USAGE OF OLD MAPS AND THEIR DISTRIBUTION WITHIN THE FRAME OF WEB MAP SERVICES

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1. Abstract

Old maps are powerful tool in providing valuable information about the landscape. Traditionally, hard copies of old maps are stored in archives. The Internet, particularly Internet application and servers, have changed the way cartography works. Old maps can now be viewed on the Internet, can be compared with other maps or be distributed to other web map servers. Particularly the wide distribution of old maps on the Internet is the step into the future, when maps will be easily accessed and widely used. Typical users of old maps are environmentalists, historians and general public.

The Czech Republic disposes of old maps from the era of Austria-Hungarian Empire. New web applications are being developed at the CTU in Prague, purely for use of maps from this period. Currently, a common web browser allows viewing maps from the 2nd Military Mapping, performing search for specific village or comparing this map with other data. The data is also distributed within the frame of web map services in national coordinate system S-JTSK in order that everyone in the Czech Republic can join this data into his own GIS application. Using this model, the data can be used in the Internet even in common desktop GIS connected to the Internet.

2. Old maps digitizing

As we mentioned earlier, old maps are an interesting and valuable source of information. Until recently, old maps were treated only as historical documents and therefore archived. Thus it was necessary to go to the archive if one wanted to obtain information from the old map. Nowadays, this process has been made easier by digitizing of all kinds of historical documents, including maps. There is no need to work with the original data now but the

digitized copy is being used. Scanning is the main method used for digitizing of old maps. Other methods, like using digitizer on original maps, are very rare.

Before scanning the old map, we have to decide which parameters are suitable for our purposes. There are three main parameters of scanning: type of scanner, scanning density and colour depth. Careful scanning of old maps or plans is an art that must be done with a skill and with respect for the medium being handled. Therefore large format scanners are usually used. The map is laid down on the scanner table and the camera is moving above the map and scans the data. Other types of scanners, where the map is moving through the scanner, are not recommended as it can cause damage of the map. Nevertheless these types of scanners are much cheaper and are used for maps, where damage is not expected. It’s very difficult to use a scanner with smaller format of scanning area than the actual map format. After the scan, the data need to be put together, which is not simple and result is often not ideal.

Scanning density, usually expressed in dpi (dots per inch), determines the size of the smallest picture element (pixel). During our research on old maps processing (including scanning) we found that the best values for commonly used old maps is 300-500 dpi. Using lower density leads to loss of information. On the other hand, higher density leads to larger amount of data and higher requirements for hardware equipment. Every map has its typical characteristics and it is generally very difficult to determine the right value of scanning density.

The colour depth determines how many values can any pixel of the image hold. The most often used values of colour depth are 2-bit data (b/w), 8-bit data (256 colour greyscale or 256 colour palettes) or "true colour", which contains 8-bit data for every colour channel (RGB). True colour consists of 16.7 million colours. We decided to use true colour scanning. Old maps are usually in colour and using some colour palette could worsen the information on the map.

We reached conclusion that the best solution for old maps scanning is a large format table scanners, density between 300 dpi and 500 dpi and true colour depth. The scanned data should be stored in the raw format, not compressed. Ideal is to store the data on some

medium (DVD) in open format like TIFF without compression. For later work, data can be compressed; density or colour depth can be lowered.

3. Old maps Internet distribution

After the data are digitized, results can be distributed through media like DVD or through the Internet. We have to keep in mind, that usual map (50 x 50 cm) scanned with 300 dpi and true colour presents 100 MB of data. This amount of data is still not suitable for normal Internet transfer.

There are two reasons why to distribute old maps. As mentioned above old maps are valuable source of information. Information from the map can be analyzed, compared with other sources and could be a very important part of environmental research. Secondly old maps are part of cultural heritage of any country. They are usually viewed as valuable artistic performances.

