Chateaux and Castles on Old Maps and Photographs in the Czech Republic

Ing. Jiri Krejci*, Ing. Arnost Muller*, Assoc. Prof. Ing. Jiri Cajthaml, Ph.D.*

* Czech Technical University in Prague, Faculty of Civil Engineering, Department of Geomatics, Czech Republic

Abstract. Chateaux and castles are an important part of cultural heritage in the Czech Republic. The aim of this project is to put together all available old maps and plans from the last two centuries as well as historical photographs of 60 selected objects. The emphasis is to point out not only close but also the wider surroundings of the main object (chateaux), including parks, gardens, and churches, as well as administrative, manufacturing and agricultural buildings. Research of surroundings helps by describing the economic and cultural background of the entire manor. Collection and processing of old maps is performed during the first phase of the project. The second phase of this project deals with the processing of vast amounts of selected old maps and documents in a uniform manner in order to secure data consistency. All documents found during the first phase are carefully selected, old maps and plans are digitized and georeferenced. Some objects included such as buildings, land use and roads are then vectorized and stored within a geodatabase as vector layers. The third phase of this project leads to a public web mapping application with spatial bookmarks or filters of all studied objects enabling quick access to specific chateau to castle. The application allows overlaying of various raster as well as vector layers from different times and also includes old photographs comparing them with up to date photographs. In addition, this paper introduces the possibilities of 3D procedural modelling and presentation of 3D scenes on the internet.

Keywords: chateaux and castles, cultural heritage, old maps, photographs, web mapping, 3D procedural modelling

1. Introduction

Chateaux and castles are an important part of cultural heritage in the Czech Republic. Chateaux, manors and their surrounding landscapes have gone

through important changes incurred by social, industrial and proprietary changes over the last two centuries. There are many historical sources such as maps, plans, photos, scenic views and text documenting the state of art from chateaux, castles and manors in the past.

The aim of this project is to put together all available old maps and plans as well as historical photographs of selected objects within one web mapping application. The emphasis is to point out not only close, but also the wider surroundings of the main object (chateaux), including parks, gardens, and churches, as well as administrative, manufacturing and agricultural buildings. Research of surroundings helps by illustrating the economic and cultural background of the entire manor.

The most commonly used source of spatial location and relationships of castles, chateaux and their surroundings are old maps and plans. Collection of these historical materials is being performed during the first phase of the project. The next phase deals with the processing of collected data, i.e. georeferencing and vectorization. The last phase leads to a public web mapping application.

This project, supported by the Ministry of Culture of the Czech Republic, focuses on 60 selected chateaux and castles, all within property owned by the government of the Czech Republic and under the administration of the National Heritage Institute. Due to the large scope and the current state of this project, which is still being solved, this paper presents preview of the up to date results of the selected chateaux.

2. Data sources

Extensive research of various public archives is currently still being carried out, due to the large number of objects. This includes the databases and archives of the National Heritage Institute, State Regional Archives, State District Archives, municipal archives, and Central Archive of Surveying and Cadastre. Some resources such as old photographs are found in private or previous owners' (aristocrats) collections. Important information is also provided by castle wardens. Lists of historical property belonging to individual chateaux are used for manor territory definition by historians, which is described both spatially (as a separate polygon or point layer) as well as textually. Field research includes taking up to date photographs, which are then be compared to the old photographs (example in figure 1).

Old building plans, floor plans along with plans of structural-historical surveys, are essential to show the development and use of castle buildings and interiors. Subjects of interest are not only castle buildings, but also service

yards (farmsteads), mills, sawmills, iron-mills, gamekeeper's houses, churches, chapels. Basically, this includes all the important objects in either close or wider surrounding, thus integrating economic and cultural
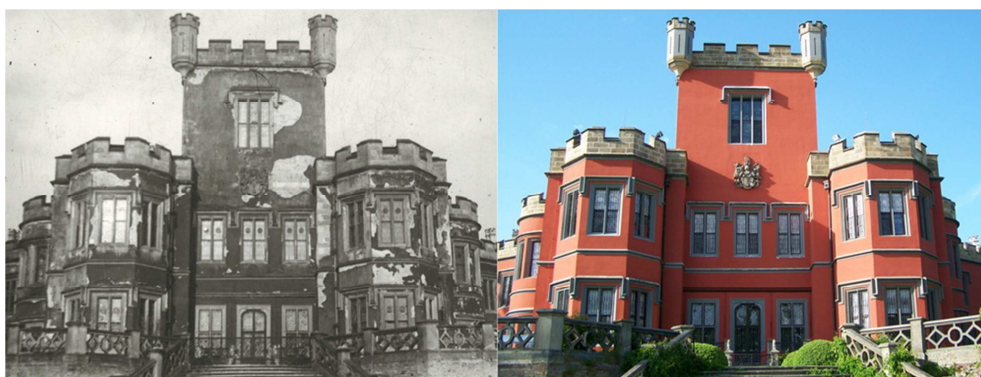
background of the whole domain.

