

Temporal Visualization and Data Analysis of Archaeological Finds: Case FindSampo

Babatunde ANAFI, Semantic Computing Research Group (SeCo), Aalto University, Finland.

Eero HYVÖNEN, Semantic Computing Research Group (SeCo), HELDIG – Helsinki Centre for Digital Humanities, University of Helsinki, and Aalto University, Finland.

Mikko KOHO, Semantic Computing Research Group (SeCo), HELDIG – Helsinki Centre for Digital Humanities, University of Helsinki, and Aalto University, Finland.

Keywords: *Visualization—Semantic Web—Archaeological finds— Temporal—Timeline*

CHNT Reference: Babatunde Anafi, Mikko Koho and Eero Hyvönen. 2020. Spatio-temporal Visualization and Data Analysis of Archaeological Finds. Case: FindSampo. W. Börner and CHNT Organization Committee. Proceedings of the 25th International Conference on Cultural Heritage and New Technologies. DOI: xxxxxx.

Introduction

Cultural Heritage (CH) collections, data, and artefacts used to be available mainly in galleries, libraries, archives, and museums (GLAM). Nowadays CH data is available also online, and it can be searched, analysed, and presented using various methods and visualizations tools. However, many of these methods do not take adequate advantage of the nature of CH data. Even when the CH data dimensions are exploited, the choices of visualization sometimes fall short.

This paper concerns a portal part for Finnish archaeological finds as Linked Open Data, FindSampo¹ (Hassanzadeh et al. 2020), and especially its timeline-based visualisation application for studying archaeological artefacts and their categories in time. FindSampo is part of the Finnish Archaeological Finds Recording Linked Open Database (SuALT) project, which is a response to the rapidly growing popularity of metal detecting in Finland. The project aims to develop digital web services to cater for archaeological finds made by members of the public, especially metal detectorists (Thomas et al. 2018). The goal of the prototype is to 1) support the metal detectorist community in learning archaeology and their hobby, 2) the help the Finnish Heritage Agency in recording the finds in their databases, and 3) to support Digital Humanities researchers (DH) by helping them to study the data with data-analytic tools. This paper provides an insight and a possible solution into one of the research questions posed by a collaborating historian: Is it possible to map the temporal spread of records (for example as a timeline), filtering for specific types of record by object type, material used, geographical locations, etc.?

Sampo Platform for Studying Archaeological Finds

FindSampo portal is a new member of the "Sampo" series² of Linked Open Data services and semantic portals, based on a national Semantic Web infrastructure. The prototype includes a user-

¹ <http://seco.cs.aalto.fi/projects/sualt/>

² For a list of Sampo portals, see <https://seco.cs.aalto.fi/applications/sampo/>.

centric faceted search combined seamlessly with data-analytics tools for visualising the filtered data on a table, a timeline chart, and on maps. There is also an option to export the results in CSV form for further analysis in external tools.

In the design of FindSampo portal, the technologies were chosen based on technical efficiency, user needs, and the nature of the data—especially the spatio-temporal dimension of the data. The prototype is based on the Sampo model³, the Sampo-UI⁴ framework, and several third-party libraries and visualisations. It is a single-page application, and therefore page reloading is not needed when navigating around the application. This enables the user to use it more efficiently in the places where the Internet connection is slow. FindSampo is based on a set of modern JavaScript libraries, such as React⁵, Re-dux⁶, Material UI⁷, and Sass⁸ on the client side. The server is implemented using NodeJS⁹ and ExpressJS¹⁰ to enable a lightweight interaction with external services.

The portal provides an interactive multiple linked view environment that deals with themes (key words), geography (maps), timelines, and their interrelations. It caters for the spatial dimension of the data by providing two map views: a point map and heatmap. Therein the user can see the geographical distribution of the finds and learn about them.

FindSampo uses archaeological find data from the Finnish Heritage Agency as source data. The data contains approximately 3000 finds from Finland, ranging temporally from 8000 BC to 2000 AD, in a structured format, with each find described with 50 metadata fields. The source data is converted into RDF format and published as Linked Open Data, which is used in the portal directly from a public SPARQL endpoint. FindSampo utilises Semantic Web and emerging Web technologies to provide a platform for studying archaeological finds. Semantic Web technologies, such as ontologies, are used for harmonizing the data within Finnish archaeological data sources and for establishing interoperability with international archaeological resources. For this purpose, the Finnish ontologies were aligned with, e.g., the Art and Architecture Thesaurus (AAT)¹¹ of the Getty Research Center.

Visualizing Archaeological Finds on a Timeline

For the temporal dimension, the period associated with each find is converted to a discrete range to accommodate all finds. The portal features a novel interactive timeline chart, where the user can easily see the distribution of the finds on a timeline chart. Here the timeline segments represent finds which are grouped by material types and assigned colours for conspicuity and differentiation. This provides the user with a new kind of perspective to the material distribution of the finds in time.

