Advanced Visual Interfaces to Represent Cultural and Historical Facts and Associations in the CrossCult EU project

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ABSTRACT

The European CrossCult project, dedicated to the enhancement and dissemination of European cultural heritage thanks to new technologies, has offered the possibility to compare different research fields and, at the same time, to develop new methodological approaches. IT experts, computing engineers, historians, art historians and archaeologists have worked in four pilots for developing semantic knowledge and technological tools useful to create meaningful interactive experiences, both for individuals and groups. This paper provides an overview of the tools developed to display interactive visualizations of cultural and historical facts and associations.

KEYWORDS

Cultural heritage, interactive visualizations, mobile applications

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1 INTRODUCTION

For decades, scholars have called to implement citizen-centred approaches in order to stimulate knowledge integration, reflection and retention in teaching and dissemination of Cultural Heritage. Nowadays, the advent of *Digital Humanities* is convincing more and more stakeholders that Information Technologies are key to realising the change. The EU project CrossCult (www.crosscult.eu) has created an open platform for web and mobile applications to deliver new experiences in line with this vision, building upon two main pillars:

- The technologies of the *Semantic Web*, together with the numerous and growing *Linked Data* resources, which help classify and interrelate facts of culture and history.
- The availability of multi-platform software libraries to render interactive, data-based visualizations of such facts and associations.

In this extended abstract, we first provide an overview of the CrossCult platform, followed by a summary of the main functionalities of the visualization components.

2 THE CROSSCULT PLATFORM

The CrossCult platform is a complex ensemble of software aimed to provide services to different types of stakeholders, including museum curators and experts, data scientists, cultural app developers and system administrators (through different web-based frontends) as well as current and future museum visitors (through Android or iOS apps). The operation of the web-based and mobile frontends is supported by a backend that provides infrastructure and instrumentation for hosting the core components (see Fig. 1).

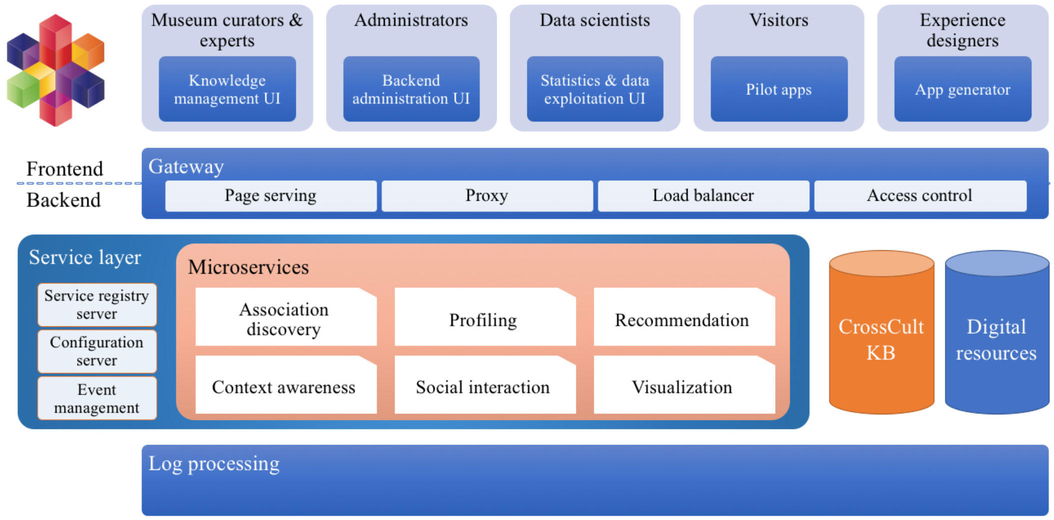

Figure 1: Block diagram of the CrossCult platform.

At the core of the platform, the CrossCult Knowledge Base is a repository for storage, management and retrieval of semantic information. It implements a single and generic upper-level structure that acts as a semantic layer of common concepts and relationships, building on standard *Semantic Web* technologies to facilitate interoperability with *Linked Data* resources. These include CIDOC-CRM (the *Conceptual Reference Model of the International Council of Museums and the International Committee for Documentation*)[1] and general-purpose resources like SKOS (*Simple Knowledge Organization System*)[2] and FOAF (*Friend Of a Friend*)[3].

