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Digital reconstruction of Perczel's globe

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Summary:

The 132 cm diameter manuscript globe of Perczel from 1862 is among the largest ones of Central Europe. This sphere suffered severe damage during the storms of the history of the 20th century. A restoration was carried out in the 1970's but due to the improper solutions it caused further information loss. The steps of the reconstruction project are the following: creating a digital facsimile of this globe in order to archive its present state; finding the possible source materials that were used for compiling the globe; reconstructing the globe in digital form based on the digital facsimile globe, the original source materials and contemporary descriptions of the globe; creating a renewed copy of the globe. The original and the reconstructed digital globe will also be placed in the Virtual Globes Museum (<http://vgm.elte.hu>).

This paper describes the methods of this project and the first results of the work.

Introduction

The authors' method of photograph-based globe digitizing was developed for the Virtual Globes Museum (VGM) (Gede and Márton, 2010). This method, however, can be used not only for visualizing old spheres on computer screen, but also for helping a digital reconstruction process on them.

The giant (132 cm diameter) manuscript globe of László Perczel is really an object worth taking care of. The sphere (Fig. 1), which was finished in 1862, became internationally recognized when it was exhibited and won a golden medal at the 3rd International Geographic Congress in Venice, 1881.

According to the contemporary descriptions (Fodor, 1954; Ambrus-Fallenbüchl, 1963), the globe was in badly damaged state in the 1950's and 60's, which was probably a side-effect of the two world wars.

In the late 70's, a restoration was carried out by Lajos Stegena. The damaged surfaces were covered by a new layer of paper on which only the geographic graticule is depicted (Fig. 2). The globe was given a new lacquer layer, which soon became dark yellowish, at the same time partly dissolving the red ink of the settlement names (Márton, 2008). Unfortunately, no photographs were taken of the damaged parts before the restoration process, so the original look of the globe can only be suspected, mainly based on the few descriptive publications from the 50's and 60's.

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Figure 1. Perczel's globe at the Map Room of the Hungarian National Széchényi Library.



Figure 2. The patches of restoration.

Digitizing the Globe

Photographing

The authors managed to take a photo series of the globe surface in 2008. Although it was thought to be a routine task after digitizing many smaller spheres for the VGM, the special circumstances made the work hard.

Due to its size and mass, it was impossible to move the sphere to a photo studio. Even the doors of its current exhibition room are too narrow to take it out. Furthermore, the meridian ring must have been not rotated in the calendar frame, because any other position of the globe axis apart from the fully vertical one would have been leading to deformation of the brass ring.

So the good old practice of rotating the globe all around in front of a fixed camera and lamps had to be forgotten.

However, Zoltán Nemes, our talented photographer managed to photograph every part of the globe. The solution sometimes involved even the use of a ladder (Fig. 3). Unfortunately, in this way it was impossible to ensure homogeneous lighting conditions for all the photos.



Figure 3. Photographing the globe.

Creating a Virtual Copy

The next step was the georeferencing of the photos. The technology was the same as for the other spheres in the VGM (Gede, 2009). A special program helped determine the projection parameters of the photos, and all the images were transformed into Plate-Carée and assembled into a large map (Fig. 4).



Figure 4. The Plate-Carée map of the globe.

Due to the size of this image (120 000*60 000 pixels), only reduced versions were used for the VRML and KML models of the globe. These models (Fig. 5-6) are useful for giving an overall impression of the current state of the globe, but their resolution does not allow examining all the small details. The brightness differences are results of the varying lighting conditions.

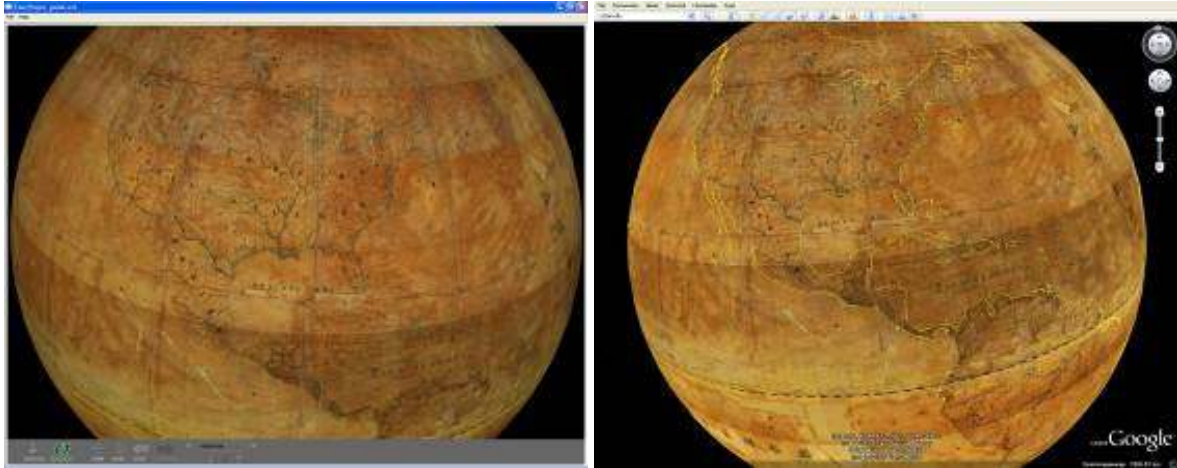


Figure 5-6. The VRML and KML models of the globe.