Old maps can be divided into two main groups. These groups are based on a proper method of their Internet map distribution. The first group contains maps, which are not suitable for distribution within some contemporary coordinate system. These maps, usually older ones (sometimes called "early maps") are not very precise. There is no possibility to use global transformation such similarity, affine or projective into some coordinate system, because of big residuals on control points. The better solution is to use some piecewise transformation (TPS, rubber-sheeting), which can rectify the image. If the image is badly distorted the map is not suitable for distribution in some system. From our point of view, it is better to keep the data in their system without transformation. As we don't know the cartometric basis of these maps, they are primarily used only as images. Possible technologies for these maps are described in the next paragraph.

3.1 Distribution of non precise maps

Every image (not only map) can be distributed through the Internet in many ways. Web pages, which are focused on historical maps, usually use the simplest method - pure XHTML. However, XHTML is not suitable for large image data publishing. Therefore, many pages use only map data in very bad resolution. There are other methods based on

XHTML such as "clickable maps", which improve the pure XHTML. Other methods are based on a server application, which can serve the data in high resolution in real time. We explored the field of these applications and chose Zoomify software. It is a Flash application, which works very fast with high resolution data after the initial preparation. The work with Zoomify is very intuitive.

As we chose this method we started to work on web portal focused on the Czech old maps. The work was completed by our student Filip Antos and the result can be viewed at http://mapserver.fsv.cvut.cz/antos. The most known maps were scanned (usually reprints) and prepared for Zoomify distribution. Other information about maps were collected and written into XML files. Final web application displays these data using CSS. Screenshot from our application can be viewed on Figure 1.

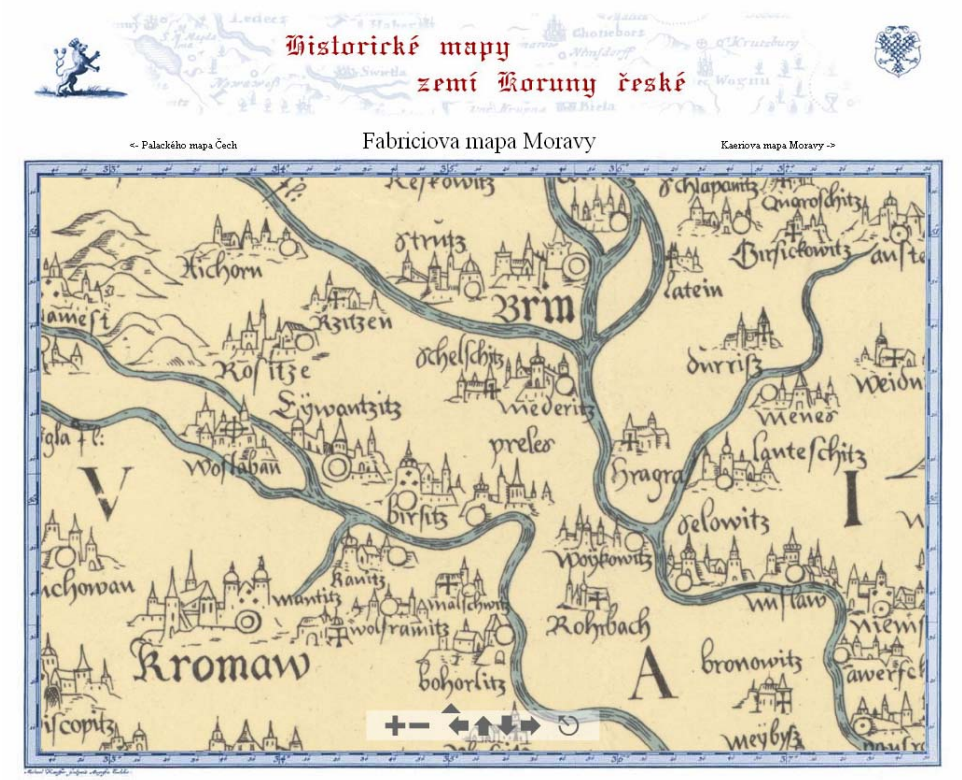

Fig. 1 - Depiction of Czech old maps web portal

3.2 Distribution of precise old maps

The second group contains data that are precise enough for geometric transformation without bad distortion. It can transform the maps using piecewise transformation or some more precise maps, where global transformation can be used. This data should be

transformed and stored with relative spatial information. Process of data transformation is called georeferencing. Georeferenced data usually contains the “real” data in some raster file format (TIFF, JPEG, PNG) and information about their spatial position. This information can be written right into the header of graphic file (for example GeoTIFF) or can be written into external text file (for example “world file”). Based on our experience, the best way is to store the data in TIFF format with relative world file TFW. Sometimes it can be efficient to use JPEG compression with JGW world file. The structure of world file is very simple and defines basic six parameters of affine transformation between raster data and coordinate system. What more, the world file is widely used and almost every software “understands” it.