Next to the CrossCult Knowledge Base in Fig. 1, a number of software modules provide high-level, application-oriented services covering six major functional areas, namely "*Association discovery*", "*User profiling*", "*Recommendation*", "*Context awareness*", "*Social interaction*" and "*Visualization*". Each functional area is covered by one or more technological modules, which offer distinct services within the area (e.g. chatting and micro-blogging) or address different facets of a single issue in a complementary fashion (e.g. carousel-based profiling vs interaction-based profiling, item recommendation vs path recommendation, etc.).

The following sections describes the components from the functional area of "*Visualization*", which share the goal of providing versatile interactive graphical representations of knowledge excerpted from the CrossCult Knowledge Base or contributed by the users themselves.[4] The components have been implemented as open-source apps in the Ionic framework[5], which allows easy deployment both as web applications or Android/iOS mobile apps.

[1]www.cidoc-crm.org
[2]www.w3.org/2004/02/skos
[3]www.foaf-project.org
[4]The project has developed a number of tools to aid in the generation of such knowledge, as can be seen in the official deliverables found at www.crosscult.eu/en/resources/deliverables/
[5]ionicframework.com

3 VISUALIZATION OF ASSOCIATIONS

The "*Visualization of associations*" component is intended to offer interactive visualizations of graphs of nodes and connecting arrows, to let users explore associations among different concepts. The nodes and arrows can be used to display relevant information upon user interaction (clicking, dragging, zooming, . . .). The visualizations are built with `vis.js`[6], a library that supports many types of network/edge graphs, including animations, auto-layout and auto-clustering. This library turned out to be more convenient than all other alternatives due to portability and good performance on different types of mobile devices. Indeed, `vis.js` has gathered a growing community of developers and increased its portability, whereas other projects (e.g. `Sigma.js`[7]) lagged significantly behind.

The component offers samples of the following features, showcasing different types of cultural and historical content as shown in the snapshots of Fig. 2:

- representation of graphs with different node types, links and navigation aids;
- selective hiding of nodes according to tags in the defining data;
- node interactions displaying informative pop-ups linked to Wikipedia or Europeana entities;
- nodes linked to multiple-choice questions;
- addition, edition and removal of nodes by app users;
- interfaces for full customization of the visualizations.

4 VISUALIZATION OF TIMELINES

The "*Visualization of timelines*" component provides visualizations of snippets of information (text, images or audio/video clips) linked to events and/or periods on a timeline. As in the case of associations

