The concept of movable heritage cartographic presentation on the interactive map

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Abstract: This paper presents the proposition of cartographic presentation of the movable cultural heritage on interactive map. The original solution on how to link movable monuments with geographical space as well as the different types of spatial reference were described. The text shows both: the way of presentation of single movable monuments and collections of historical objects. The proposed solutions were based on the assumption that the number of heritage resources shown on the map is huge and, what is more, they can keep growing. So, the proposed solution must be able to apply for a resource of indeterminate size. For the presentation of the movable heritage the traditional methods of cartographic presentation, as well as interactive technologies were applied.

1. Introduction

Adapting representation methods to the increasing range in kinds of task that visual geospatial representations must support is one of the research challenge in the development of geovisualization, indicated by the International Cartographic Association (MacEachren and Kraak, 2001). Therefore, the research on proposed methodology for mapping movable heritage were undertaken. In particular, cartographic representation of movable monuments on the map were included to the project. It was assumed that proposed solutions should be based on the quantitative and qualitative methods of cartographic presentation as well as the dynamic and interactive methods of communication (Virrantaus, Fairbairn and Kraak, 2009). The article presents the essence of the proposed concepts, and examples of practical solutions adapted in a pilot study.

Existing geographic information systems on cultural heritage focus mainly on historical objects, which relation to the geographical space is obvious – on immovable monuments. Location of historical buildings, cultural landscapes or cemeteries is easy to define. Thus, the preparation of GIS on such heritage focuses on the database structure development and methodology of joining spatial and descriptive information (Duran et al., 2004) as well as performing simple spatial data analysis (Zottoli, 2002). In

Poland, there are also a lot of cultural heritage systems, based so far only on the cultural resources stocktaking (Seidel-Grzesinska and Lawniczak, 2004), mainly immovable heritage resources (Journal of Laws, 2003). In such systems, only information related to the historical record (Minister of Culture, 2004) is collected, and finally only locations of these objects in geographic space are presented on the map (Gregory, 2007). These solutions are mainly based on existing technological solutions implemented already in GIS, and data cartographic presentation is based on their direct visualization on the map. There is no comprehensive solutions for mapping movable monuments so far, as well as methods of using modern technologies to obtaining additional descriptive information on them in a standardized form (Wajs, 2003).

2. Movable heritage in geographical space

The Polish law on protection and care of monuments (Minister of Internal Affairs and Administration, 2003) defines a monument as „*immovable or movable stuff, their parts, or assemblies, which are man-made or connected with man activities, which give us a witness of the past*". According to this definition immovable and movable monuments, as well as archaeological sites are protected in Poland. The sights of moving, among others, are: works of art, literature, numismatics and library materials.

Bearing in mind the above definition, from the spatial information point of view, movable monuments are these cultural objects, which reference to the geographic space is (or can be) changeable over time. The immovable monuments, i.e. architectural monuments (churches, castles, palaces, etc.) have a simple, constant geographic location – they are located in a particular place in space. The movable monuments are not permanently connected with one place in space – they can be easy moved from one place to another one. Most of movable monuments were created in some place, were stored in other places in the past, and now can be found in another one (in an archive, museum, or library). Moreover, such a monuments – e.g. written documents (manuscripts, oldprints) – may refer to other locations in geographic space via their content or images. They can provide information about places other than those in which monuments arose or were stored.

The above situation concerns the European cultural heritage resources very often. They were scattered through the countries and the world for many centuries. As a rule, works were created in one place, are related to completely different places by their content, and now are stored in still other place. Moreover, the elements of the same collection are stored in different places, often in distant archives or museums. Because of complicated Polish history plan of Wieliczka (located near Krakow) is stored in Gdansk (in the north, the sea), and the plan of Zabludow (located east of Bialystok) in Warsaw University of Technology. The example of many spatial references of one movable monument shows the Figure 1.