Analyzing the globe

Database of settlement names

In order to help the following reconstruction, a geo-database is being created of the settlement names of the globe. Until now, the areas of Europe, South America and Africa have been completed, as a part of the final essays of three Cartography students of the Department (Nyuli, Tóth, Való, 2008).

They imported the Plate-Carée map of the specified areas into MapInfo and created a new layer, marking all the settlement marks. The data fields connected to these points were the following: name (that can be read on the globe); suspected name (if the name is not fully legible); current name (if the place has a different name currently); doubt (a flag signing whether the name can be determined doubtlessly or needs further investigation).

The results are distressing: only the 30 percent of the names can be determined doubtlessly.

Areas to be Replaced

The map in Figure 7 shows the areas of the globe that are subject of replacement. These are the territories mentioned above where the restorer placed a new paper layer with the graticule lines only. The largest patches are the ones in the Indian Ocean, at the coast of Western Africa and all along the Equator. These polygons will later serve as masks for cropping the source maps.

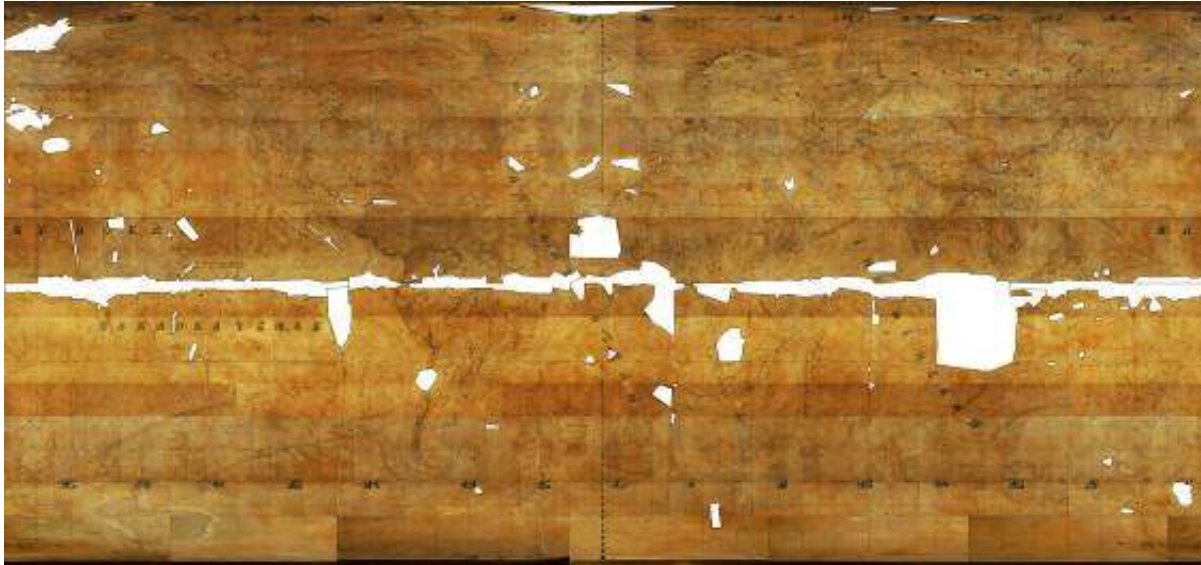


Figure 7. Areas to be patched.

Reconstruction

Looking for Possible Sources

The missing areas will have to be redrawn during the reconstruction work. The geometrical base of this work has to be formed by maps which could have been sources for the original globe. The main criteria for a possible source map are its date (it must have preceded the globe) and its geometry (e.g. matching coastlines). This latter is a very good age indicator in the 18-19th century: the knowledge about the planet's geography changed very rapidly in this time. Another point is the origin of the map: the author probably used sources that came from the countries of the Austrian Empire, Germany or other lands nearby.

This is the current state of the research (in January, 2010). Luckily, many old maps can be viewed nowadays on the Internet, which facilitate the work, but it is still hard to find materials that satisfy all the mentioned criteria.

Patching the Globe

To “patch” a damaged area on the sphere, the source map has to be georeferenced and transformed into Plate-Carée. By adding the transformed image to the globe map as an overlay, their content can be compared thoroughly. If the source is adequate, it has to be cropped using the previously drawn polygons, and merged into the globe's Plate-Carée map (Fig. 8).



Figure 8. A damaged part of the original globe (left); possible source material (middle); the patched map (right)

Creating Gore Maps

When all the missing areas are patched, the gore maps have to be created. It can be done by a simple projection transformation: ten-degree wide segments of the Plate-Carée map are reprojected into Cassini's projection (Fig. 9). In the case of smaller globes these segments could be wider (20-30 degrees), but wider gores for such a large sphere would cause many crinkles during the mounting.



Figure 9. A Platte-Carée segment (above) transformed into Cassini's projection (below).

