

Map-Mashups in the Study of Cultural Heritage

Emmanuel Stefanakis
Department of Geodesy and Geomatics Engineering
University of New Brunswick
Fredericton, NB, Canada
estef@unb.ca

1 Introduction

Maps are a popular and effective tool in archaeology and history. Through map visualizations researchers, educators and students can explore and understand settlement and migration patterns, the importance of physical boundaries and geomorphology, the diffusion of goods and ideas, and much more. Recently, the technological evolutions in online mapping and geospatial web offer the possibility to build interactive map visualizations with little effort and investment. A wide bunch of efficient and easy-to-use software tools are available to developers. Many of them are also free-to-use (or even open source) and offer a functionality that is competitive to the one offered by commercial systems. In addition, data availability has also exploded. Base map and image layers for the whole planet in high resolution is easily accessible and in most cases free-to-use. Additional data can be combined with these layers and generate the so called, *map-mashups*.

The last few of years, the author has conducted a series of projects to investigate the usability and to recognize best practices of applying map-mashups in studying the cultural heritage. For this reason, he has collaborated closely with educators, historians and archaeologists. Several prototype applications referring to events from mythology to classical ages and recent history have been developed and evaluated. Various tools and APIs have been adopted for this reason, such as, Google Maps API, OpenLayers API, MapServer, and GeoNetwork Opensource. Freely accessible base layers (such as Google/Bing/OSM and MODIS layers) have been enriched with valuable archaeological and historical data to generate the content of the aforementioned map-mashups.

The scope of this paper is to briefly introduce these prototypes (Section 2) and then highlight the challenges and opportunities of the map-mashup framework in a better understanding of our cultural heritage (Section 3). The development of appropriate standards and best practices for both the content and the functionality of map-mashups applications as a tool for studying and understanding the past are anticipated to have a strong potential to both research and education in archaeology and history.

2 Map-mashup Prototypes

In the last few years, modern map-type resources have been used extensively in various disciplines. Aligned to this new trend, the use of map-mashups in cultural heritage has been examined through the following series of prototype applications, built mostly to assist educational programs in schools and museums.

A Journey to the Ancient Greek Myths: The first prototype (Figure 1a) is an educational framework for modeling, analyzing and visualizing the Ancient Greek Mythology. This prototype aspires to help elementary school students and other general users in getting a clear geo-spatial perception of the mythology events.

The Roman and Byzantine Empires: The second prototype (Figure 1b,c,d,e) is a map mashup application to assist the subject of history in Grade 5 of the Greek Elementary School. The scope of the mashup application was to enrich the map content of the textbook, highlight the geographical aspects of the Roman and Byzantine Empires, and show how the geographical space affects the people's life and history. The prototype has been evaluated extensively by school teachers and students.

The Antikythera Wreck: The third prototype (Figure 1f) is built for museum visitors and shows the alternative origins and courses of a ship, which sank around 150 BC. The ship was discovered by sponge divers on the Greek island of Antikythera in the early 1900s. The wreck produced numerous statues dating back to the 4th century BC, as well as the world's oldest known analogue computer, the Antikythera mechanism. The device is displayed in the National Archaeological Museum of Athens. The user may select, read and visualize the various opinions of the scientists in regards to the origin of the mechanism and the course of the ship.

The Battleship "G.Averof": The fourth prototype (Figure 1g,h) has been developed as part of a research project for the promotion and enrichment of the Battleship G.Averof's museum. The battleship "G. Averof" was a legendary warship of the Greek fleet with an active history in three wars (Balkans, World War I and II). It is the world's only surviving heavily armoured cruiser of the early 20th century. Appropriate map mashups show the "life" in the battleship during the war periods, its movement in space-time and detailed mapping of the naval engagements and other operations, and various virtual visits on the ship decks.

The History of New Brunswick as of Historical Map Collections: The fifth prototype is a collection of tools to extract knowledge hidden on historical maps. Graduate students are digging into the Provincial Archives, scanning historical maps and microfiches and try to recognize and record the socio-economic and geomorphological changes that took place over the last two centuries. Valuable resources are being generated for the following areas (Figure 1i,j,k,l): (a) the City of Fredericton; (b) the UNB Campus, (c) the Mactaquac area near Fredericton; (d) the Grand Lake Meadows; and (e) the Kouchibouguac National Park in the East coast of the Province. The ulterior scope is twofold: firstly to make this content easily accessible to the users by generating a geospatial catalog and appropriate map-mashups,

and secondly to semantically enrich this content by attaching to it appropriate metadata.

The Migration of Loyalists to New Brunswick: The last prototype is a collection of map-centred educational resources and programs to reveal the history of Loyalists in New Brunswick (Figure 1m,n). The map-mashup application is running on the web and offers an educational framework to the migration of Loyalists to New Brunswick and the history of the city of Fredericton, with special focus on the Loyalist settlement in the city and its surroundings.