Movable cultural heritage resources, defined in the above way, were the start point of the project research. It should be noted that the archaeological sites are often regarded as a movable monuments, but due to the fact that they concern the traces of
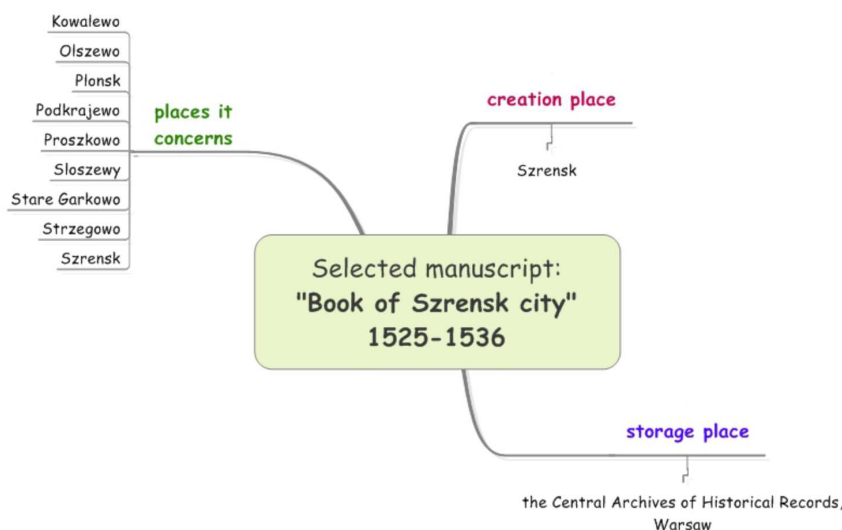
Fig. 1. A few spatial references of one movable monument
(source: Moscicka and Marzec, 2010)

human activity located in the ground or under water, they are classified separately in the Polish law and practice (i.e. in the Polish registry of monuments) and they were not included in the project.

3. Methodology used

The essence of the proposed solutions is that if movable monuments may have several places in the geographic space associated with them (several different localizations), so such monuments should be presented on a map as a object related to many places in the geographic space simultaneously (Moscicka and Marzec, 2010). It was assumed that the proposed map would enable presentation and access to the monuments through all these places.

To develop a map of movable monuments the wide range of thematic data, together with the cartographic background, were necessary. In this case "thematic data" means comprehensive information about monuments: their physical features, author, subject, history description etc. There are a huge number of movable monuments in the World. What is more, they are scattered all over Poland and the World and a lot of them still do not have a digital form. So, it is not possible to determine the size of a complete set of data, which should be presented on the map. It is also not possible – either on research or implementation phase – to have all the resources of movable cultural heritage in one place. In such case, there is a high risk to prepare chaotic and overloaded maps, which are illegible (Kraak and He, 2009). So, to make heritage maps more readable,

specific visualization strategy should be implemented. Therefore, it was assumed that the way of presentation monuments on the map should take into consideration:

– undefined and any size of cultural resources,

– enlarging of the resources amount and types of spatial reference.

It was assumed that proposed solutions should be comprehensive in both theoretical and technological aspects. They should cover all stages of work: from source data preparation to their presentation on the map. It was also decided to use source data in the same form as they are used by experts in monuments documentation. Only this approach ensures a database development in the future, effectively expanding the resources amount presented on the map and the integration of distributed cultural heritage resources.

The above assumptions apply to both: the scope of metadata describing the monuments and the way of saving this information, as well as the method of publishing information on monuments in the Internet.

Therefore, as a thematic source data digital copies of monuments were used. These are electronic documents presenting historical objects currently used to protect and preserve them. These electronic documents contain not only the document's content (image), but also his reference to the logical structure – the construction, links to other documents and technical data. Digital monuments are described with the use of metadata, it means structured information which facilitate search, control, understanding and managing the huge amount of digital heritage resources (Minister of Internal Affairs and Administration, 2006). Metadata are currently defined in international standards that describe monuments. These define what kind of elements (and how) can (or should) be present in the description of an electronic copy of the monument, to obtain the basic characteristics of the monument and to meet the requirements for electronic documents. Information related to the geographical space, that can be used to link the monuments with the map, are also included in standardized descriptions of digital monuments.

