FindSampo Platform for Reporting and Studying Archaeological Finds Using Citizen Science

Pejam Hassanzadeh[1], Eero Hyvönen[1,2], Esko Ikkala[1], Jouni Tuominen[1,2], Suzie Thomas[3], Anna Wessman[3], and Ville Rohiola[4]

[1] Semantic Computing Research Group (SeCo), Aalto University, Finland
[2] HELDIG – Helsinki Centre for Digital Humanities, University of Helsinki, Finland
[3] University of Helsinki, Department of Cultures, Finland
[4] Finnish Heritage Agency, Finland

Abstract. This paper introduces the FindSampo Reporter and Portal platforms for reporting and studying archaeological finds on the Semantic Web, respectively. FindSampo brings together members of the public, scientists, cultural heritage managers, and archaeologists utilising citizen science mediated by Linked Open Data and emerging Web development technologies. Our focus is on reporting technical results on designing the user interfaces and on evaluating the Reporter part in a field test.[5]

Keywords: Citizen science · Semantic Web · Archaeological finds.

1 A Citizen Science Platform for Archaeological Finds

The popularity of metal detecting has grown rapidly in recent years. Many European countries have therefore started to develop digital reporting services to collect, analyse, and study archaeological data: 1) Portable Antiquities Scheme (PAS)[6] records[7] archaeological discoveries found by members of the public in England and Wales since 1997 [1]; 2) Digital Metal Finds (DIME)[8] is an online platform for reporting metal detecting finds in Denmark [10]; 3) Portable Antiquities of the Netherlands (PAN)[9] is an online portal in use in the Netherlands [9]; 4) Metal-Detected Artefacts (MEDEA)[10] is an online portal developed in Flanders for metal detectors [2, 10]; 5) ILPPARI[11] is a portal of the Finnish Heritage Agency (FHA) for reporting archaeological finds by citizens [11].

[6] PAS: https://finds.org.uk/database
[7] 1.4 million finds have been reported by more than 14,000 citizens by now.
[8] DIME: https://www.metaldetektorfund.dk
[9] PAN: https://portable-antiquities.nl
[10] MEDEA: https://vondsten.be
[11] ILPPARI: https://www.kyppi.fi/ilppari

FindSampo is a new research prototype of the SuALT project[12] aiming to study and improve the reporting process and analysis of archaeological finds based on collaboration of the public, academic researchers, archaeologists, and the FHA [4, 11, 8]. The system includes two interlinked applications: 1) FindSampo Reporter, a mobile reporting system for finds, and 2) FindSampo Portal for analysing and studying the finds collection on the Web. The intent is to use citizen science to enable citizens to participate in archaeological research and improve themselves in different stages of reporting, and to expedite processing of reports. Such involvement allows participants to improve themselves and also learn more about archaeology. In this way, archaeological data becomes more quickly and comprehensively available and accessible for research purposes and Digital Humanities (DH) [3].

This paper presents the design principles of the FindSampo Reporter and Portal user interfaces and results of a first field test for evaluating the Reporter part with metal detectorists. In contrast to the aforementioned related works, FindSampo is based on Linked Open Data. FindSampo Portal is yet another member in the "Sampo" series[13] of Linked Open Data services and semantic portals [7], based on a national Semantic Web infrastructure [6].

2 User Interface Design: FindSampo Reporter and Portal

A user-centred design approach was adopted right from the beginning in the design process of FindSampo Reporter. Requirements were elicited at an early stage using online surveys and interviews, and they have been evaluated continuously through showing and reviewing mock-up interface designs with end users and finally in field testings [8].

Another key decision was to enforce a mobile-first strategy, which optimises the design firstly for mobile devices and afterwards for others. Adopting a mobile-first approach is critical because especially the archaeological find reporting functionalities are intended to be used in the field. On the other hand, it is more natural to carry out tasks related to data analysis on a desktop with a large screen, so it is important that the user interface adapts to larger screens also. Figure 1 shows how the user interface adapts to different screen sizes in order to reduce the user's cognitive load.