[6]visjs.org
[7]sigmajs.org

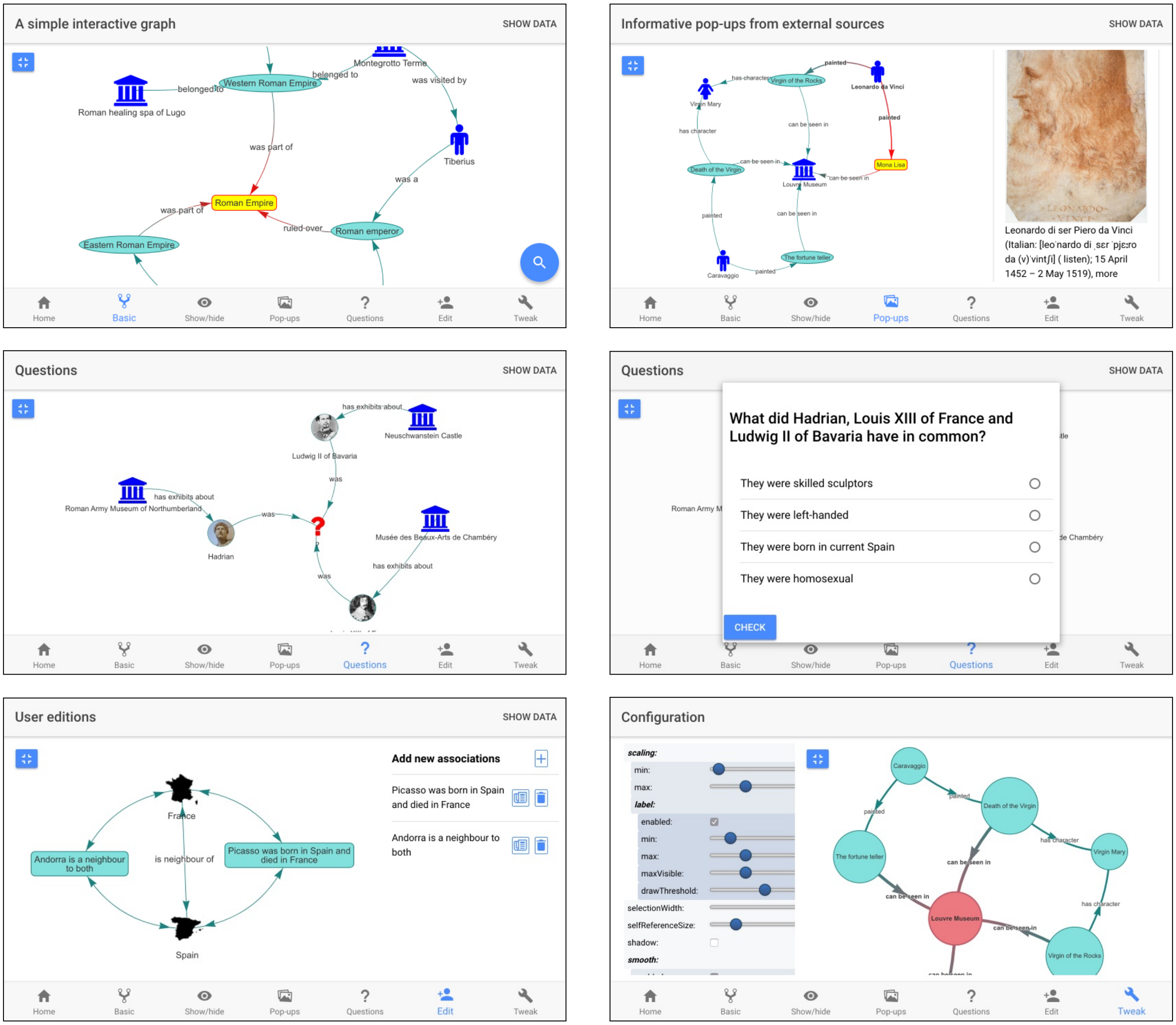

Figure 2: Snapshots of the "*Visualization of associations*" component.

explained above, the timeline visualizations are built with `vis.js`, which turned out to be more convenient than all other alternatives —including the popular Timeline.js[8]— due to its light weight, portability and good performance on resource-constrained devices. Other software resources considered at first, like the SIMILE widgets[9], have not evolved to keep up with the recent developments in web technologies, while `D3.js`[10] does remain at the cutting edge of technology, but its programming constructs are too low-level to be reasonably used by the target users of the CrossCult platform.

[8]timeline.knightlab.com
[9]www.simile-widgets.org
[10]d3js.org

The component offers samples of the following features, some of which are illustrated in the snapshots of Fig. 3:

- representation of timelines with different types of items, item groups, styles and basic navigation aids;
- usage of timelines as interactive indices of content;
- events and periods linked to multiple-choice questions;
- timelines as boards for games of dragging events to their proper place in time;
- interfaces for full customization of the visualizations.

5 VISUALIZATION OF MAPS

The "*Visualization of maps*" component is intended to provide visualizations of snippets of information linked to specific locations or