Figure 1. Chateau Hradek u Nechanic on old and present photograph

The most valuable and commonly used old maps across all objects are the Imperial Imprints of the Stable Cadastre (scale 1 : 2 880) from the years 1826–1843. Due to their geometric precision and visual attractiveness, these maps are suitable for vectorization, and form an excellent base layer for the web mapping application and 3D visualization.

The State Derived Map (scale 1 : 5 000) – from the early 1950s shows situation of area about hundred years later (1950s). Cadastral maps and the State Derived Map (both illustrated in figure 3) provide a continuous base map for every object.

Figure 2. Detail of the map of the Hradek domain from 1903

Broader spatial information and historical context provide maps of domains (illustrated in figure 2), castle surroundings, parks, gardens and forestry maps. These maps and maps of Military Mapping Surveys covering the whole Czech territory serve as a base layer for wider economic and cultural background of domains.

As up to date layers data from the Czech Office for Surveying, Mapping and Cadastre are used. These are vector plots of cadastral map from the Registry of Territorial Identification, Addresses and Real Estate (RUIAN), Digital Terrain Model of the Czech Republic 5th generation (DMR 5G) and Orthophoto.

Figure 3. Examples of the Imperial Imprints of the Stable Cadastre from 1839, Cadastral Map from 1891, the State Derived Map from 1952 and present Orthophoto of the Chateau Slatinany.

3. Data processing

The second phase of the project deals with the processing of vast amounts of selected old maps and documents. All documents found during the first phase are carefully selected, old maps and plans are digitized and georeferenced into the national coordinate system. Historical photographs are geolocated. Selected map features (such as buildings and roads) or areas (castle surroundings and plot land use) are vectorized.

3.1. Georeferencing

The core of georeferencing process is the selection of control points and geometric transformation (Cajthaml & Havlicek 2014). There are many types of transformation, either global (with unique transformation key) or local (usually based on interpolation methods). Depending on the type of map either global or local transformations are used.

For early maps with unknown reference coordinate system set of ground control points is essential to transform the data. For newer maps with defined map sheets layout, corner points of the map frame can be used for transformation as well.

For multiple map sheets a special method of georeferencing has been developed, which results in one seamless map (Cajthaml 2013). All data is stored in a uniform manner in a geodatabase in order to secure data consistency.

3.2. Vectorization

The focus of the project regards buildings situated nearby castles' or chateaux' main buildings or buildings and areas somehow connected with them. Important economic a cultural objects on maps of domains as well as objects recognized by archival survey are vectorized. This allows broader insight into the domain area and its economy. Old and present photographs are localized and stored as point layers including attributes of photograph description, owner, orientation angle, etc.

Vector models of maps of the Stable Cadastre, other old cadastral maps, State Derived Maps and present cadastral map bring information about situation from the middle of the 19th century until now. Therefore, close surroundings of castles on selected maps are vectorized completely allowing a comparison of land-use in different periods of time and castle area development. Changes of land-use during time can be studied together with the history of the main object. For this type of analysis it is essential to control objects' topology and attribute domains for data consistency.

4. Visualization

4.1. 2D visualization

Modern technologies enable interaction with maps in an online environment in the form of web mapping applications. Georeferenced old maps can be published using map servers (Pacina & Cajthaml 2015), (Havlicek et al. 2014). The application created in this project uses ArcGIS Server services and serves three main purposes.

