteristic lakes found in the area are Lake Emerald (a former chalk mine), Binowskie, Glinna Wielka. In the southern part of the Forest there are also streams, brooks, glades, passes. In the northern part, on the other hand, are located hills covered with forest area, where you can find erratic boulders scattered throughout the area, monuments of nature. The Beech Forest includes villages with a rich history, spatial arrangement or monuments. These include Kolowo, Gliniec and an area incorporated into Szczecin such as Plonia. Most of the most interesting hiking trails run right through the aforementioned villages (this is also due to the fact that there are monuments or places for campfires and resting, etc.). In the southeastern part of Szczecin County (including the study area) there are numerous unique species of birds, amphibians, reptiles and the reintroduction of the dormouse that once became extinct here (Domian, Kędra 2010).

Fig. 1. Location of the research area: Puszcza Bukowa
Source: geoportal.gov.pl.

METHODS

The research used the cartographic survey method, UCD, and used geo-information operations on BDOT10k data. A JavaScript programming process was carried out (along with Html, CSS) using the Leaflet library. The field work served as an important source of material for multimedia, which is an important element of the developed service. The entire research process was organized in four fundamental stages such as conceptual, preparatory, executive and publication of the service.

The conceptual stage is devoted to defining and characterizing the goals for the visualization of online maps, the application as well as its other elements, among others, the signature. As a result of this stage, a mockup for the site was created.

The preparatory stage is another process of achieving the purpose of the work, in which the author downloaded layers from BDOT10k constituting the base for the map or as additional elements of it, along with trimming them to the boundaries of the study area. The data were then processed using mapping programs (Qgis) so that in the next stage they were ready to be implemented in the application code. In this stage, the author also created documentation of the area in order to more accurately present the objects found in the Beech Forest.

The executive stage is the programmating implementation of the research, in which the author, after collecting the information and data he needed, proceeded to act in the programming language (JavaScript) and the program designed for it, the coding process took place. This process allowed him to combine previously collected documentation, layer with BDOT10k, as well as perform visualization of his data including designing signatures for maps.

The publishing and evaluation stage was the posting of the multimedia service using an FTP (File Transfer Protocol) account while the evaluation consisted of pointing out the advantages and disadvantages of the service from the point of view of the public user.

In the conceptual stage, a mock-up was created, shown in Figure 2, which includes preliminary assumptions related to the basic design of the map service in terms of the placement of all its elements such as buttons, view panels, transitions between other maps and how the user interacts with the service (Medyńska-Gulij 2011).

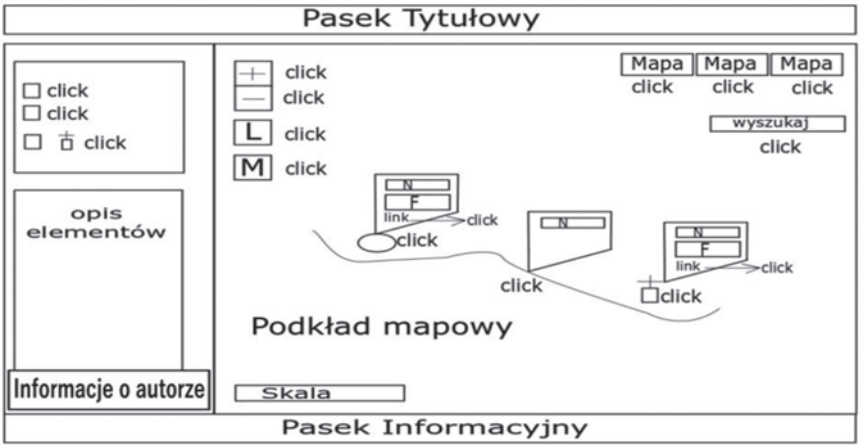

Fig. 2. Web application mock-up

PREPARATORY STAGE – COLLECTION AND PROCESSING OF SOURCE MATERIALS

This stage involved processing and selecting vector layers taken from BDOT10k. All operations on the data were performed in the Qgis program. First of all, it was the selection of specific layers that form the basis of the base of the standard map, historical map, tourist routes, thematic map, in the form of additional elements such as buildings, lakes, or churches. Then proceeded to create the boundaries of the Beech Forest area in vector form. The boundary layer created in this way was also used to trim selected layers within the extent of the