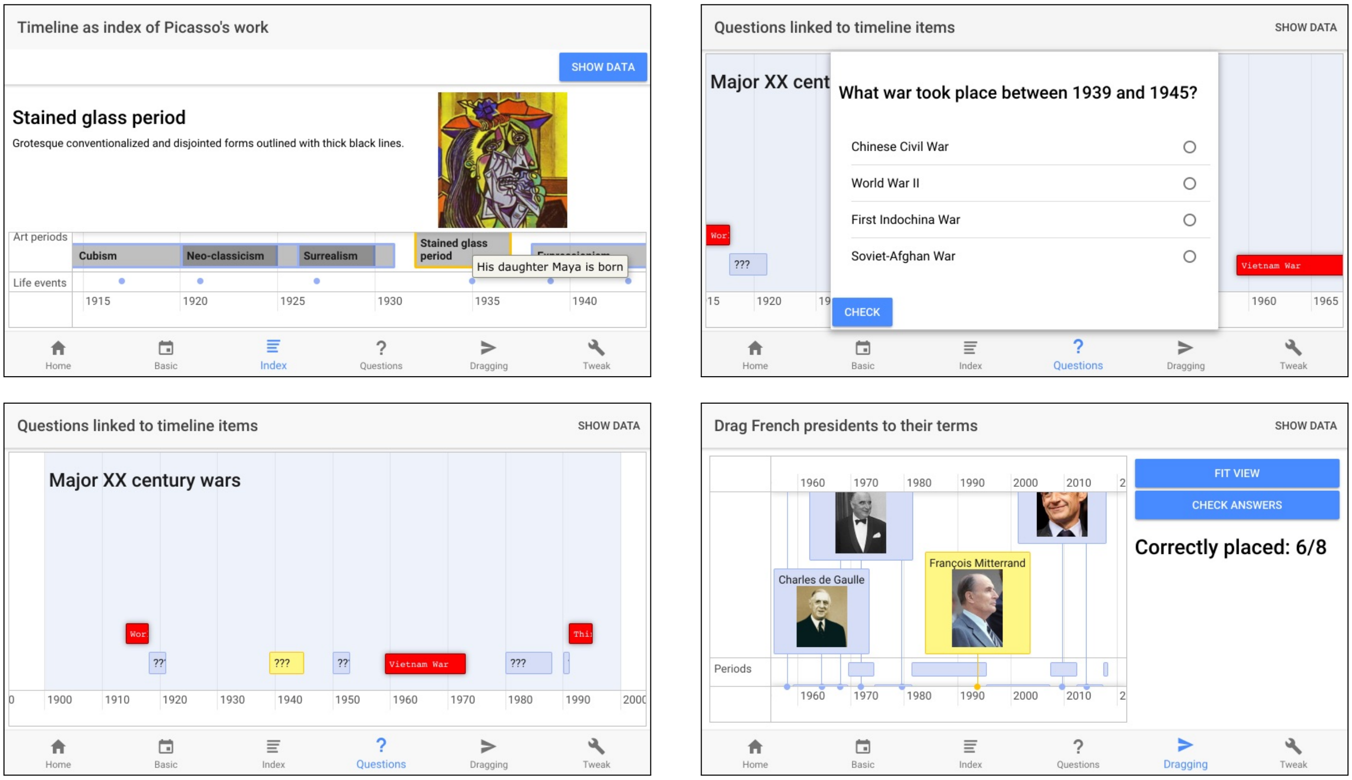

Figure 3: Snapshots of the "*Visualization of timelines*" component.

regions on a map. Initially, the component was based on the Google Maps API, but later on this was substituted by Mapbox[11] because of its greater versatility, portability, lighter weight, and more convenient license terms. OpenStreetMap[12] was considered at first, too, but it did not evolve its API to the point that Mapbox has, and the latter's support for interactive content, 3D buildings, animations and data management, among other features, are unrivalled nowadays. Mapbox also integrates nicely (same data formats, similar API patterns) with `Turf.js`[13], a library for advanced geospatial analysis that can be used to ease the implementation of user interactions, as well as with Tableau[14], a professional platform for data analytics. Samples of abstract maps (meaning "*non-spatial or quasi-spatial representations of data*") have been implemented using *vis.js*.

The component offers samples of the following features, some of which are illustrated in the snapshots of Fig. 4:

- representation of maps with venue markers, customizable styles and basic navigational aids;
- data-based animated maps linked to timelines;
- clustering and analysis of geolocated textual comments;
- dragging pictures over an area in a game of searching for the right placement of heritage items;
- representation of countries as nodes in a graph of associations, with semi-automatic layout mimicking geographical location, and data-based behaviour of nodes and links;
- presentation of indoor maps.

6 CONCLUSIONS

The visualization components described in the preceding sections have been used in the four pilot applications of CrossCult, which involve large cultural venues, small and medium sized-ones, and even historical cities as a whole. These experiences have proven that the software libraries employed, together with the semantic underpinnings created in the project, provide great versatility to create meaningful interactive visualizations that favour the understanding of cultural and historical facts and associations.