Additionally, in order to maximise the efficiency of the find reporting process from the citizen's point of view, the need to enter data is minimised. The reporting process consists of short and simple questions that express only one idea and are easy to answer. The process is split into a series of self-contained steps to make the report flow understandable. FindSampo Reporter provides help during the reporting process with the aim of making find reporting as easy as possible. Such a process improves finders' knowledge of archaeology and would also reduce the workload of FHA's officers as the quality of the reports improves. Figure 2 shows some example steps of the reporting process above-mentioned: if

[12] SuALT project: https://blogs.helsinki.fi/sualt-project

[13] For a list of Sampo portals, see https://seco.cs.aalto.fi/applications/sampo/.

the user is on the find spot, the coordinate information as well as time can be read automatically from the mobile phone (image on the left); the find spot can be seen and edited also later on (image in the middle); the depth of the find can be set with a slider (image on the right).

The idea of minimising the reporting work of the metal detectorists was deemed important in order to foster reporting of finds in the first place, since according to our interviews, metal detectorists seem to like reporting tools that would record less information. However, from the archaeologists/heritage managers' viewpoint, it is necessary to collect all relevant data about the object and its find context. So, we are facing here a somewhat challenging situation to develop a platform for all user groups' needs. Our solution proposal in FindSampo Reporter is that additional information can be collected from the detectorists, if needed, after they have provided the basic information of the find, and a connection between the finder and FHA has been established.

In FindSampo we plan that all validated archaeological objects found in Finland would be openly available to the public with the exact find spots. This would help metal detectorists to find promising areas for exploration. Furthermore, opening the find data in detail, would be useful for Digital Humanities research. For this purpose, the FindSampo Reporter prototype already includes a semantic portal for searching and viewing the finds on maps, with additional linked information from other relevant GIS services of FHA. For example, it is possible to see on maps not only the individual finds but also protected archaeological sites where metal detecting is forbidden by law.

However, disclosing the exact find spot data is a challenging and critical decision for openness still to be confirmed, as many archaeologists argue that there is the danger that disclosing the exact find spots would lead to looting. In many countries and systems, such as DIME in Denmark, location data is fuzzified before publishing. Furthermore, according to our interviews, the detectorists usually would not like to disclose their find spots immediately but want to investigate them first by themselves. The compromise solution we are aiming at the moment is to disclose the exact find spots only after a period of time, say one year. If the find spot is deemed important, it is then also possible to add it in the list of protected areas.

The data of validated finds will be accessible via the FindSampo Portal based on the Sampo-UI framework[14] and a SPARQL[15] endpoint at the Linked Data Finland platform[16]. The initial version of FindSampo's public Linked Open Data database contains approximately 3600 archaeological finds, and more finds will be added as the FHA delivers new validated data.

The validated finds can be studied through different views in the FindSampo Portal, based on the Sampo model [7]. This model includes three components: 1) A "business model" for harmonizing, aggregating, and publishing heterogeneous, distributed contents based on a shared ontology infrastructure. 2) An

[14] Sampo-UI homepage: https://seco.cs.aalto.fi/tools/sampo-ui/
[15] SPARQL: https://www.w3.org/TR/sparql11-query.
[16] Linked Data Finland Portal: http://www.ldf.fi

approach to interface design, where the data can be re-used and accessed independently from multiple application perspectives, while the data resides in a single SPARQL endpoint. 3) A two-step model for accessing and analyzing the data where the focus of interest is first filtered out using faceted semantic search, and then visualized or analyzed by ready-to-use DH tools of the portal.

An important part of the FindSampo Portal is the underlying ontology infrastructure, a basis of the Sampo model. As a starting point, the MAO/TAO ontology for Museum Domain and Applied Arts of the Finnish ontology infrastructure FinnONTO [5] available today at the Finto.fi service[17] is used. This ontology is being enriched with new concepts extracted from the finds databases and is being aligned with international ontologies, such as AAT[18] and PeriodO[19], as part of the ARIADNEplus project[20].

In FindSampo Portal, the finds can be analysed and interpreted using faceted search which enables users to analyse, filter, and organise data by applying multiple criteria at the same time. Thus, users can browse a large amount of data based on the specific search criteria such as object type, material, period, municipality, and province. Furthermore, users can view archaeologically significant sites with tutorials to gain knowledge about archaeology and also the rules of law in their pastime. Figure 3 shows the different views for visualising archaeological data with faceted search in FindSampo: the Clustered Map view (on the left) is used for providing the user with an aggregated view of filtered finds on the map; the HeatMap view visualizes the distribution of the filtered finds in colors; the Table view lists the finds in a traditional way; the Statistics view illustrates statistical distributions of the finds along different facet dimensions, here based on the material of the selected finds.