study area (i.e. using a so-called mask). For this purpose, a map base saved in JPG, made available at http://gryfino.szczecin.lasy.gov.pl/ by the Gryfino Forest District/State Forestry, was downloaded, and then the file was loaded into the Qgis program. After loading JPEGA, a vectorization process was performed to obtain the boundaries of the Beech Forest in vector form. The resulting layer was saved and used as a mask. The next step was to use the "Trim" geoprocessing tool and the "trim mask" setting of the previously created layer (Beech Forest boundaries) and the "source layer" in the form of individual layers selected from BDOT10k.

The next step was to export the layers saved as Shapefile to a GeoJSON file. In the preparatory stage, photographic documentation was also taken showing characteristic places, monuments, etc., appearing on the map in the form of signatures. The information extracted from the environmental intelligence (photos) was used in the application code, and then combined with the point elements of the map as additionally information about a given object displayed in the upper right corner, after tapping on the selected signature.

EXECUTIVE STAGE – CODING

In the executive stage, the coding process took place in Visual Studio. The processed data (layers) in the form of GeoJSON was saved as a JavaScript file. The entire content of a given layer was rewritten into a single variable which made it possible to combine it with the rest of the code also taken from the Leaflet library and place this data in the form of a point, polygon, etc. on the map background. It is worth noting that before placing the elements on the map, a design and framework for the application was made, consisting of several sub-pages interconnected by HTML and CSS. With their help it was possible to design polygon layers (orchards, forests) or vector layers (roads), specifying their dimension, saturation, etc. The basis for working on signatures, in addition to Visual Studio, was Inkscape, so that it was possible to design according to one's own layer design (polygon, point, vector). Figure 3.1 shows a sample code snippet that allows you to implement an object (in this case, a signature) with given appearance-related properties, into the map under development. Figure 3.2 shows a code snippet written in CSS, responsible for giving styling to the various parts that build the map service.

The opening view of the site includes panels that serve the function (Figure 4) of special switches to individual sub-pages, including a block to the map tab, the legend, and to a block describing the Beech Forest. What's more, the tab answers a question about why the study area was selected and presents its attractiveness. In addition to this, an identical heading is placed on each page along with the name of the study area, namely "Beech Forest". The "Maps" tab includes individual types of map primers

```
<div id="first_map">
    <script>
        let map = L.map('first_map', {
            minZoom: 12,
            maxZoom: 17,

        }).setView([53.327030, 14.679795], 13);

        let granice1 = L.geoJson(puszcza_bukowa, {style: style_granica}).addTo(map);

        function style_granica(feature) {
                return {
                    weight: 3,
                    opacity: 1,
                    color: 'black',
                    fillColor: 'lightgreen',
                    fillOpacity: 0.5,
                };
        }

        let lasy1 = L.geoJson(las, {style: style_lasy}).addTo(map);

        function style_lasy(feature) {
            if ("iglasty" == feature.properties.KATEGORIA) {
                return {
                    weight: 0.2,
                    opacity: 1,
                    color: 'black',
                    fill: 'url(sygantury/iglasty.svg)',
                    fillOpacity: 1,
                };
            }
```