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[11]www.mapbox.com
[12]www.openstreetmap.org
[13]turfjs.org
[14]tableau.com

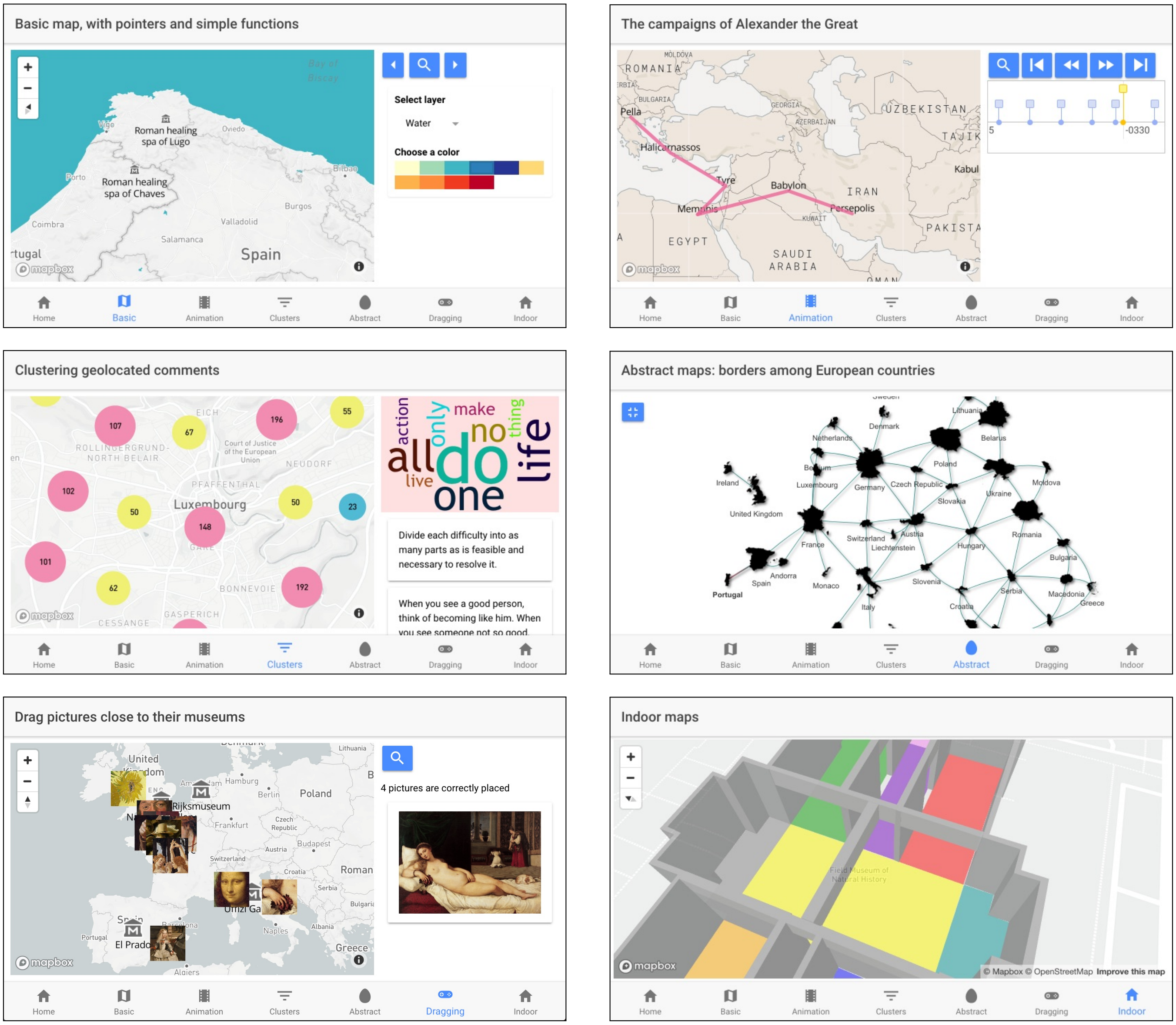

Figure 4: Snapshots of the "*Visualization of associations*" component.

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