To meet the above conditions geographic information system for the movable cultural heritage resources were designed. The content of its spatial database were visualized on the interactive map. The conceptual solutions have been implemented in the pilot studies. It covers: movable heritage database development, information system creation, movable monuments cartographic presentation and monuments images and descriptions publication.

4. Movable heritage on a map

The analyzes have shown that different aspects of movable monuments spatial references can occur if we consider any set of monuments, as well as we focus on a one chosen object. As a result, two different points of view on movable monuments can be presented on the map:

– map provides information on historical collections; these are sets of works presented in different spatial aspects. This way both, all resources stored in the database,

as well as the resources selected from database with the use of user's criteria, can be presented on a map;

– map provides information about one single monument; as in the collections presentation they may be presented in different spatial aspects.

As it was already mentioned, data linking historical collections and individual works with the geographical space are derived from the metadata of digital copies of monuments. They were prepared in accordance to the international standards . The result of using them is cartographic presentation of information on movable monuments on the map. It is realized by creating "temporal maps". This maps are generated from a geospatial database stored in the computer from which specific selection has been made in order to answer specific requirements or objectives (Kraak and Ormeling, 2011).

The essence of method of presentation on the map the above information is shown in the Figure 2. Both, historical collections and individual monuments, are referred to the map by three basic types of spatial references. They are as follow: the place of their creation, the place of storage and places related to their subjects. The proposed solutions use the same methods of identification and presentation different types of spatial references. They are applied for both the collection of monuments, as well as for one of them. It means that places of monuments creation from one collection and place of creation individual object are presented with the use of the same symbol (icon). The same concerns other types of spatial references. The result is a common legend for both types of information, and hence faster perception of the presented content. Therefore, the icons presenting the different types of spatial references were developed. They mean:

places of monuments creation;

places of monuments present storage;

places connected with the monuments subject.

Cartographic presentation of movable monuments is based on the process of symbolization. Symbols representing monuments are related to points (localities) or areas (administrative units). As a graphic variables shape, and color are used, which differentiate types of monument references.

However, the traditional methods of presentation are not enough to map of movable heritage which should represent huge amount of information potential (Dong and Ran and Wang, 2012). So, due to the possibilities of the interactive technology, traditional methods of cartographic presentation have been modified. First of all, interactivity of the map, instead of differentiating the symbols size in dependence of the phenomenon intensity, has been applied. This resulted mainly from the fact that huge amount of the
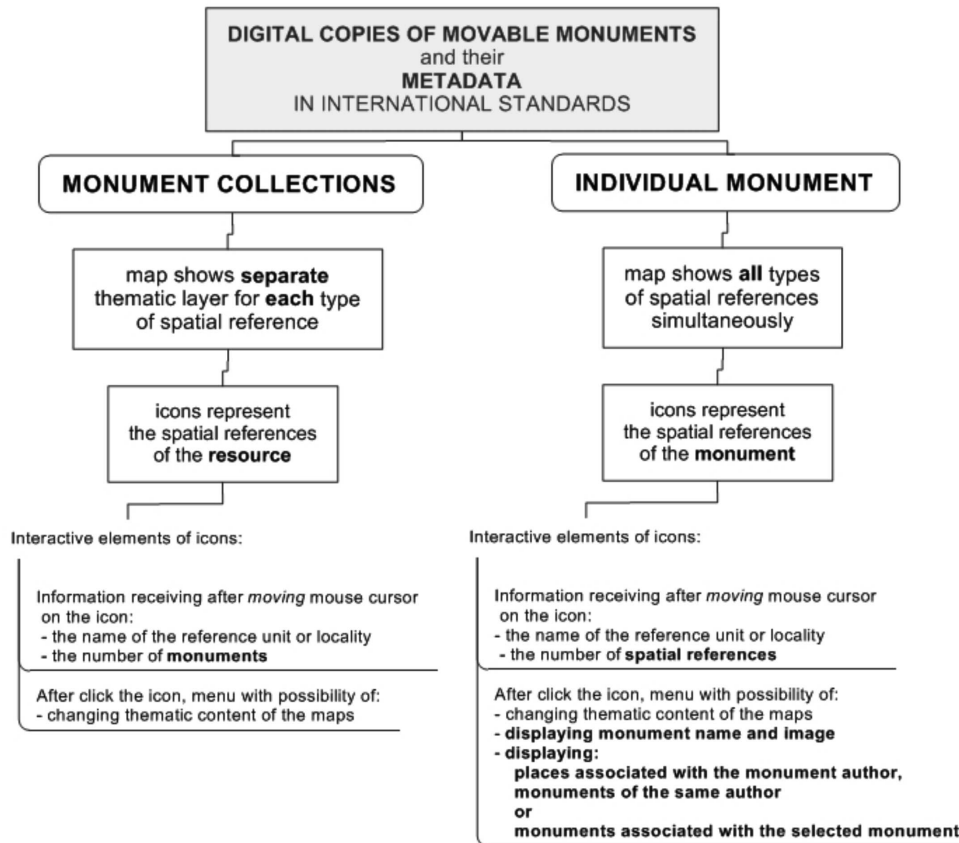
Fig. 2. The way of presentation movable heritage on the map