If we have georeferenced data, we can re-project them into the demanded coordinate system and distribute it as other maps (only as image). If we want to save the spatial information for latter use, we need to use some server application which can work with the georeferenced data. Such application is usually called map server. These types of server programs can take the data from storage (server, hard disk) and can generate appropriate part of the data in some coordinate system and sent it to the client.

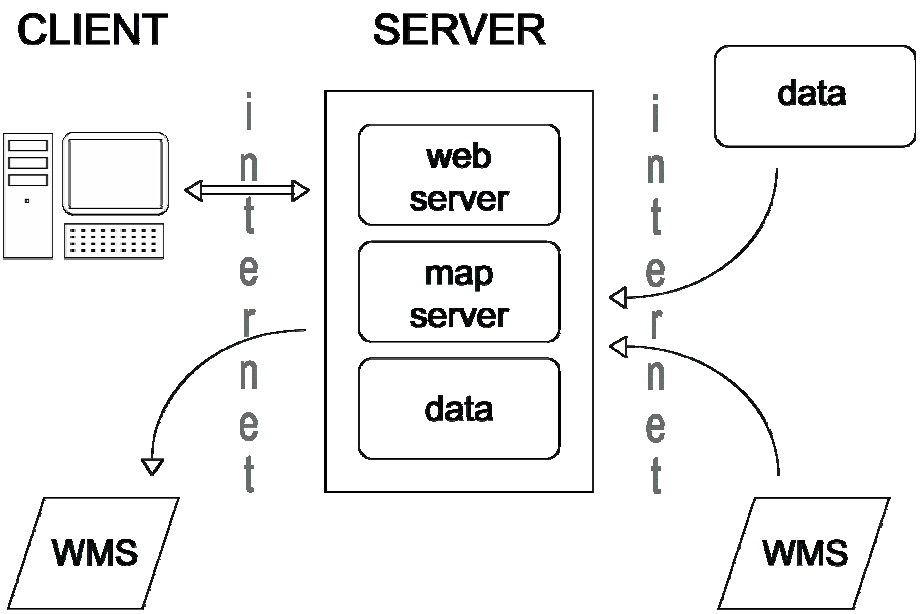

Fig. 2 - Structure of client – server architecture

The structure of the whole system is presented on Figure 2. Clients are usually computers with only Internet browser. On the server there is a need for two applications: web server and map server. Web server receives the request from the server and recognizes values of send variables. Then these parameters are passed to the map server. It collects the data from data storage (local disk or data server), re-projects the data and generates the final image, which is sent as a part of XHTML page. This is the basic principle of web map service (WMS service). These data can be very easily connected to other GIS software (desktop or Internet). The standard of WMS is very precisely described by OGC on http://www.opengis.org.

4. Our projects based on WMS and UMN MapServer

When we decided to use old maps within the frame of web map services, we were standing before some questions. Which data can be used? Which software should be used? After our research on map server software, we decided for UMN MapServer. It is free application, which is very suitable for our purposes. As the first data, rasters of 2nd military mapping of Austria-Hungary was chosen. These data were scanned in Vienna for Ministry of Environment of the Czech Republic. One of the original data can be seen on Figure 3. All map sheets can be viewed in Zoomify application on http://oldmaps.geolab.cz.