Fig. 3.1. Example code snippet to implement the signature

```
}

#help_background {
    background-color: rgb(170, 127, 19, 0.95);
    border: 2px solid rgba(50, 50, 50, 0.90);
    width: 30%;
    height: 6%;
    margin-top: 7%;
    margin-left: 32.5%;
    font-size: 20px;
    text-align: center;
    font-family: "Arial Black", Gadget, sans-serif;
    color: #d2691e;
    text-shadow: 0px 0px 0 rgb(166,104,0),
                 1px 1px 0 rgb(77,15,0),
                 2px 2px  0 rgb(-12,-74,0),
                 3px 3px 2px rgba(0,0,0,0.42),
                 3px 3px 1px rgba(0,0,0,0.5),
                 0px 0px 2px rgba(0,0,0,.2);
    box-shadow: 0px 2px 14px 0px rgba(39, 50, 50, 1);
    position: absolute;
}

#help_background:hover {
  cursor: pointer;
  opacity: 0.8;
  transform: translate(10px, 5px);
}

#text_help {
  background: rgb(74,164,71);
  background: linear-gradient(147deg, rgba(74,164,71,1) 22%, rgba(28,83,46,1) 100%);
  width: 100%;
  height: 100%;
  font-size: 22px;
```

Fig. 3.2. Sample code snippet in CSS responsible for providing styling for different parts of the map service

characterized by a specific theme and appearing in the form of switches directing the user to a separate page that presents a specifically selected map. These include historical map, general geographic map, tourist map and orthophotomap. There are also switches in the form of blocks allowing the user to concretize the selection of the appropriate type of map, the subject of which the recipient is interested in.

Fig. 4. The first page of the application

The "Maps" panel received additional buttons having references to related other sub-pages, among others, the Home Page (Figure 5). In Fig. 5, on the left side, special buttons have been created, consisting in facilitating in concretizing the user's choice to a particular map. When a click is made, the service redirects to the selected web map. The analogy is with the selection of a map window panel with an attached image (Figure 5).

Fig. 5. Contents of the "Maps"

A key factor for cartographic presentation was the development of thematic maps under the "Maps" tab. The first general geographic map was completely

developed using layers taken from BDOT10k (Figure 6). It presents a variety of content, including the basic objects of each locality or area that is a reserve, landscape park, etc.

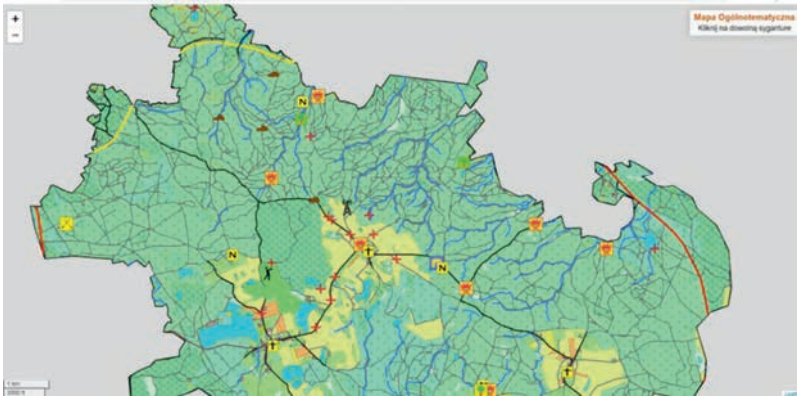

Fig. 6. General-Geographical Map

The historical map, on the other hand, has cartographic signatures related to the historical issues of the presented area, such as the Carl Ludwig Gené monument, bridges or bunkers from the first half of the 20th century (Figure 7) (Rzeszotarska-Pałka 2013).

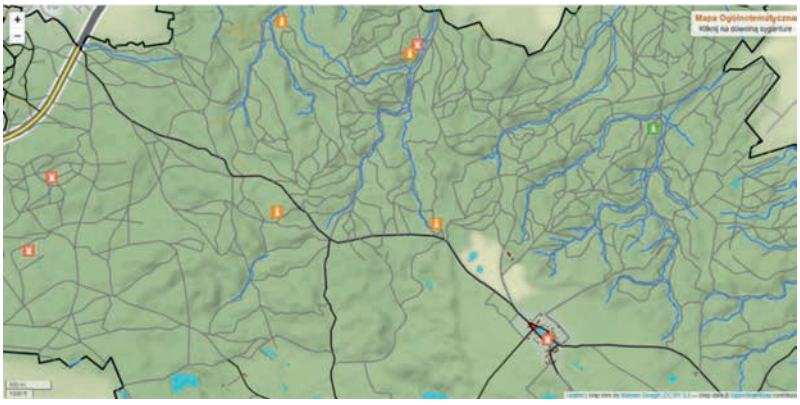

Fig. 7. Historical Map

Individual patterns and characters were taken from https://www.flaticon.com/. Simple characters were used according to the 'flat icon' principle (Medyńska-Gulij 2021). Other web maps included in the "Maps" tab were created based on downloaded map primers from https://geojson.io/. In combination with the previously designed and selected signatures, layers, the service was