movable heritage still do not have a digital form and they are spread around the World. So, it is not possible to have in one place all monuments which can be presented on the map. What is more, these resources can be constantly expanded, so methods of presentation included such kind of data, have to be applied. The automation of the process of presentation cultural heritage on the map was also taken into account. For this purpose, solutions which can be possible to use too much greater resources while maintaining the readability of the map, were applied.

Developed map allows to present information at different levels of detail. Icons representing spatial references of collections or individual monuments are related to administrative subdivisions of the country. Depending on the map level they are vo-ivodships, districts, municipalities. The most detailed maps provide references to the specific localities.

There is a few differences in the movable monuments way of presentation. In case of collection each kind of spatial reference is presented as a separate thematic layer. So, there are three thematic layers, each for different type of spatial references. Each of these layers contains the same set of monuments, but presents them in different

spatial aspect on the map. It means that in one moment, only one thematic layer is shown on the map. In case of a single monument, all three types of spatial references are presented in the same time. They are also located on different thematic layers, but all types of spatial references are presented on the map together.

As it was mentioned, the spatial references are presented by icons. They symbolize spatial references of the resources (set of monuments) in case of monument collections, whereas the spatial reference of one chosen monument in case of single object. Icons have the same size, and all their quantitative traits are realized by interactive elements of the map.

Moving the mouse pointer over the symbol or clicking on them results in map interactivity. A different role to each of these actions is assigned:

– after moving mouse cursor over an icon, additional information about the specified icon are presented. Labels with the name of administrative unit or locality and the number of monuments (for a collection of monuments) or the spatial references (for a single monument) are displayed. Therefore, this function is responsible for providing information about the quantitative characteristics of the resources presented on maps.

– after clicking an icon, menu with options for quick changing thematic map content is displayed. The menu contains elements common for both collection of monuments and individual object. In case of one monument menu, features characteristic only for him, are also added. Therefore, the function is responsible for providing information (and display them on the map) on monuments related to the resources currently presented on map.

The above solutions allow to present on the map: resources of indeterminate (any) size and the objects of indeterminate (any) number of spatial references. The correctness of the proposed solutions was tested in practice during the experimental work.

4.1. Presentation of the monument collections

When we think about the presentation monument collections, it means that information about some set of monuments is displayed on the map. These may include both the presentation of all objects from the database or some part of them, selected with the use of spatial, time, subject etc. based criteria (Moscicka, 2011). Monument collections are presented on the map in accordance to the previously agreed principles. The possibilities and limitations of the map are also taken into account.

In case of monument collections cartographic presentation it was assumed that – as background maps exist at different levels of detail – the monuments should also be presented with varying levels of detail.

According to the assumptions, monuments are shown on the map in relation to the administrative units and, only at higher level of map detail, to the specific locations. Such solution provides a readability of thematic data on the map in case of significant increase the number of monuments in database.