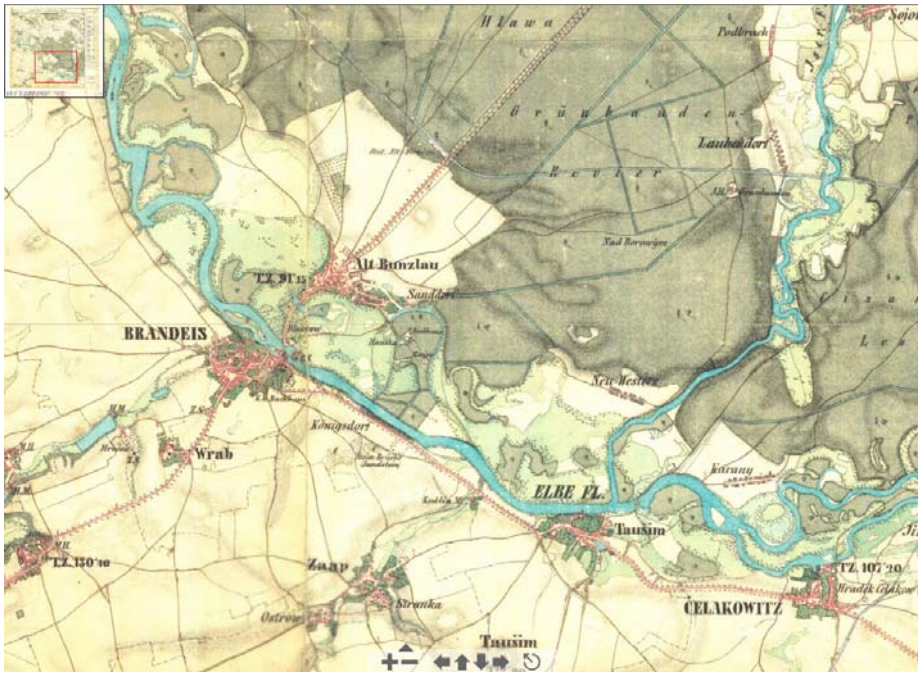

Fig. 3 - Depiction of Zoomify application of 2nd military mapping of Austria-Hungary

Now the data are available through WMS for public use. Everyone can join these data into their application (either desktop like ArcGIS or another map server). It is very easy to use and people who are interested in maps can view this data without the need of downloading the original. As the data are distributed in national coordinate system S-JTSK almost everyone can re-project the data into another system. If data are distributed through WMS, the time of carrying out the request is important. We used two methods of increasing the speed of the application. Building pyramids on raster data increases the speed of the data transfer because of pre-created data in lower resolution layers. Then only needed data are transferred instead of high resolution data. The second method is to index the raster data using vector index layer. The raster data are cut into smaller files indexed by this layer. The response of server in high resolution of data is much better.

What is interesting on web map services is the fact that the data can be joined into any application, which keeps the standard. WMS is very popular now and so data are very easily usable. One of the most popular applications in the world of Internet maps is Google Earth. It certainly keeps the standard of WMS and any published WMS map can be added as a layer to it. Google Earth also enables 3D view of the data. Old maps can be very easily visualized in 3D using Google Earth (see Figure 4).