First, it offers spatial bookmarks (filters) of all studied objects enabling quick access to specific chateau or castle. The left panel in figure 4 with chateaux thumbnails gallery is linked to the map in that the spatial extent of the map window limits the display of thumbnails. The user decides whether to use the map or the shortlist.
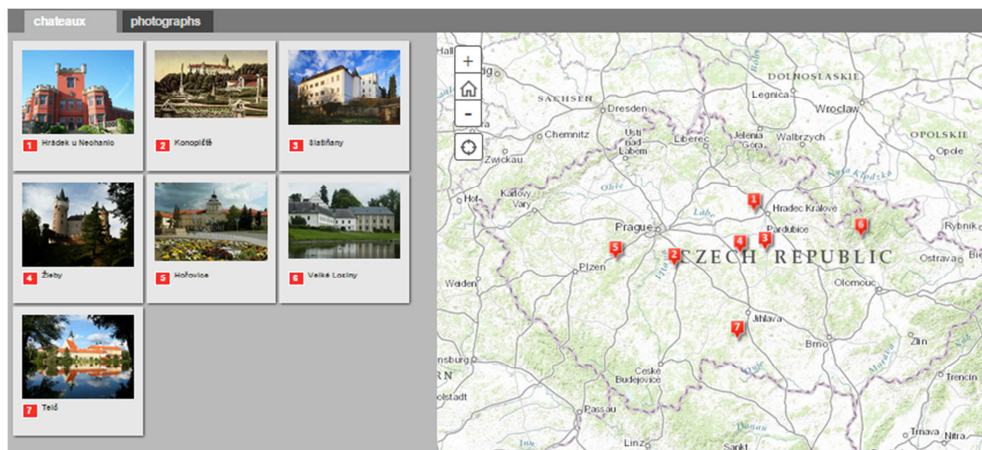

Figure 4. Web mapping application - shortlist of objects

Second, it presents and compares various layers (maps and plans). The application allows overlaying of various raster and vector layers from different times using the swipe tool. Objects of interest within the manor (e.g. gardens, churches, administrative, manufacturing and agricultural buildings) are represented by points, where each point leads to a popup (shown in figure 5) with more information or photograph of the object.

Third, it serves as a photograph gallery, which is linked to the map in the same way as castle thumbnails. There are historical photographs compared to current photographs. Each photograph is represented by a special cartographic point symbol (sector of a circle), which next to the location also shows the point of view of the camera. Appropriate pairs (historical and present photograph) are stored in the same location (depiction in figure 6).

The application will be complemented by text information about chateaux, their surroundings, gardens, economic background of domains and their former owners, aristocratic families. The application has been created using the ESRI platform using ArcGIS Server and ArcGIS online.
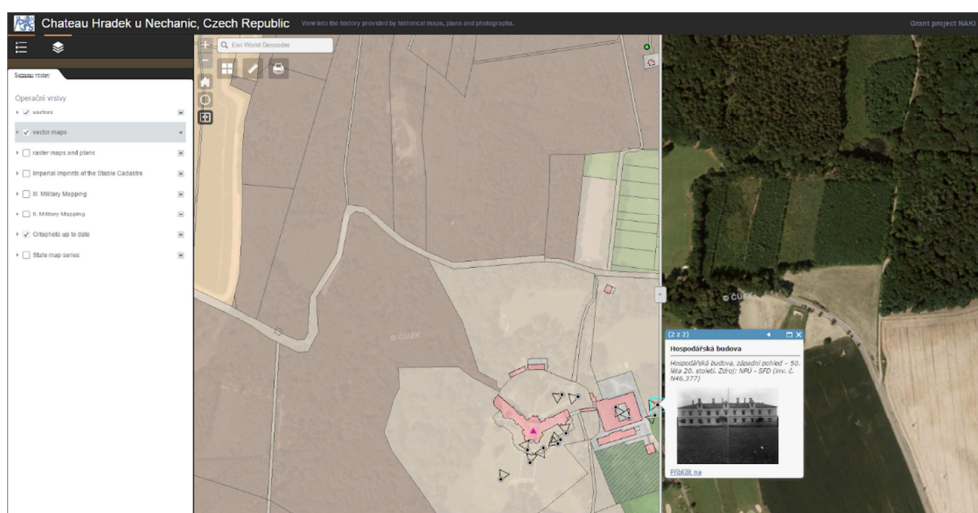

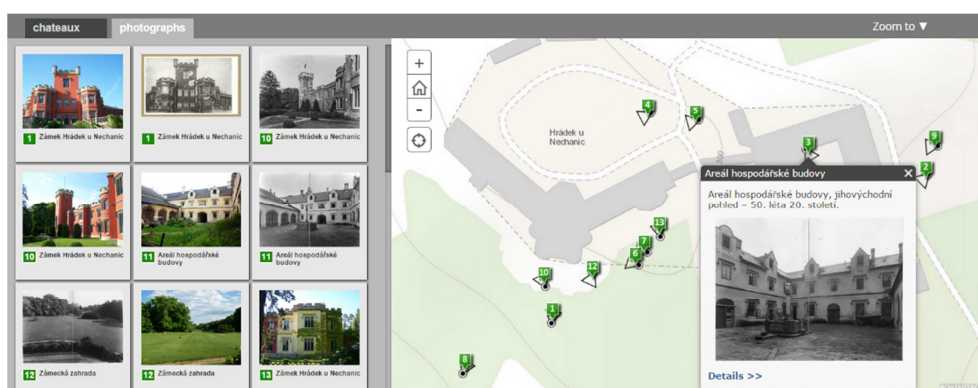**Figure 5.** Web mapping application - layer list and swipe tool

Figure 6. Web mapping application - geolocated photographs

4.2. 3D visualization

The data which was processed in order to establish the two-dimensional web mapping application can be also used for the creation of three-dimensional scenes. Georeferenced old maps, together with a digital terrain model can serve as a basis for 3D models of buildings. Other important data sources for 3D modelling are historical technical documentation of a castle or a chateau and the feature classes which were prepared during the vector-ization process.