As the result of many trials, the way of monuments presentation at different levels of detail, was developed. It has been adapted to the levels of detail of the reference

map and realized in the application by using "zoom" tool. At each level of detail icons represent the same type of spatial references. Only reference units, for which monuments are related, are changed. Collections related to lower and lower subdivisions provide more detail information on the presented resource.

Each icon on the map – for each type of spatial references and at each level of detail – is active. After moving a mouse cursor on icon, you get information about the size of the resource it means number of monuments and the name of the reference unit to which presented heritage is related to.

At the first level of detail (on the start map) monuments are displayed in relation to the basic units of the Polish administrative division, to voivodships. Now, there are 16 voivodships in Poland so it ensures excellent readability of the map. The example of a map at the first level of detail is presented in Figure 3. It shows the whole content of the pilot database presented on the basis of places of monuments creation. When we move mouse cursor on any icon, the information that i.e. 71 monuments were created in Mazowieckie Voivodship, is displayed.
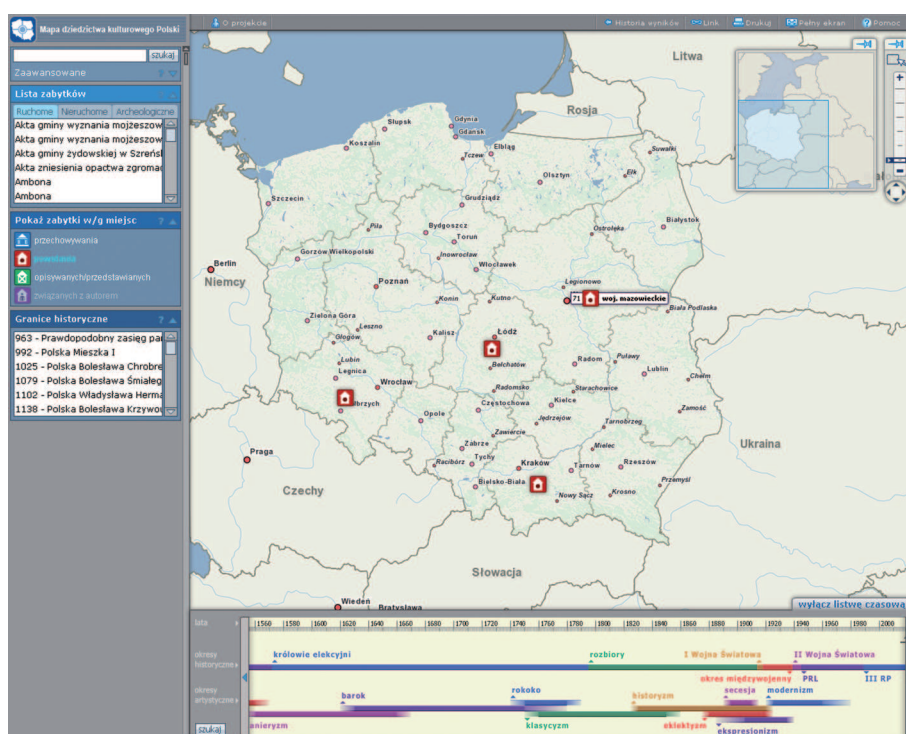

Fig. 3. The places of monuments creation at the first map level

The next level of a map detail gives more accurate information on monument resources. Heritage is related here to the lower administrative subdivisions – the districts. Moving the cursor on any icon, as in the previous case, gives the information about the number of monuments represented by the icon and also the name of the district

to which a given number is related to. We can notice on this map that among the 71 monuments of the test resource created in Mazowieckie Voivodship, 20 of them were created in Plonsk district.

The next two levels of detail (the third and the fourth level) show monuments in relation to the administrative units of the lowest order, the municipalities. These two maps, the same as in case of the background maps on these levels, contain the same thematic content. The difference between them is only the map scale (map zoom). This solution was provided for better perception of the information presented on the most detailed maps. Icons displayed on the third and fourth map level show that there are only two monuments created in the municipality of Plonsk, among 20 monuments created in the district called Plonsk.