enriched with several diverse web maps tailored for audiences with different knowledge profiles. Additional windows with photographs of objects or "photo gallery" have been programmed to include other media. Figure 8 and Figure 9 show the selected signature with the additional activation of the "Gallery" window in order to maintain more interaction with the user. In order to make such functionality possible it was proceeded to program it, thus enabling more accurate visualization of objects with the help of previously taken photographic documentation in the field.

Fig. 8. Presentation of the object using the window with the photo gallery after clicking on the selected signature

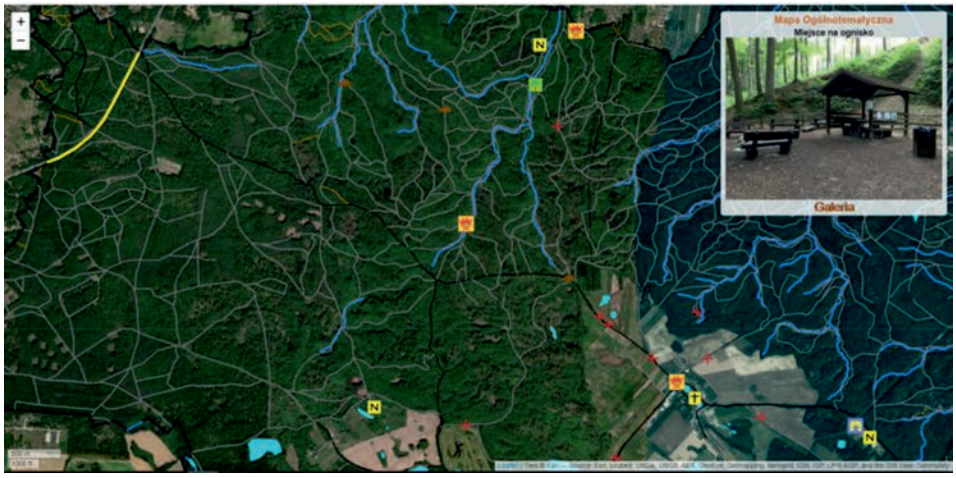

Fig. 9. Presentation of the object after clicking on the selected signature

PUBLICATION AND EVALUATION STAGE

The publication consisted of exporting the created service to the public space, which required the creation of its own website domain with a limited availability date. The publicly accessible map service includes the following maps: a general geographic map, a historical map, a tourist map and an orthophotomap. Each of these maps presents different thematic qualities, but they have parts in common in some respects, such as particular signatures are presented in several maps. The pragmatic aspect of this service is worth emphasizing, because the user has access to many thematic spatial information according to his own needs (Medyńska-Gulij 2010).

Each cartographic product should be evaluated according to its usefulness for acquiring new knowledge about the geographic environment and according to its attractiveness to a potential user (Medyńska-Gulij 2021). In the case of the developed service, one can state its advantages of openness to the placement of new thematic maps and the addition of relevant multimedia. Among the advantages is also the high timeliness of geographic information, thanks to the use of the Polish Topographic Objects Database. The biggest advantage of the service is its openness to new information, the ability to use open standard formats designed to represent simple geographic objects along with their non-spatial attributes such as the GeoJson format.

