Tutorial: Live Collaborative Immersive Analytics Development with DashSpace

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Abstract—In this half-day tutorial, we introduce participants to DashSpace, a new, open, malleable, and collaborative platform for immersive, situated, and ubiquitous analytics. Participants will learn about the platform, its components and authoring mechanisms, and how these can be used to author visualizations which can be experienced in Augmented Reality. We will explore different usage scenarios and enable participants to build their own prototypes, in their own browsers. The prototypes will be ready to view and interact with through HMDs that we will provide. Finally, we will show how participants can extend their prototypes to use advanced features of the platform. DashSpace builds upon several tools from the Webstrates stack and Web-based immersive analytics platforms.

Index Terms—Web-based technologies, collaborative visualization, Augmented Reality, eXtended Reality.

1 Motivation and Background

Immersive [8], situated [11], and ubiquitous analytics [9] (IA/SA/UA) envision scenarios where heterogeneous devices can be used in combination and multiple users can work in collaboration around data. While there are many research prototypes in this domain, there is a lack of a common platform to build upon. Furthermore, many prototypes build on proprietary game engines such as Unreal or Unity, which make distribution and reuse more difficult, require niche knowledge which is not often found in enterprise environments, as well as being prone to changing license agreements. We therefore advocate for the use of open standards, such as WebXR in order to overcome such restrictions [7].

During the last year we created two iterations of an open, malleable, and collaborative platform for IA/SA/UA: DashSpace [3,4]. We published both DashSpace as well as a its core WebXR framework Spatialstrates [5] on GitHub.[1][2] DashSpace and Spatialstrates build on the know-how and technical synergies between Web-based IA/SA frameworks, such as VRIA [2] and Wizualization [2], UA frameworks such as Vistrates [1], and dynamic-media environments such as Webstrates [10], all converging together since 2019, through the binding affordances that the reliance on Web technologies enables.

We deem the tutorial framing particularly well suited to introduce DashSpace in depth to a broader audience of IA/SA/UA researchers, with the goal of creating a growing and interoperable platform for these interaction flavors. We envision to grow the platform and create a "component store" or package repository with self-contained components and packages that can be mixed and matched within the same platform without the need to install new applications on multiple devices or re-implementing common features.

2 Tutorial Overview

The tutorial is split into three main parts. The first part provides an introduction to the key concepts of DashSpace and its functionality where we will demonstrate various use cases of DashSpace. The second part allows participants to try out the platform itself, using headsets that we will provide. Lastly, the third part will explain how the platform itself can be extended, for example, to add custom components. The overall planned schedule is as follows:

- **Part 1: Introduction and Demonstration (75 min)**
  - Welcome and introduction (5 min)
  - Key Concepts of DashSpace (15 min)
  - How to use DashSpace (15 min)
  - Use Case Scenario Demonstrations (30 min)
  - Q&A (10 min)
- Coffee Break (30 min)
- **Part 2: Hands-On Session (30 min)**
- **Part 3: Extending the Platform (45 min)**
  - DashSpace's Software Stack (10 min)
  - Walkthrough of Creating a Custom Component (25 min)
  - Q&A and Wrap-up (10 min)

2.1 Part 1: Introduction and Demonstration (75 min)

After a short welcome and introductions from the team (5 min) we will start the tutorial with a general introduction of DashSpace and important concepts that are required to use it (15 min). First, we will introduce terminology such as *pieces* and *groups* and how they can be used to author visualizations. We will introduce the *grouping* and *proximity authoring* mechanisms for authoring visualizations with DashSpace.

After an initial presentation, we will demonstrate the use of the platform through a guided example using an HMD, which video feed is streamed to a projector (15 min). The demonstration will also present how DashSpace can be used in Augmented Reality. During the demonstration, we will share a URL link to the demo prototype, which participants can use to create their own copy of the prototype, and follow along during the demonstration on their laptops using mouse and keyboard.

The remainder of Part 1 will be spent on demonstrating multiple usage scenarios of DashSpace and to showcase its wide applicability (30 min). The prototypes used in these usage scenario will also be shared with participants to try and extend them themselves.

We will conclude Part 1 with an open Q&A session (10 min), allowing participants to ask questions or discuss how they used DashSpace during this part.

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[1] DashSpace: https://github.com/Webstrates/DashSpace
[2] Spatialstrates: https://github.com/Webstrates/Spatialstrates

2.2 Part 2: Hands-On (30 min)

During the coffee break, we will set up multiple HMDs and stream the video feed of some of them to any available projectors or screens. Participants will be invited to try out DashSpace in an immersive environment, using the multiple examples we presented during the first part. Being primarily designed for immersive devices, such as HMDs, this part of the tutorial enables participants to fully experience the platform, after having learned the basics during the first part, in order to prevent participants from feeling overwhelmed. The organizers will moderate activities and guide participants during this session. Additionally, we will prepare collaborative examples, where multiple participants can work co-located in the same 3D scene.

2.3 Part 3: Extending the Platform (45 min)

The last part of the tutorial will focus on diving deeper into the architecture of DashSpace and its extensible software stack (10 min). DashSpace is designed as a modular, extensible, and reprogrammable platform—a single click on the "Edit" button will open the built-in Cauldron editor [6] and allow users to inspect or edit the source code live. We will demonstrate how these capabilities can be used to extend DashSpace with custom types of visualizations or elements within the scene (25 min). Similar to Part 1, participants can follow along and try to reprogram their own copy of the prototype using their own laptop—however, this is optional.

Again, we will conclude this part with a Q&A session and an overall wrap-up (10 min).

3 Level of the Tutorial and Attendance

Part 1 and 2 of the tutorial and the hands-on session will be useful for anyone who wants to learn what DashSpace is and how to use it. Participants do not require any technical skills to attend the first two parts. However, a basic understanding of Vega-Lite[3] will be helpful for following the visualization examples within DashSpace.

Part 3 of the tutorial will be particularly useful for anyone who wants to extend the platform and create custom visualizations and components. Participants should have a strong level of experience in Web technologies (JavaScript, HTML, and CSS) as well as an intermediate level of experience in React.[4] Participants should also have a basic understanding of Three.js[5] and/or React Three Fiber.[6]

We expect the tutorial to be attended by 20–30 participants.

4 Tutorial Organizers

Marcel Borowski received the Ph.D. degree in 2022 from Aarhus University. He is a postdoctoral researcher in the Department of Computer Science at Aarhus University in Aarhus, Denmark. His research interests include interactive systems, malleable software, and spatial computing. He is the main developer of the DashSpace and Spatialstrates platforms.

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[3]Vega-Lite: https://vega.github.io/vega-lite

[4]React: https://react.dev

[5]Three.js: https://threejs.org

[6]React Three Fiber: https://r3f.docs.pmnd.rs

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