3 Implementation

In the design of FindSampo, a variety of Web development technologies were analysed and as a result, the most appropriate ones selected for implementing it. The technologies were chosen on the basis of technical efficiency and user needs.

FindSampo Reporter utilises the Semantic Web and emerging Web development technologies to provide a platform for reporting and studying archaeological finds. It is a single-page application and therefore, it does not need page reloading when navigating around the application. Such a structure enables users to use it more efficiently in the places where the Internet connection is slow.

FindSampo uses a set of modern JavaScript libraries such as React[21], Redux[22], Material UI[23], and Sass[24] to build the client. The server is implemented

[17] http://finto.fi/maotao/en/?clang=fi
[18] https://www.getty.edu/research/tools/vocabularies/aat/
[19] https://perio.do/en/
[20] https://ariadne-infrastructure.eu/
[21] React: https://reactjs.org
[22] Redux: https://redux.js.org
[23] Material UI: https://material-ui.com
[24] Sass: https://sass-lang.com

using NodeJS[25] and ExpressJS[26] to enable a lightweight interaction with external services. Semantic Web technologies, such as ontologies, are used for harmonizing data within Finnish archaeological data sources and establishing interoperability with international archaeological resources.

4 Evaluation

To gain in-depth understanding of FindSampo Reporter from a user-centric perspective, a field testing was performed with a small number of metal detectorists [4, Ch. 7]. After reporting the finds through FindSampo Reporter, the detectorists filled out a user experience survey. As a result, the overall impression of the prototype was very good, and all metal detectorists very likely would recommend it to friends or colleagues in the future. Furthermore, the detectorists were fairly well satisfied with the reporting system. All participants found FindSampo more efficient, attractive, and easier to use than the FHA's current reporting service ILPPARI. The testers in particular liked the mobile-friendly user interface, efficient and effective reporting process, automatic location identification, and search page for validated archaeological finds.

5 Discussion and Future Work

FindSampo takes the current state of archaeological find databases a step further by providing a mobile platform that combines the advantages of the existing ones and also utilises citizen science, Semantic Web, and emerging Web development technologies. The evaluation of the prototype and user experience surveys reveal that the platform improves significantly archaeological data collection, analysis, and interpretation processes. Furthermore, it provides further research opportunities by visualising and linking archaeological data as well as improving its availability and accessibility.

In the future, the members of the public can hopefully participate in all stages of research and report processing using FindSampo and ILPPARI, the legacy system of FHA for find report management. FindSampo aims at building a community in which everybody gains benefits, including volunteers, research communities, heritage managers, and also the whole society using citizen science. Furthermore, FindSampo is going to generate data models that are semantically interoperable with existing cultural heritage databases, other European archaeological resources in order to provide research opportunities by visualising archaeological data as well as improving its availability and accessibility. The data will be part of the Pan-European ARIADNEplus infrastructure[27].

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[25] NodeJS: https://nodejs.org
[26] ExpressJS: https://expressjs.com
[27] https://ariadne-infrastructure.eu

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Appendix: Figures

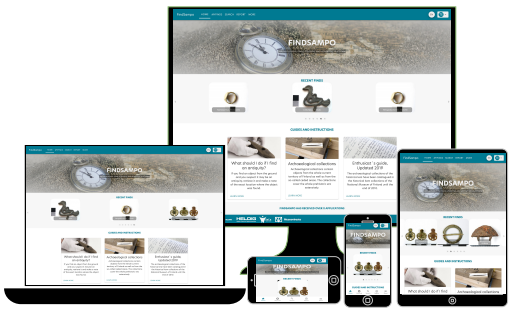

Fig. 1. FindSampo user interface on different screen sizes.