CONCLUSIONS

The performance of the map service under the assumptions used here demonstrates that a properly designed and coded collection of spatial information can significantly affect the dissemination of cultural knowledge in protected areas. As the main conclusions of the study can be mentioned the potential high functionality and accessibility for the public user. In turn, for geographically profiled users, this service offers the possibility of adding further spatial information. An additional advantage is the possibility of adding specialized further thematic maps about the Beech Forest area. The huge potential hidden in IT technologies is their constant improvement and uninterrupted development, and consequently their increasing use for knowledge transfer in multimedia services.

LITERATURE

GeoJson, https://pliki.wiki/extension/geojson.
Geoportal, https://www.geoportal.gov.pl/dane/baza-danych-obiektow-topograficznych-bdot.
Główny Urząd Geodezji i Kartografii, http://www.gugik.gov.pl/projekty/gbdot/produkty.

Domian G., Kędra K., 2010: *Bierna ochrona przyrody a bioróżnorodność na przykładzie Puszczy Bukowej koło Szczecina*, Przegląd Przyrodniczy, 21 (2), 52–78.

Horbiński T., Cybulski P., Medyńska-Gulij B., 2021: *Web Map Effectiveness in the Responsive Context of the Graphical User Interface*. ISPRS Int. J. Geo-Inf., 10, 134.

Horbiński T., Cybulski P., Medyńska-Gulij B., 2020: *Graphic design and placement of buttons in mobile map application*. The Cartographic Journal, 57 (3), 196–208.

Izdebski W., 2020: *Infrastruktura danych przestrzennych w Polsce*. Geo-System Sp., Warszawa.

Wabiński J., Mościcka A., 2019: *Natural Heritage Reconstruction Using Full-Color 3D Printing: A Case Study of the Valley of Five Polish Ponds*, DOI: 10.3390/su11215907.

Koch W.G., 2007: *Zum Wesen der Begriffe Zeichen, Signatur und Symbol in der Kartographie*, [w:] *Begriffe zur wissenschaftlichen Kartographie/Contributions to scientific cartography*, TUDpress, Dresden, 53–64.

Kramers E.R., 2008: *Interaction with Maps on the Internet – A User Centered Design Approach for The Atlas of Canada*. Cartographic Journal, 45, 98–107.

Medyńska-Gulij B., 2021: *Kartografia i Geomedia*. Wydawnictwo Naukowe PWN, Warszawa, ISBN: 978-83-01-21554-5, ss. 286.

Medyńska-Gulij B., 2015: *Kartografia. Zasady i zastosowania geowizualizacji*. Wydawnictwo Naukowe PWN, Warszawa, ss. 228.

Medyńska-Gulij B., 2014: *Cartographic sign as a core of multimedia map prepared by non-cartographers in free map services*. Geodesy and Cartography. Vol. 63, 55–64, DOI: 10.2478/geocart-2014-0004.

Medyńska-Gulij B., 2011: *Kartografia i geowizualizacja*. Wydawnictwo Naukowe PWN, Warszawa, ss. 216.

Medyńska-Gulij B., 2010: *Map compiling, map reading and cartographic design in "Pragmatic pyramid of thematic mapping"*. Quaestiones Geographicae, 29/1, 57–63, DOI: 10.2478/v10117-010-0006-5.

Nadleśnictwo Gryfino, http://gryfino.szczecin.lasy.gov.pl/.

Pruszyński J., 2001: *Dziedzictwo kultury Polski. Jego straty i ochrona prawna*, t. 1. Kantor Wydawniczy „Zakamycze", Kraków, ss. 50.

Qianli Dong, Qingping Zhang, 2020: *3D scanning, modeling, and printing of Chinese classical garden rockeries: Zhanyuan's South Rockery*. Heritage Science, 8 (1).

Rzeszotarska-Pałka M., 2013: *Możliwości rewitalizacji zdegradowanych terenów rekreacyjnych na przykładzie Wzgórza Elizy w Szczecinie*. Teka Komisji Architektury, Urbanistyki i Studiów Krajobrazowych, 9.

Żyszkowska W., Spallek W., Borowicz D., 2012: *Kartografia tematyczna*. Wydawnictwo Naukowe PWN, Warszawa.