

A Preliminary Design Space for Immersive Data Storytelling

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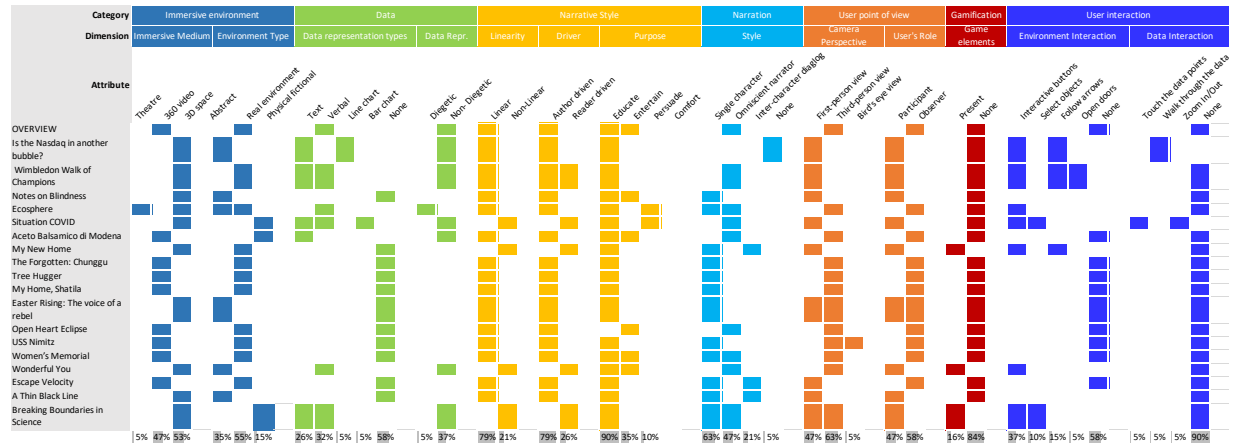


Figure 1: The preliminary immersive data story design space highlighting our findings on each dimension based on the analysis of nineteen immersive data stories which resulted in thirteen dimensions across seven categories.

ABSTRACT

This work presents a preliminary design space for immersive data storytelling that is informed by multi-disciplinary views and current practice. We interviewed experts across multiple disciplines, including museum designers, architectures, and game designers, to understand how they communicate stories through real and virtual-immersive mediums. We used the interviews to inform the dimensions of the design space and analysed a systematic selection of publicly available immersive stories. Our design spaces consists of 13 dimensions across 7 categories. We present insights into this design space as common practice or areas for future research.

1 INTRODUCTION

Immersive storytelling combines the art of storytelling, including digital elements such as audio and video, with immersive technologies such as Virtual Reality (VR) and Augmented Reality (AR). Narrative visualisation [4], and more broadly *data storytelling*, combines data visualisations with storytelling techniques such as sequencing, narration, and pacing to communicate a consistent and coherent data-based narrative in an engaging and compelling way. We posit that there is a clear progression from narrative visualisation to immersive storytelling. Isenberg et al. [2] follow this progression by defining *immersive visual data stories*; though their focus is on the broader meaning of immersion as it relates to the feeling of engagement, whether through immersive technologies such as VR or techniques such as gamification.

This work presents a preliminary design space for *immersive data storytelling* to help identify patterns in existing work as well as identify opportunities for future research. For our purposes, we

define immersive data storytelling as: *the use of storytelling and information visualisation techniques to convey data insights in immersive environments across the Mixed Reality (MR) continuum*. For this initial exploration, we focus on Virtual Reality (VR) due to the relative maturity of the technology, though we suggest avenues to explore Augmented Reality in future work.

The design space is informed by two activities: 1) a set of multi-disciplinary interviews, and 2) a review of existing publicly available works. By conducting multi-disciplinary interviews with experts across disciplines that deal with storytelling in physical and digital immersive spaces, we identify opportunities, challenges, and practices for creating stories in these spaces. These experts cover a range of disciplines, including museum designers, architects, game designers, and filmmakers. Second, through a review of a set of existing publicly available immersive VR stories, we can more broadly identify current practices for immersive storytelling. The synthesis of the findings from these two activities and existing narrative visualisation design spaces define our preliminary design space (Fig. 1).

2 EXPERT INTERVIEW FINDINGS

We conducted semi-structured interviews with experts across disciplines that deal with storytelling in physical spaces. Interviewees were asked question about their current practice and challenges, and their responses recorded and thematically coded. Interviewed experts were identified through professional networks and chosen based on their area of expertise and their availability to participate in the interview. Each interview lasted for 45–60 minutes. Eight experts were interviewed:

- **[muse]** Science communication museum exhibition designer
- **[jour]** Journalist and academic in immersive journalism
- **[scw]** Creative and screen writer
- **[arch]** Professor in architecture
- **[desi]** Professor and practitioner in communication design
- **[desi2]** Professor in serious games and digital heritage
- **[game]** Game designer and developer
- **[film]** Traditional and immersive film director

The interview analysis resulted in nine key themes around storytelling in physical or immersive environments:

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Soundscape: Interviewees indicated that the soundscape (environmental sounds, narration, and interactive sounds) are crucial to immersing and engaging users in the environment. Sound can also be used to draw people’s attention in immersive environments [jour][film][desi2].

