Web-based Immersive Analytics in Handheld Augmented Reality

PRIFYSGOL BANGOR UNIVERSITY

Panagiotis D. Ritsos **James R. Jackson** **Jonathan C. Roberts**

{p.ritsos, j.r.jackson, j.c.roberts} @bangor.ac.uk

Introduction

We explore the use of contemporary web-based technologies for the creation of immersive visualizations for handheld Augmented Reality (AR), combining emerging and established JavaScript libraries.

Motivation

The recent surge of virtual reality (VR) interfaces has prompted researchers and developers to explore new ways of visualizing data in immersive environments. However, little attention has been given to the paradigms of augmented and mixed reality (AR/MR).

Nowadays, a developer can use game-engine ecosystems to create content both for VR and AR/MR. Yet, driven mainly from efforts to investigate the prospect of standardization and interoperability in VR/MR, we have an aspiration to develop VR/MR applications using web technologies.

In particular, as a large number of contemporary tools for visualization are based on web technologies, there is scope in exploring the synergy between such tools and the emerging VR/MR web-based ecosystem.

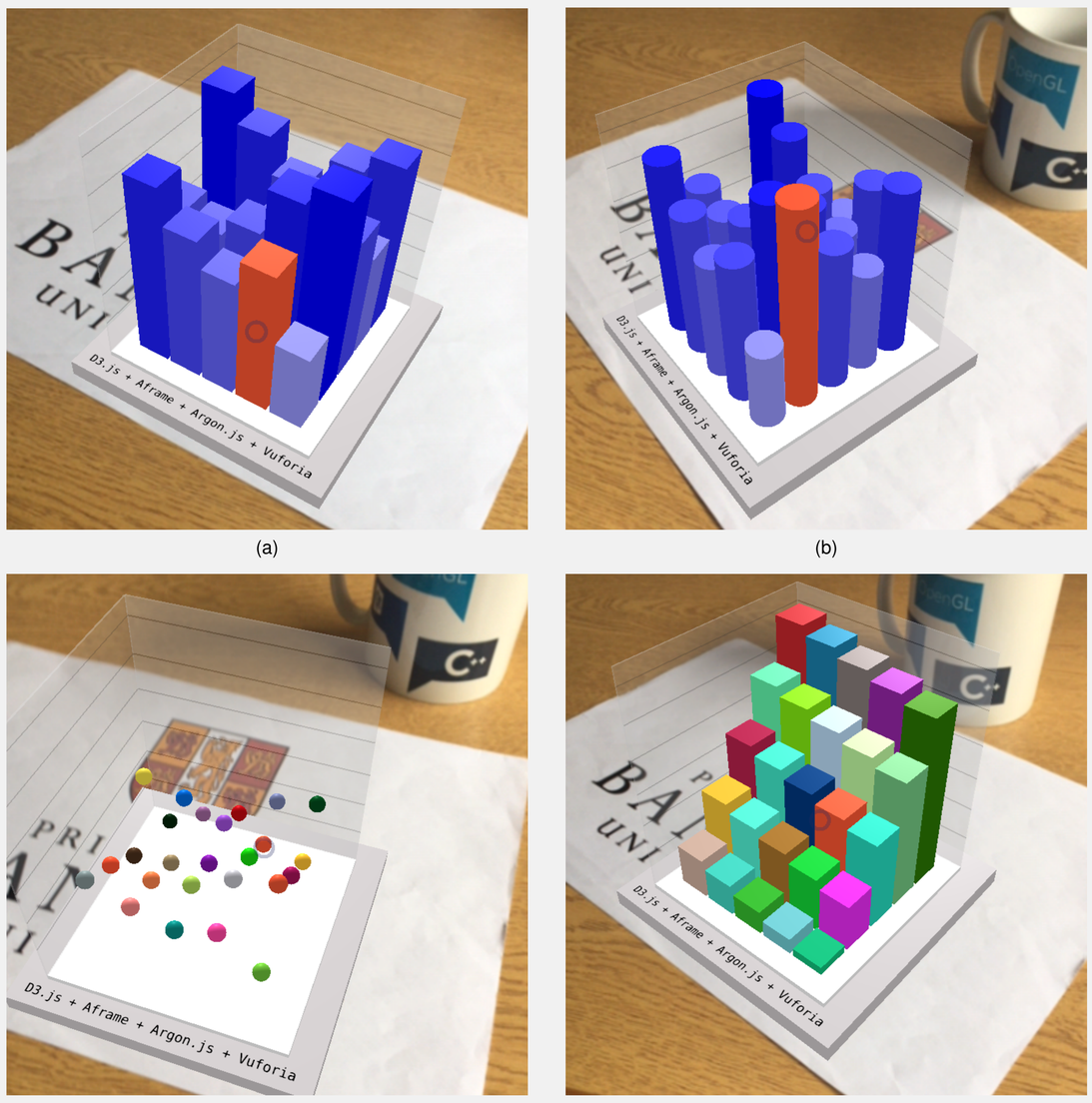
Our Prototype

Our prototype uses the Argon4 Augmented Reality open-standards browser [1], which works on iOS and Android, and is especially suited to display AR content created with Argon.js. The latter is a framework for building AR applications, originally built for the Argon browser, but now supporting other WebRTC compliant browsers.