3 Challenges and Opportunities

Since 2005, when Google Earth was released, researchers and professionals around the globe from almost all disciplines have been using online maps as never before and can now see a different view of the Earth, the country and the neighborhood they live in. They are using map visualizations to communicate, express their perception of the past, present, and future. The use of map-mashups in the study of cultural heritage is aligned to this new trend. End-users, including educators and students, have been exposed extensively to the applications listed in the previous Section. Based on their comments and evaluations, it is clear that map-mashups offer a strong potential in informing, educating or increasing people's awareness for past events as well as for the crucial role of the geographic space to make them happen.

Nevertheless, map-mashups is still an immature means of communication in terms of their educational value and effectiveness. Facing a similar situation with GIS technology, map-mashups are being built by *technical experts* with strong skills and understanding of geospatial web technology for *end-users* with substantial exposure and understanding of the application needs. Both groups are expected to work in close collaboration and narrow the existing gap and side-effects between developers and domain experts to the establishment of best practices, specifications, and certified methods for the use of map-mashups in the study of archaeology and history.

Towards this direction, at the University of New Brunswick, our research scope is currently twofold: (a) the recognition and standardization of both the content and functionality constructs of map-mashup applications for archaeology and history teaching; and (b) the development of a relevant authoring tool.

As regards to the former, a map mashup application consists of numerous units, which refer to its (i) content, or (ii) functionality. As for the content, the application consists of base maps (e.g., the satellite image or a historical plan of the area of interest), static add-ons (e.g., vector data like lakes, rivers, cities or administrative boundaries at specific points in time; or raster images like gravures and plans), dynamic add-ons (e.g., moving patterns and population flows), etc. As for the functionality, the application provides a set of basic mapping tools (e.g., zoom-in/out, pan, and switch on/off content data), more advanced navigation and searching tools (e.g., query the content based on criteria, find routes and accessibility patterns), etc. We aspire to build a formal description of all these units, understand their semantics and categorize them appropriately.

As regards to the later scope, an authoring tool for map-mashup applications in archaeology and history teaching is

going to be developed based on the aforementioned formal description. An authoring tool is a software package or a set of tools that can assist the generation of hypertext or multimedia applications by linking together objects, such as a paragraph of text, an illustration, or a music piece. Most authoring systems also support a scripting language for more sophisticated applications. The authoring tool will be based on an open source script library with advanced mapping functionality (the OpenLayers API) and will implement an application-driven library with all scripts listed in the formal description.

Acknowledgements

The author wishes to thank the funding agencies, collaborators and students who contributed to this research (to be named in the final version).

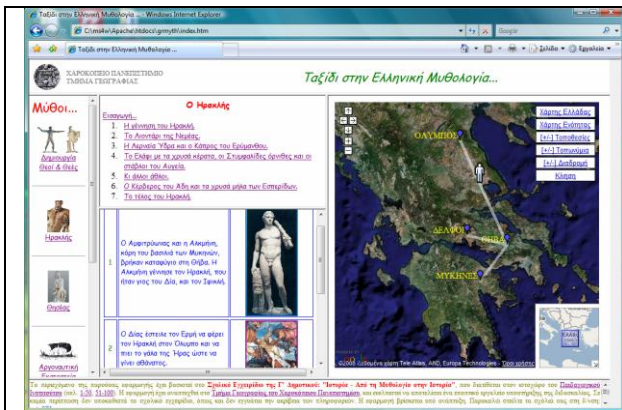
References

- [1] Stefanakis, E., 2012. Map Mashups and APIs in Education. In: Peterson, M. (Ed.). *Online Maps with APIs and Mapservices*. Springer.
- [2] Stefanakis, E., 2010. Introducing map mashups in Primary School. *Proceedings of the 6th Inter. Conference on Geographic Information Science (GIScience 2010)*, Zurich, Sept. 14-17, 2010.
- [3] Gadolou, E., Papadaki, H., Stefanakis, E., Kritikos, G., Cao, Y., Hannemann, A., Klamma, R., and Kovachev, D., 2010. Storytelling, Spatial Standards and Cultural Heritage Management. In the *Proceedings of the 13th AGILE Conference*, Guimaraes, Portugal, May 10-14, 2010.
- [4] Stefanakis, E., and Kritikos, G., 2008. The battleship "G. Averof" promotion and enrichment of the museum archives. In *Proceedings of the XXI ISPRS Congress, Commission IV, WG IV/1*, pp. 67-72, Beijing, China, July 2008.
- [5] Stefanakis, E., 2008. A journey to the ancient Greek myths - An enhanced educational framework to storytelling with geo-visualization capabilities. In the *Proc. of the 1st Inter. Workshop on Story-Telling and Educational Games (STEG '08)*, Maastricht, The Netherlands, Sept. 16, 2008.