The timeline chart was implemented using the Timelines chart library¹² by Vasco Asturiano¹³. It is made up of groups of finds layered one above the other and each group contains layers of finds. It also features an interactive interface and a timeline brush at the bottom which users can use to

³ Sampo: <https://en.wikipedia.org/wiki/Sampo>

⁴ Sampo-UI: <https://seco.cs.aalto.fi/tools/sampo-ui/>

⁵ React: <https://reactjs.org>

⁶ Redux: <https://redux.js.org>

⁷ Material UI: <https://material-ui.com>

⁸ Sass: <https://sass-lang.com>

⁹ NodeJS: <https://nodejs.org>

¹⁰ ExpressJS: <https://expressjs.com>

¹¹ <https://www.getty.edu/research/tools/vocabularies/aat/>

¹² Timelines-chart: <https://github.com/vasturiano/timelines-chart>

¹³ Vasco Asturiano: <https://bl.ocks.org/vasturiano/ded69192b8269a78d2d97e24211e64e0>

explore the finds either by zooming (dragging) on the chart directly or on the timeline brush. Users can also click on a find to learn more about the find on its own landing page. This library was chosen for the implementation, because its evaluation suggested that it can facilitate visualisation design principles such as serendipity, generosity, and criticality (Windhager et al. 2019). It is also capable of showing other dimensions of the data in addition to the temporal dimension by grouping the data using that dimension. For example, the finds shown in Figure 1 <https://www.inklusiiv.org/re> grouped by material type in the FindSampo user interface.

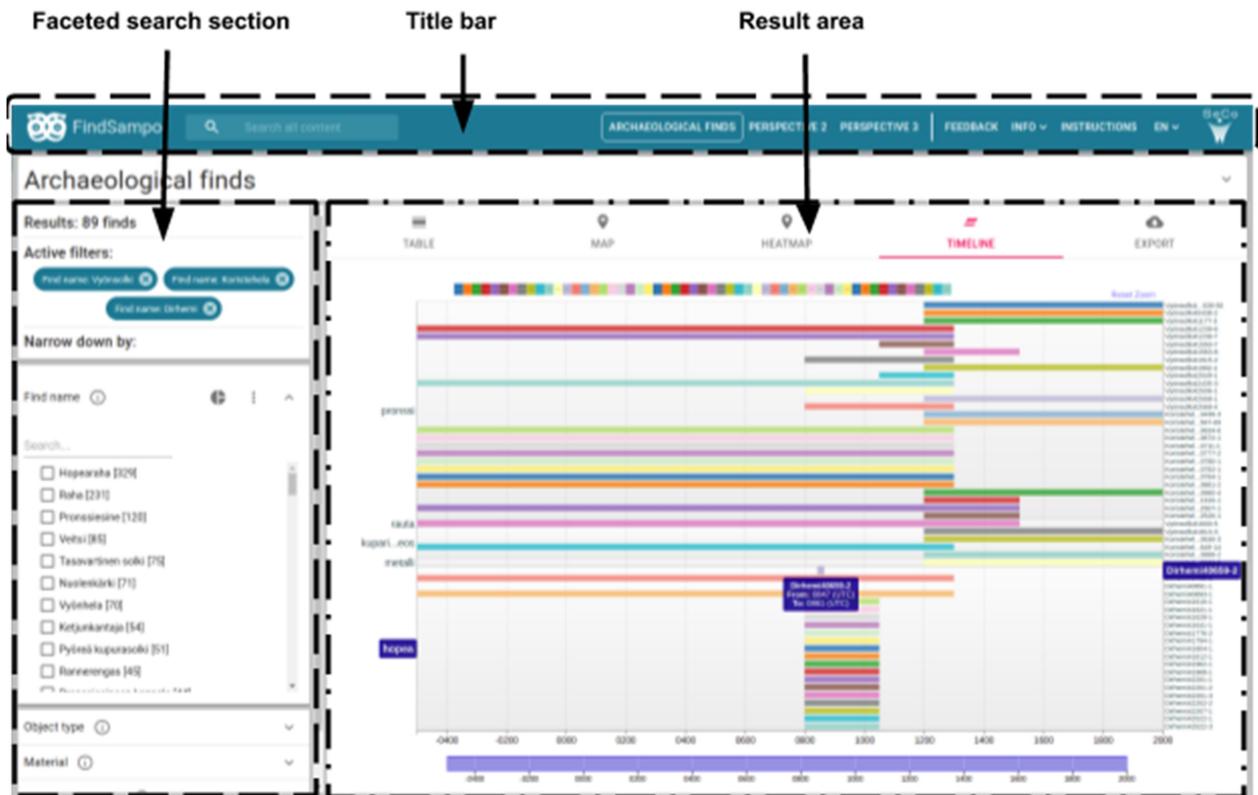


Fig. 1. The novel timeline visualization in the FindSampo portal's user interface, in which the faceted search filters the result set to be visualized.

References

- Hassanzadeh, Pejman, Hyvönen, Eero, Ikkala, Esko, Tuominen, Jouni, Thomas, Suzie, Wessman, Anna, and Rohiola, Ville: FindSampo Platform for Reporting and Studying Archaeological Finds Using Citizen Science. 3rd Workshop on Humanities in the Semantic Web (WHiSe), CEUR Workshop Proceedings, in press, 2020.
- Thomas, S., Wessman, A., Tuominen, J., Koho, M., Ikkala, E., Hyvönen, E., Rohiola, V., and Salmela, U. (2018). SuALT: Collaborative Research Infrastructure for Archaeological Finds and Public Engagement through Linked Open Data. In: Digital Humanities in the Nordic Countries, 3rd Conference (DHN 2018), Book of Abstracts, Helsinki, Finland. url: <http://heldig.fi/dhn2018/boa.pdf>.
- Windhager, F., Federico, P., Schreder, G., Glinka, K., Dörk, M., Miksch, S., and Mayr, E. (2019). "Visualization of Cultural Heritage Collection Data: State of the Art and Future Challenges". IEEE Transactions on Visualization and Computer Graphics, 25 (6), pp. 2311–2330.