There is a little different way of monuments presentation on the next two maps (levels five and six) than in the previous four cases. At these levels monuments are no longer presented in relation to administrative units but directly to localities (Figure 4). This is indicated by a change the icon appearance – they are complemented by an arrow indicating to which locality it refers.
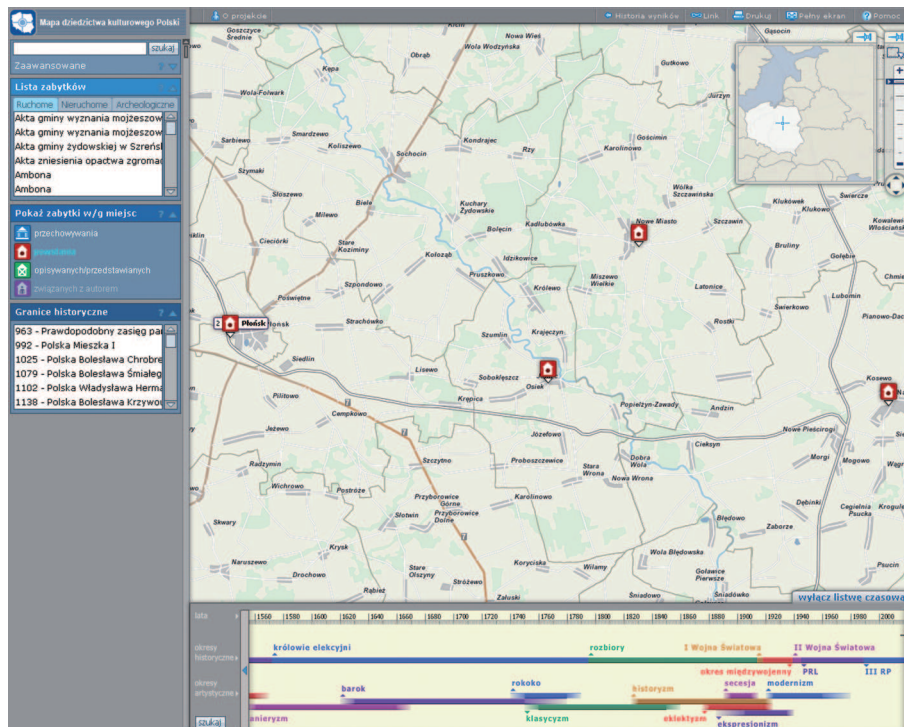

Fig. 4. The places of monuments creation at the sixth map level

Levels five and six have the same thematic content. The number of villages is the only difference between them. The sixth level contains all villages from the map in scale 1:200 000.

The above rules were shown with the example of maps presenting places of monuments creation. The same guidelines were applied for icons symbolizing storage places of monuments and places of their subjects, and they are also used at all levels of map detail.

4.2. Presentation of a single monument

As it was already mentioned, information on a single freely chosen monument can be also presented on the interactive map. Such map shows all the monument places in the same time differentiating them according to the type of spatial reference. The same icons, as in case of collections, are used for presentation references of a one monument. This facilitates the understanding of the significance of each spatial reference, regardless of whether the map presents a collection or a single monument.

The way of presentation information about a single monument, as in case of collection, is dependent on the level of map detail, on which they are presented. It is also based on the administrative division of the country at 4 levels and localities at two most detailed levels of the map. Such solution was needed to clearly present significant accumulation of spatial references on a small area. This situation occurs mainly in the presentation based on a monuments subject (e.g. villages, to which archive document refers).

When we select any title from the monuments list (this option is located on the left side of the application) information about one single object will display on the map. All places associated with the selected monument will be shown on the map. This is a major difference between presentation of the collection and one monument. In the first case only one type of spatial references (eg. only the storage locations or just creation places) are presented. In the second case all types of references are shown together. Therefore, there can be locality (one place) with several different spatial references assigned. Thus, we can get a slightly different monument references presentation of on the start map. It depends on the location places in geographical space and can occur as the follow:

– the various spatial references of one monument are located in different voivodships: icons indicating the specific spatial reference (each in a different voivodship) are displayed. An example is shown in Figure 5.

