International Cartographic Association
Association Cartographique Internationale

Migrating the Atlas of Switzerland to the Web: A comparative analysis of 2D and 3D open-source web rendering frameworks

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Keywords: Atlas Cartography, Open Source Geospatial Technologies, Web Cartography and Map Services

Abstract:

The Atlas of Switzerland (AoS) was founded in 1961 as the Swiss national atlas. Until 1997 it was published as a printed edition with a total of 13 editions, resulting in 596 individual maps. In 2000, the first interactive version of the AoS was published on CD-ROM, with sales of more than 14,000 copies. It was praised and awarded for its intuitive user experience, interactive thematic maps (mostly choropleth and diagram maps) and 3D panoramic views and block images. It was succeeded by AoS 2 in 2004 and AoS 3 in 2010, both published on DVD. Version 3 included improved thematic maps in 2D and 3D, and many new atmospheric effects in the panoramic views or block images.

AoS version 4 (also known as AoS online), released in 2016, currently serves as the production version. It employs a virtual globe framework (osgEarth) for 3D rendering and the Chromium Embedded Framework (CEF) with a reactive JavaScript application for the user interface. Despite being available for free download and online map and geodata access, AoS online requires local installation, posing challenges for users in restricted IT environments and lacking support for portable devices like tablets and smartphones. To address these limitations, the upcoming AoS version 5 will operate entirely within a web browser, utilizing native web technologies.

The chosen framework(s) for the web version of AoS 5 must meet key criteria for optimal functionality. They should robustly render maps in both 2D and 3D formats, supporting various projections beyond web mercator for enhanced visual presentation. Sophisticated symbology features, including multi-level symbols and data-defined symbology, are necessary. Automated labeling with collision avoidance and graphical effects like blend modes, selective masking, and shadows are crucial. Thematic mapping support, encompassing heat maps, aggregations, chart maps, and scaled symbols, is also essential.For 3D rendering, the framework must support level of detail (LOD) management for terrain and 3D objects. Preferably, it should provide a globe view and an intuitive navigation interface for small scale 3D rendering. In addition, the framework should allow for the display of 3D charts and scaled 3D symbols, while maintaining support for thematic mapping features.

Interactivity is a key aspect, requiring intuitive navigation tools, feature attribute display, a profile tool and a legend that interacts seamlessly with the features on the map. There should also be a TypeScript API to facilitate interaction between the rendering engine and the AoS UI, which is based on Vue.js.

Good rendering performance that meets acceptable standards is required. Compatibility with mobile devices is essential to ensure accessibility across platforms. In addition, the framework must be distributed under an open source licence to promote transparency and community collaboration. Finally, preference will be given to mature projects with a reasonably large developer base and an active community.

While researching various rendering frameworks, it became clear that no single framework satisfies all of the above requirements in its entirety. AoS 5 will therefore select a combination of different rendering frameworks and techniques.

The AoS team is currently exploring several frameworks for the project. These include **deck.gl**, offering both 2D and 3D rendering via WebGL and WebGPU technologies, with WebGPU being its modern successor. Another contender is **CesiumJS**, primarily focusing on 3D rendering with WebGL. Additionally, **qgis-js**, designed for 2D rendering using WebAssembly and the QGIS rendering engine, is under consideration. **Giro3D**, emphasizing 3D rendering based on the three.js library and WebGL, is also being evaluated, albeit not yet tested.

Abstracts of the International Cartographic Association, 7, 117, 2024.
European Cartographic Conference – EuroCarto 2024, 9–11 September 2024, TU Wien, Vienna, Austria.
https://doi.org/10.5194/ica-abs-7-117-2024

Prototypes with the above listed frameworks are currently being implemented. In addition, a comparison matrix is maintained, listing capabilities, problems, demos and examples, advantages and disadvantages of the rendering frameworks.

The presentation will demonstrate our prototypes, discuss the advantages and disadvantages of the rendering frameworks and potentially also our decision of selected frameworks for the upcoming web-based Atlas of Switzerland version 5. With the switch to one or more of the discussed frameworks, the AoS would be one of the first online atlases using such modern technologies such as WebAssembly or WebGPU.

Moving to a QGIS-based rendering engine, packaged as a WebAssembly binary and running in modern web browsers, leverages decades of development. It taps into extensive investment in symbology, labeling engines, and graphical effects. This transition promises a new era of high-quality web mapping in the interactive AoS, with sophisticated features like collision detection for labels, selective masking for point symbols, geometry generators and diverse graphical effects.

Switching to a WebGL or WebGPU 3D rendering framework maximizes device graphics hardware for tasks like terrain visualization and analysis, transferring some CPU workload to the GPU. However, this shift sacrifices high-quality cartography, as 3D frameworks lag in labeling and complex symbology options compared to 2D frameworks.

An optimal combination of different 2D and 3D technologies and frameworks should provide us with a flexible kit for the upcoming version of a web-based Atlas of Switzerland. At the time of writing this abstract, a decision on the choice or combination of rendering frameworks has not been made yet.

Acknowledgements

We thank all the developers of the above listed Open Source rendering frameworks for sharing and maintaining their projects. In addition, we thank all team members of the Atlas of Switzerland for their input. Special thanks go to Michael Schmuki and Martin Dobias for their work on qgis-js.

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https://doi.org/10.5194/ica-abs-7-117-2024