Argon.js includes AR-specific extensions of A-Frame/WebVR [2], an entity component system for Three.js. AR content can be included in a Web page, using the HTML DOM and essentially the same mechanisms as A-Frame, for primitives, entities, transformations, attributes etc. Registration mechanisms can be (geo)location-based, or marker-based, and provided via the Vuforia AR platform [3].

Data binding and manipulation is handled by D3.js [4]. The data is read from a JSON file and mapped into a 3D bar-chart using A-Frame's primitives. D3.js also provides color information for each bar, based on the data value, using a linear color scale (see Fig.1).

As A-Frame and Argon's extensions are using the DOM, integration with D3.js is simple, seamless and powerful.



(a) (b) (c) (d)

Figure 1: The Images above show different AR-visualizations of the same data set. Data binding is handled by D3.js. Marker registration is handled by the Argon framework and Vuforia. The on-screen cursor is used to highlight different bars. The 3D visualization can be rendered with: bars (a), using the `<a-box>` A-Frame primitive, cylinders (b), using `<a-cylinder>`, or as a scatter plot with spheres (c), using `<a-sphere>`. Primitives' color is dependent on the data value — (a) and (b) use a linear scale, (c) and (b) are random colors.

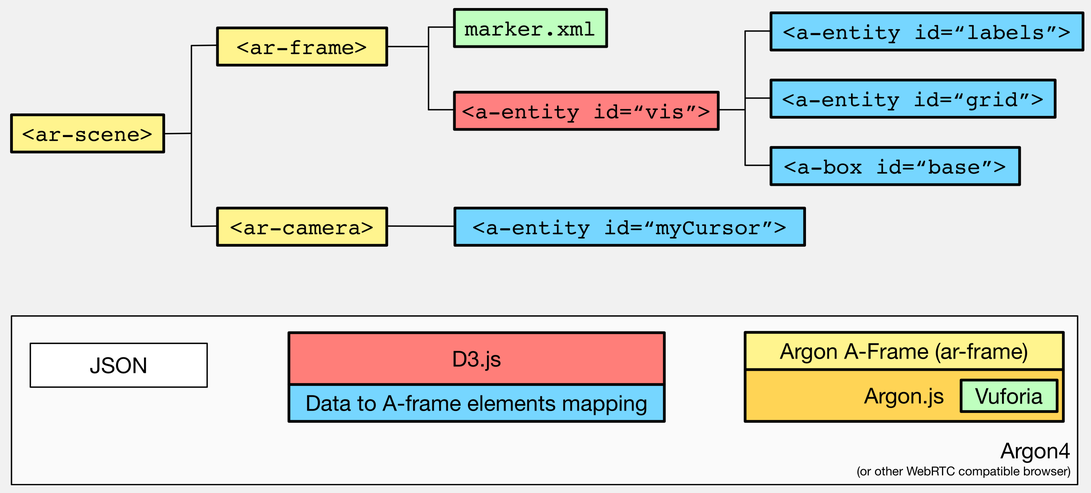


Figure 2: Our prototype is structured around the HTML DOM: at the top of the hierarchy we find Argon's A-Frame extensions ( ) along with Vuforia's tracking mechanism ( ) and access to the phone's camera. The remaining hierarchy uses D3.js ( ) to bind data to 'vanilla' A-Frame primitives ( ), for the visualization and any other graphical elements (e.g., base, grids etc).

Future Work

Our prototype combines popular web frameworks, and albeit a simple combination, it demonstrates the strength of the synergy, for AR visualizations. During preliminary user-experience investigations, users highlighted the robust registration and fast rendering (on an iPhone 6s). However, users also stressed that some form of bar annotation, highlighting and selection strategies would be useful.

We plan to investigate these in the future — in parallel to our exploration of the synergy between data visualization libraries and open-standards Web technologies for VR/MR — towards building more examples of immersive analytics in MR.

References

[1] B. MacIntyre, A. Hill, H. Rouzati, M. Gandy, and B. Davidson, "The Argon AR Web Browser and standards-based AR application environment," in *Procs. of IEEE ISMAR*, Oct 2011, pp. 65–74.

[2] MozVR. (2015) A-Frame. [Online]. Available: https://aframe.io/ (Accessed 2017-6-13).

[3] PTC Inc. (2015) Vuforia. [Online]. Available: https://www.vuforia.com/ (Accessed 2017-6-13).

[4] M. Bostock, V. Ogievetsky, and J. Heer, "D^3; Data-Driven Documents," *IEEE Trans. Vis. Comput. Graphics*, vol. 17, no. 12, pp. 2301–2309, Dec 2011.