– The various spatial references of a single monument are located in one voivodship: only one icon is shown on the map. This is a new solution which does not occur in the previous examples. This icon is cumulative and it joins a few different individual (single) icons. Cumulative icon shows several spatial references with the use of colors representing each of them. In dependence of the type of references, it contains two or three colors - the same as the basic icons colors.

– Several spatial reference of the monument is in one unit and the rest in another one (or in several others). In such case both, basic and cumulative icons, are displayed on the map.

The above rules are the same at all levels of map detail. As at the first level, cumulative icons are also present at the next levels. This situation take place when:

– monument locations are related to districts (2nd map level) and several references occur in one district;

– monument locations are related to municipalities (level 3 and 4 maps) and several references occur in one municipality.

All icons on the map are active. After moving mouse cursor on each cumulative icon, it opens and shows all basic icons, which are cumulated here. Figure 6 presents spatial references of the monument in such situation.
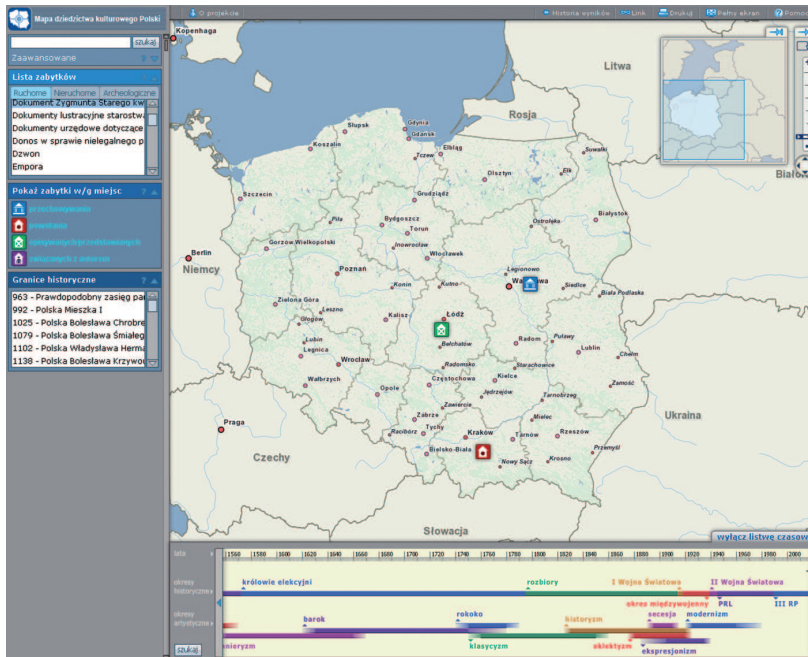
Fig. 5. Basic icons

After moving mouse cursor on a basic or cumulative icon, on the right side the reference unit name is displayed. It can be administrative unit name at 1-4 map levels or the locality name at 5-6 map levels. In the same time, on the left side of icon the number is displayed. Pay attention that this number has a different meaning than in case of monument collections presentation. In that case the number of monuments was symbolized by the icon. By contrast, in the one monument presentation the amount of spatial references is represented by the displayed number.