Basically, there are two ways to model a castle (chateau) and its surroundings in 3D: classical modelling in CAD and procedural modelling in suitable software. Because, in most cases, there is available documentation of a castle or a chateau in a particular time period, e.g. in the form of floor plans, and they are able to be modelled accurately and in greater detail using standard CAD software (Jedlicka et al. 2013).

On the other hand, it is not possible to model all buildings in the surroundings this way. It would be highly time consuming and, of course, there is no existing historical documentation of all objects inside the manor. Many buildings do not exist anymore or they were significantly rebuilt or renovated. Some information can be acquired on the basis of old photographs, but mostly the only data source available is the old map.

Therefore, surrounding buildings can be reproduced based on vectorized old maps using procedural modelling approach. Polygon layers with footprints are used as a foundation for buildings. Missing information (e. g. the height of buildings) can be chosen randomly or better considering the look of buildings in a given time. ESRI City Engine is used for procedural modelling. One example of the procedural modelling result is displayed in figure 7.

Figure 7. 3D web mapping application - example of one scene of the chateau Mnichovo Hradiste

5. Conclusion

This article introduces a project focused on web presentation of chateaux and manors in the Czech Republic. Various sources of maps, plans and photographs are included and the most important map layers are described. Old maps and plans are georeferenced and close chateau surroundings on selected maps are vectorized allowing land-use comparison. Objects of economic and cultural background of domains are vectorized and later displayed as points of interest in the web mapping application. The application provides quick access to a specific chateau or castle using spatial bookmarks and shortlists as filters. It shows georeferenced old maps and various plans, vectorized objects and areas, as well as historical and up to date photographs. The application allows users to compare various layers and photos from different periods of time.

Besides the classic way of presenting 2D data via web mapping application, this article briefly introduces the possibilities of 3D procedural modeling and presentation of 3D scenes on the internet.

The 2D web mapping application can be accessed at http://gis.fsv.cvut.cz/castles. In the future, the application will be complemented by text information about chateaux, their surroundings, gardens, economic background of domains and their former owners, aristocratic families.

Procedural modelling of chateau surroundings is currently being tested. Furthermore, selected scenes will be completed by the precise model of chateau. The first 3D scene visualization in the case of the chateau in Mnichovo Hradiste can be seen at http://gis.fsv.cvut.cz/castles/3D.

Finally, the 2D web mapping application will be transformed into a mobile application allowing the public to explore old maps and related documents directly in the field (during their castle visit) taking advantage of the built-in GPS unit in their mobile device to estimate their location.

References

Cajthaml J (2013) Polynomial georeferencing method for old map series. In 13th International Multidisciplinary Scientific Geoconference SGEM 2013, Informatics, Geoinformatics and Remote Sensing, Conference Proceedings volume I. Sofia: STEF92 Technology Ltd., 2013, p. 859-865.

Cajthaml J, Havlicek J (2014) Some important aspects influencing results of georeferencing. In 9th ICA Workshop Digital Approaches to Cartographic Heritage. Budapest: ICA Commission on Digital Technologies in Cartographic Heritage, 2014, p. 89-94.

Havlicek J, Muller A, Janata T (2014) Publishing Old Maps as Dynamic Map Services. In International Cartographic Conference Proceedings. Dresden: International Cartographic Association, 2013, p. 861-862.

Jedlicka K, Cerba O, Hajek P (2013) Creation of Information-Rich 3D Model in Geographic Information System - Case Study at the Castle Kozel. In: 13th SGEM Geoconference on Informatics, Geoinformatics and Remote Sensing, 2013.

Pacina, J, Cajthaml J (2015) Historical Data Processing, Modelling, Reconstruction, Analysis and Visualization of Historical Landscape in the Region of North-West Bohemia. In book: Modern Trends in Cartography, Edition: Selected Papers of CARTOCON 2014, Chapter: 477, Publisher: Springer International Publishing, pp.477-488.