Narration: One of the interviewees indicated that having voice-over narration can be better for engaging viewers as than images alone as “voice overs are often more powerful than having really evocative shots” [jour].

Camera angle and positioning: There are several camera angles that could be used to provide different perspectives in the immersive story, e.g. first-person view, third-person view, and bird’s-eye view. These angles may be used to empathise a point-of-view or place the audience somewhat removed from the story [jour][film].

Use of space: Creating spaces where it is convenient for the user to find information and understand the pattern which is used to layout the information in the space is crucial [arch][desi].

Gamification: Experts strongly associated immersive spaces and storytelling with gamification. There are two major components of gamifying any immersive story, reward and progression of the story. Ideally, the user receives some reward or be allowed to progress into the story after finishing a certain task [game][jour][muse][film].

Digital data representation: Rather than traditional charts and visualisations, data in immersive stories may be presented as a form of “physicalisation” or visual metaphors within the environment, where the data is transformed into objects or aspects of the environment which the user can explore and interact with [desi2].

Duration: Experts suggest keeping the duration of the immersive story somewhere around six minutes with each scene no longer than thirty seconds. If an immersive story starts to go over six to eight minutes, users can lose interest [jour].

Participant’s role: The user should have a clear understanding of their role in the story. The user could be a participant or an observer and the story may allow the user to choose roles [jour] [desi].

Interaction: The interviewees revealed that the interaction allows exploration, personalises the experience and supports decision making. Adding interactive elements help in creating an immersive and engaging environment for the users [jour][desi].

3 DESIGN SPACE

We created a preliminary design space for immersive data storytelling by combining insights from our domain expert elicitation and existing narrative visualisation design spaces with an analysis of existing immersive stories. The domain expert elicitation motivates immersive aspects of our design space. For the data storytelling aspects of the design space, we synthesise three key works: Segel and Heer [4], Cao et al. [1] and Ojo et al. [3].

We collected immersive VR stories from the Meta Quest Store, one of the prominent VR application markets. Initially, we searched for non-fictional immersive stories instead of focusing solely on immersive data stories due to their limited availability. Out of the sixty experiences collected, we filtered out fictional stories, games, applications with technical issues, and utility applications. This left us with nineteen non-fictional immersive stories for analysis. The primary author watched all the identified stories and encoded them, which were subsequently refined by all the investigators.

3.1 Results and discussion

Our preliminary design space consists of thirteen dimensions, grouped into seven categories (Fig. 1):

Immersive Environment Almost half of the 19 immersive stories use 360 video as their **Immersive Medium**, while the other half uses 3D space. One story incorporates theatre (being a 180 degree screen in an immersive theatre playing a video) alongside 3D space. Our interviews findings suggest that the immersive environment should inherit some of the similarities from the physical environment in

order to make it more relatable for the user, meanwhile the creator should also keep in mind that the immersive environment is not a replica of the physical environment. We introduced the dimension **Environment Type** as we found environments that were primarily either abstract in nature (e.g. swirling colours and floating platforms), recreations of real locations (e.g., using 360 videos), or fictional locations that could practically be real (e.g., situated on the back of a virtual boat).

Data representation Out of 40% of the stories that have one or other type of **Data Representation** including textual, verbal or graphs, only one (5%) is diegetic. This indicates that there is opportunity for further exploration in this area to see if when the data representation is embedded within the narrative, whether it supports better storytelling and engagement.

Narrative style The majority of the immersive stories are linear and author driven. In author-driven stories, the user does not have agency over the story progression, while in reader-driven stories, the user has more agency. Subjectively, we found that the nonlinear, reader driven stories appeared to be more engaging than their counterparts.

Narration There are different **Styles** of voice overs identified in the presented design space with “Single Character” (where a single character narrates their story to the audience) being the most commonly used. This may be classes as a diegetic form of voice over.

User point-of-view A direct relation can be observed between **Camera Perspective** and **User’s Role** with an exception of a few stories. In majority of the case, a first-person camera angle indicates that the user is a participant in the story, while a third person camera angle suggests that the user is an observer.

Gamification We found three data stories with **Game Elements** where the user was given a goal to accomplish by interacting with environment elements along with a reward at the end of the story.

Interaction The dimensions **Environment Interaction** and **Data Interaction** present that 42% of the stories have interactive elements in their environment and only 10% out of 19 stories feature interactive data elements. This indicates a clear need for more work in this area, as interaction is a crucial aspect of immersive data stories that sets them apart from traditional stories.

4 CONCLUSION AND FUTURE WORK

In this research, we explored immersive data storytelling and curated a preliminary design space informed by multi-disciplinary interviews and an analysis of publicly available immersive stories. The presented work concentrates on immersive data storytelling in VR. We expect that immersive data storytelling in AR is worth a separate investigation considering the unique aspects of that medium. The results of this research can be used as a starting point to create immersive data stories that effectively communicate insights to their target audience. However, it is essential to test the effectiveness of these immersive data stories in practice. User studies are necessary to explore aspects of this design space. We can improve the design space and create a more reliable framework for immersive data stories based on the results of this study.

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