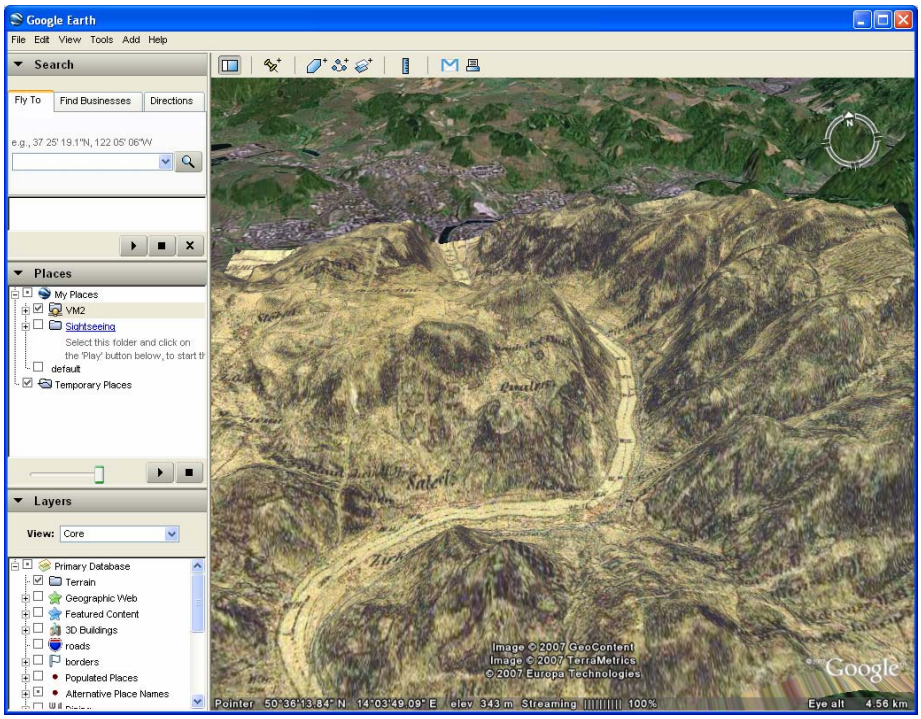

Fig. 4 - Depiction of old map visualized in 3D by Google Earth

For people not using WMS applications, we also created web client for old maps viewing. The client is based on JavaScript libraries and enables dynamic pan and zoom, other WMS layers connection and what more the possibility of finding any village in the Czech Republic. People interested in maps can explore their favourite village and see how it looked almost two hundred years ago. Screenshot from the client is on Figure 5.

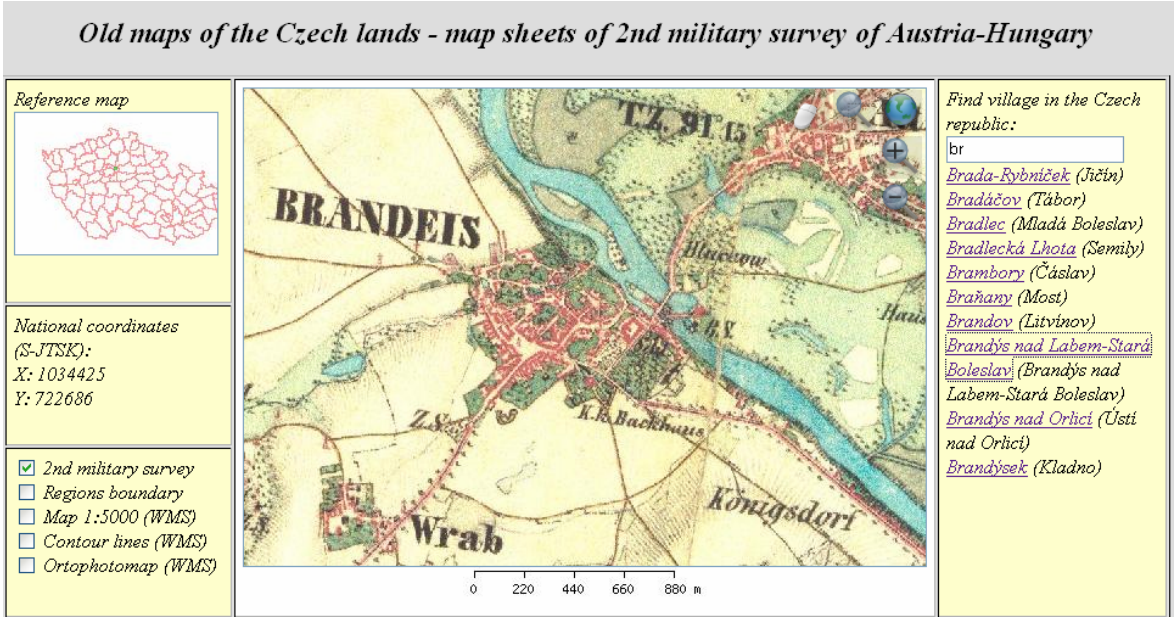

Fig. 5 – Depiction of mapserver application

5. Conclusion

The results of our research are very interesting. Old maps can be easily distributed to the users within the frame of WMS. This method has many advantages. Data must not be transferred in original form, but only in needed resolution and size. Data can be stored and maintained in one original copy at one place. The interface for data joining is well documented and free, using XML. As we see in the Czech Republic WMS is very popular and its application for old maps is very interesting.

6. References

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