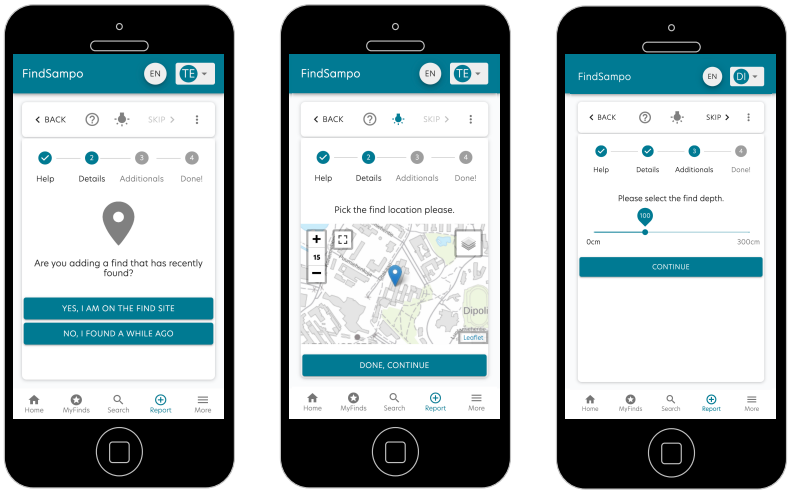

Fig. 2. Steps of the reporting process

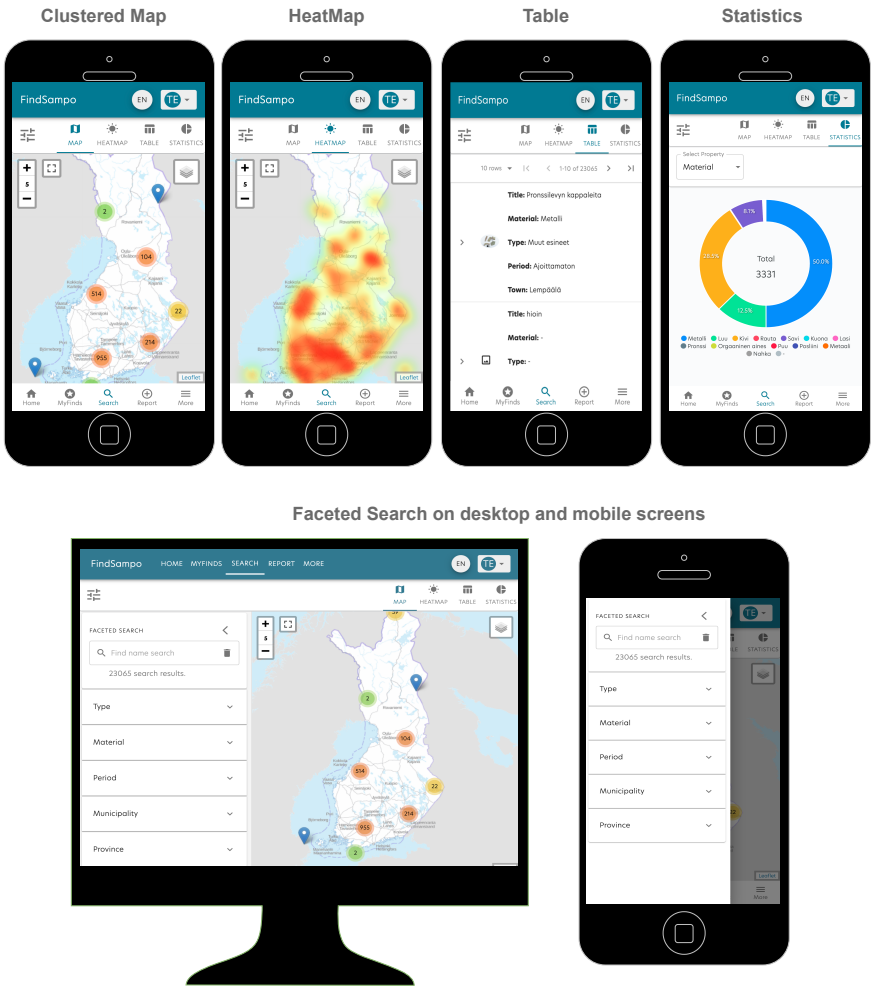

Fig. 3. Different views for visualising archaeological data with faceted search in FindSampo