At any time we can switch off some kind of reference and leave only those which are currently interested in. It can be done with the use of the left-side legend.
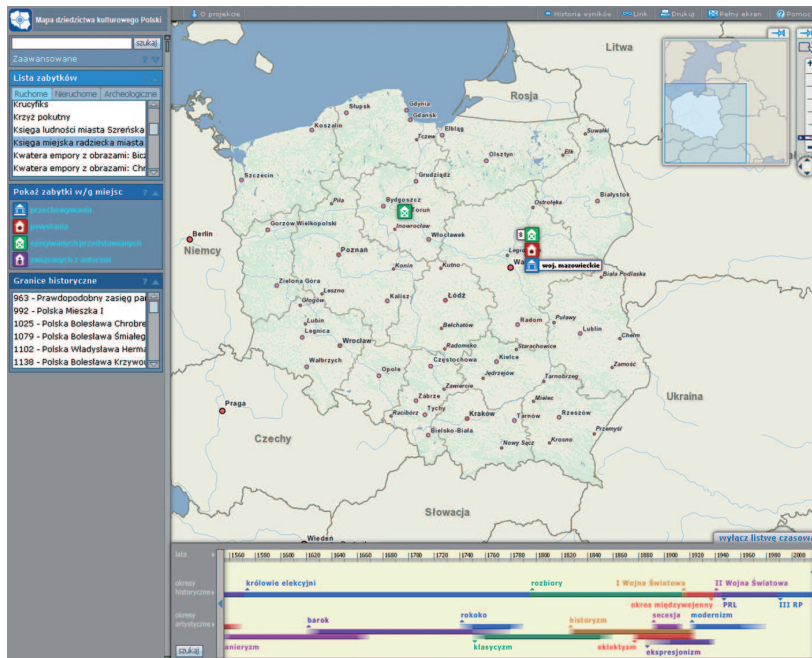
Fig. 6. Open cumulative icon

5. Conclusions

The paper describes the proposition of presentation movable heritage on a map. Undertaken research and tests show possibilities and limitations in cartographic presentation of cultural movable heritage.

First of all, it was in particular demonstrated that traditional cartographic presentation is not sufficient for the presentation of resources changing their spatial references in time. Commonly used methods of data visualization are based on one, permanent localization of the object while each of our research object can have several different locations. Bigger number of references increases the number of information presented on the map. Therefore the way of cartographic presentation should have possibility to visualized them clearly. In this case, information capacity of map based on traditional methods of presentation is not enough. The results of the project show that multimedia methods of communication can fill the above gap. With the use of dynamic and interactive elements, the range of information receiving from the maps can be extended. Moreover, the interactive elements may serve additional functions for quick change thematic maps content, and thus facilitate the use of the entire application.

Moreover, cartographic presentation of the resources, the size of which is not specified, and which continues to grow, requires a custom approach. Traditional methods of cartographic presentation can be applied to the defined size of data. I our case, final number of resources is very large so proposed visualization must take it into account. For this reason, the method of data generalization depends on map scale. Data are

referred to the administrative units and then to the localities. This solution guarantees the readability of data at any level of detail of the map, regardless of data quantity.

Described solutions are the first step in the area of access to digital cultural movable collections with the use of spatial information. It overlooks the needs and expectations related to the use of geoinformation in popularizing, protect and manage cultural heritage resources, highlighting the role and importance of cartographic presentation methods in the correct transfer of information presented on the map.

It is worth to underline that project focuses on movable monuments cartographic presentation but its results can be applied to immovable and archeological monuments also. These objects could be treated as a special case of a movable monument – with all three spatial references relate to one place – and as such object can be added to the system. Thus, an important advantage of the proposed solutions is their versatility and ability to translate research results into concrete practical applications, covering the entire cultural heritage resources and provide access to them from one common platform – map.

Acknowledgments

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Koncepcja kartograficznej prezentacji ruchomego dziedzictwa kulturowego na interaktywnej mapie

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Streszczenie

Artykuł przedstawia propozycję kartograficznej prezentacji informacji o ruchomym dziedzictwie kulturowym na interaktywnej mapie. Zaprezentowano autorskie spojrzenie na powiązanie zabytków ruchomych z przestrzenią geograficzną oraz wynikające z niego różne typy odniesień przestrzennych. W tekście przedstawiono sposób prezentacji zarówno pojedynczego zabytku ruchomego, jak i kolekcji obiektów historycznych. Proponowane rozwiązania bazowały na założeniu, iż liczba zasobów dziedzictwa jest ogromna, więc zasób prezentowany na mapie może się stale powiększać, zatem rozwiązania muszą być możliwe do zastosowania dla zasobu o nieokreślonej wielkości. Do prezentacji ruchomego dziedzictwa wykorzystano tradycyjne metody prezentacji kartograficznej, poszerzone o możliwości technologii interaktywnych.