These gore images afterwards serve as the geometrical base of the reconstruction. All the elements have to be redrawn, using a legend which is based upon the contemporary descriptions. A smaller area of the globe (a 60° by 40° quadrangle) had already been redrawn in this manner by Edit Czombos, but without the geographic names (Czombos, 2009). An old cartographer artist, József Sziládi kindly added manual hill shading to this gore, which is similar to the original. Figure 10 shows a sample area before reconstruction, without and with hill shading.

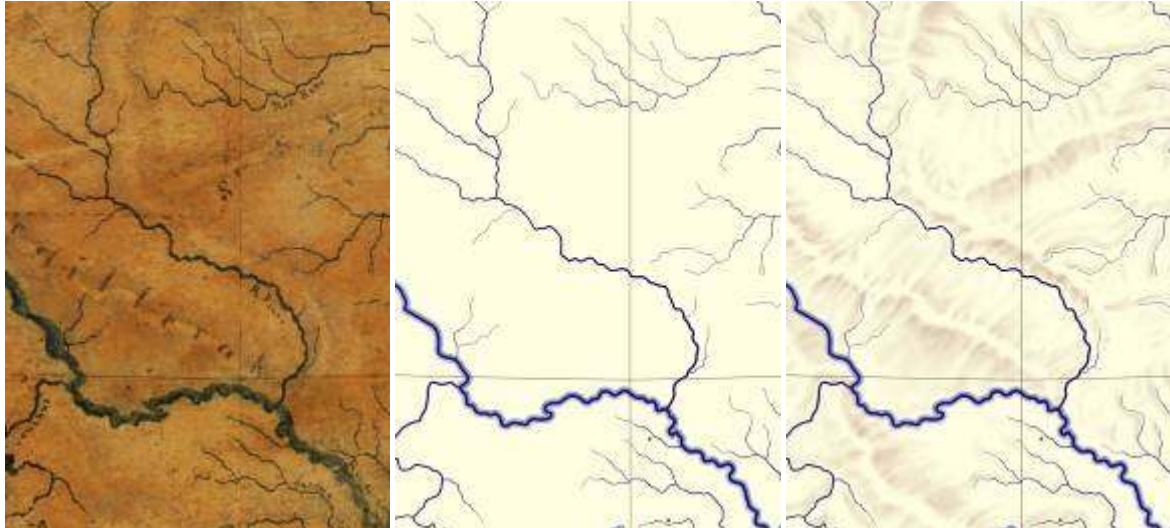


Figure 10. Original content; reconstruction without and with hill shading.

Names

Probably, the hardest issue is the question of names. Most of the missing place names can be determined using the prepared name database together with other sources and even Google Earth, but to find the original spelling we will need the help of some geographically specialized linguists. Another point is the handwriting. As the reconstruction is being made on the computer screen, the names will be typed instead of handwriting. To keep the original look of the globe, fonts similar to the original writing have to be found or created.

The Virtually and the Really Reconstructed Globe

When the whole surface of the globe will be redrawn, the reconstructed gores have to be transformed again into Plate-Carée and after creating a virtual globe from the map, the whole work can be examined as a sphere on the computer screen. (Figure 11 shows the work of Edit Czombos merged into the original globe content.) If the results are convincing, the real copy of the globe can be created. It will surely be a hard task, involving several experts of different professions as the sphere and its calendar frame also have to be reconstructed.

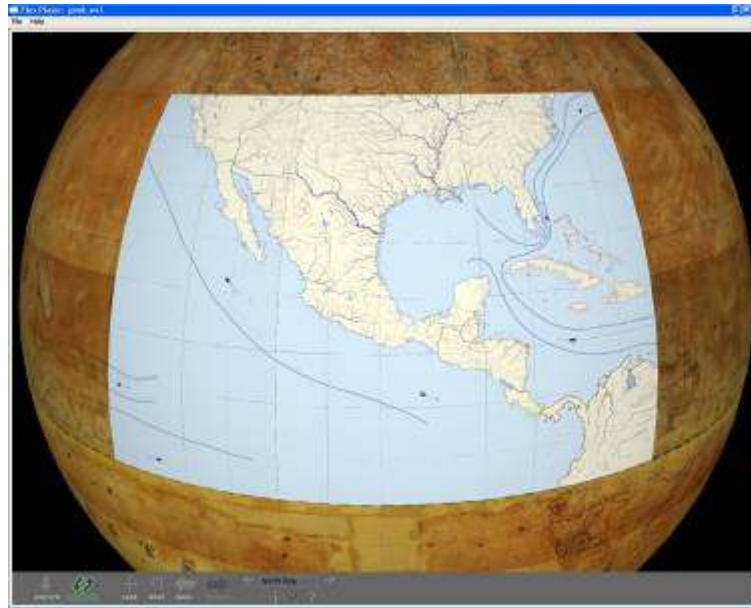


Figure 11. The reconstructed area merged into the original content and visualized as a VRML globe.

The authors' hope is that the work can be completed by 2012, thus the 150th anniversary of the original globe can be celebrated by introducing its digitally reconstructed copy.

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