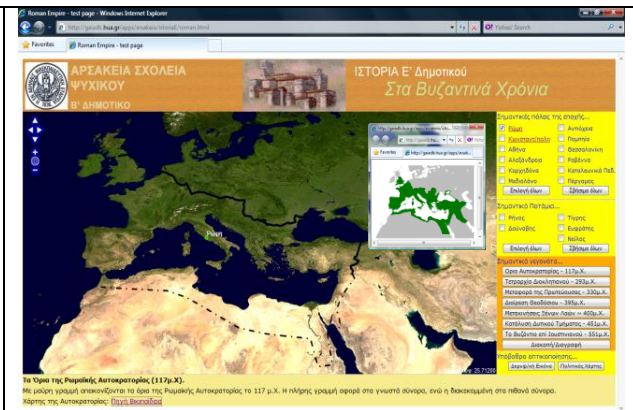
Applications (URLs)

- [1] Roman and Byzantine World: <http://gaiadb.gge.unb.ca/apps/roman/roman.html>
- [2] Antikythera Wreck and Mechanism: <http://gaia.gge.unb.ca/EAM/antikithira.html> [in Greek]
- [3] The Loyalists in New Brunswick (CMS): <http://gaia.gge.unb.ca/Loyalists.html>
- [4] The Migration of Loyalists to New Brunswick: <http://gaia.gge.unb.ca/migration/loyalists.html>
- [5] Early housing in Fredericton: <http://gaia.gge.unb.ca/eh/loyalists.html>
- [6] Historical Map Collections of the City of Fredericton: http://gaia.gge.unb.ca/wsp/Historical_Map_Collections/Historical_Maps.html

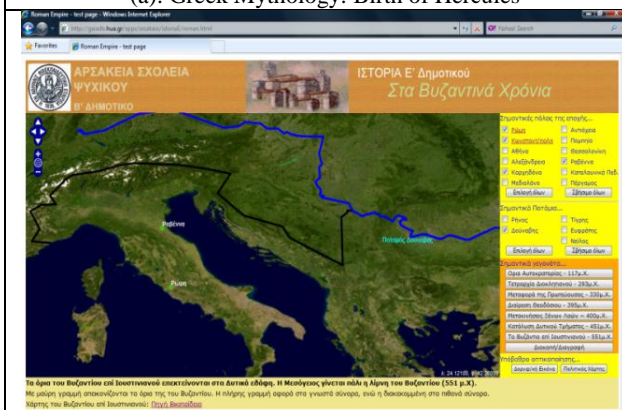
Figure 1: Snapshots from the prototype map-mashup applications.



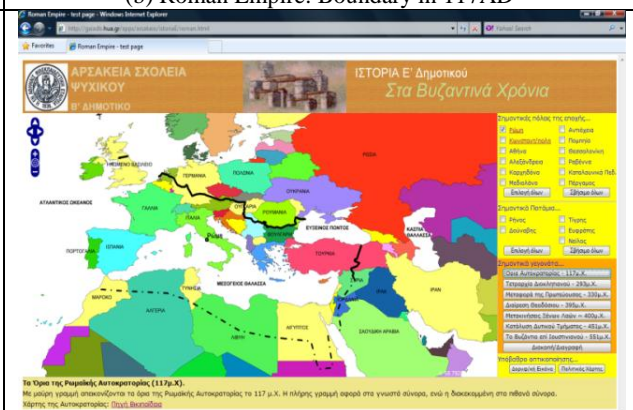
(a) Greek Mythology: Birth of Hercules



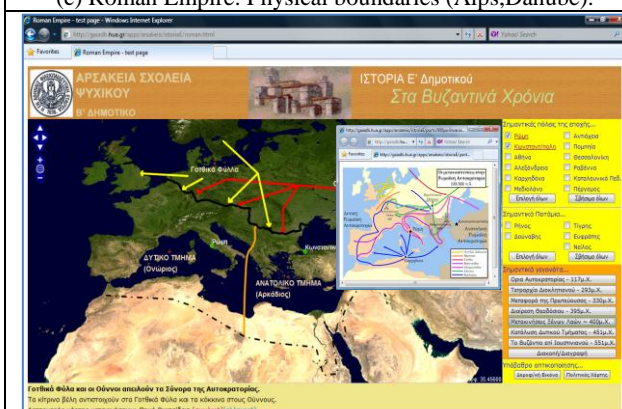
(b) Roman Empire: Boundary in 117AD



(c) Roman Empire: Physical boundaries (Alps, Danube).



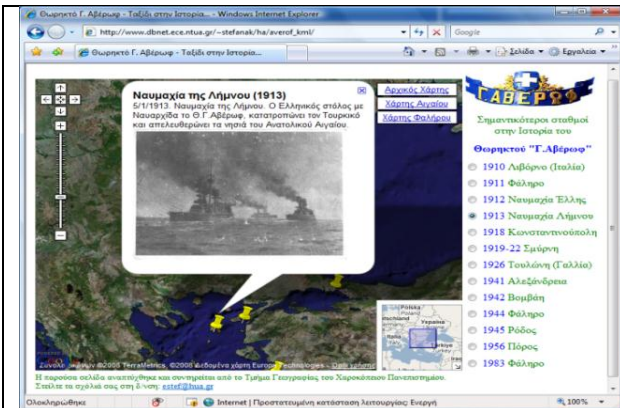
(d) Roman Empire: 117AD boundary on today's map.



(e) Roman Empire: western part collapses (451AD).



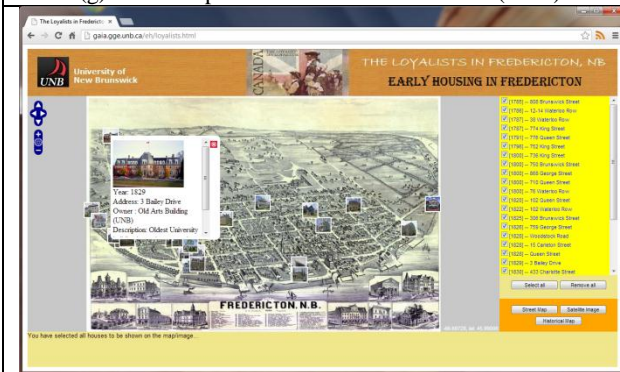
(f) Antikythera Wreck: origin of the mechanism.



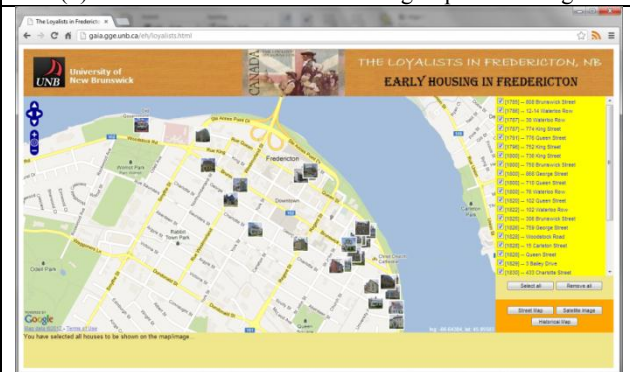
(g): Battleship G. Averof: battle of Limnos (1913).



(h): G. Averof's museum archives: geospatial catalog



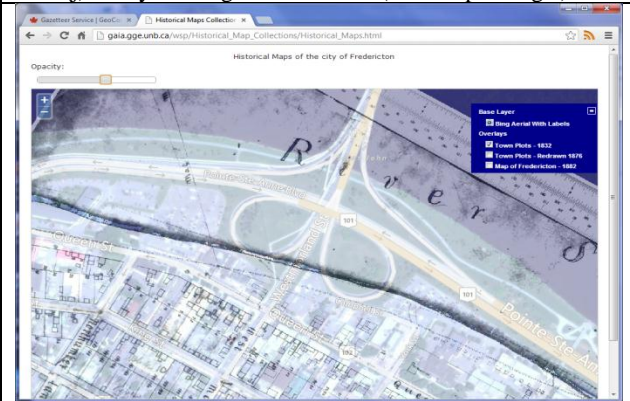
(i): Early housing in Fredericton (base map of 1882)



(j): Early housing in Fredericton (base map: Google)



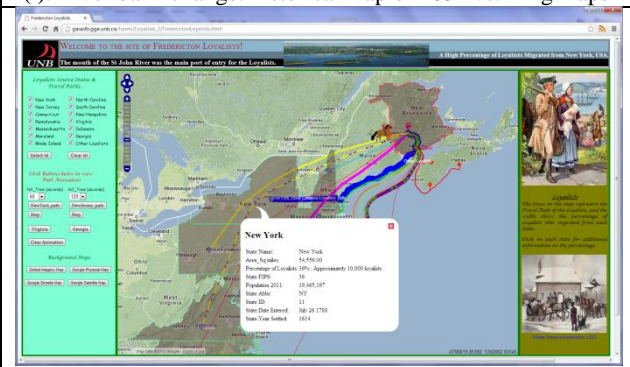
(k): Historical maps geo-referenced (base map: Bing)



(l): River bank change: historical map of 1832 vs. Bing maps



(m): CMS interface to the history of Loyalists in NB



(n): Interactive map-mashups: Migration of Loyalists to NB