Immersive visualization of COVID-19 UK travel and US happiness data

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Abstract

The global COVID-19 pandemic has had great affect on the lives of everyone, from changing how children are educated to how, or whether at all, we travel, go to work or do our shopping. Consequently, not only has people's happiness changed throughout the pandemic, but there has been less vehicles on the roads. We present work to visualize both US happiness and UK travel data, as examples, in immersive environments. These impromptu visualizations encourage discussion and engagement with these topics, and can help people see the data in an alternative way.

Index Terms: H.5.1 [Information Interfaces and Presentation]: Multimedia Information Systems—Artificial, augmented, and virtual realities. H.5.2 [Information Interfaces and Presentation]: User Interfaces—Interaction styles.

1 Introduction

The COVID-19 pandemic has prompted many people to become interested in data visualization. Visualizations have been produced on the number of people infected, deaths per population, the rate of spread, etc. Furthermore, there are many organisations that monitor global health, well-being, transport, and so on, and regularly publish their data, which cover the COVID-19 pandemic period. It is now possible to compare these phenomena before and during the pandemic. Subsequently, this wide variety of public data has fuelled the rise and use of data visualizations. Indeed, visual maps of the spread of the virus, or timelines of rate increase have all been used across media, and presented in academic publications. However, most of the visualizations that have been created are two-dimensional visual depictions and are non-interactive. While interactive dashboards have been created, they are more complex to control and use and are directed towards expert users. On the other hand, three-dimensional immersed visualizations have the potential to provide a different way to understand this data. By placing the visualizations on a phone and using the interaction capabilities of the device, users can explore the visualizations using natural movements. Alternative visualization styles have potential to engage and engender discussion. This got us thinking: how can we quickly create immersed visualizations of this data? How can we use them to encourage discussion and engagement?

In this preliminary work, we present how we created immersive data visualization depictions for two different datasets. Our first dataset, recorded by the UK Government, contains data of different vehicles, roads and regions of vehicles travelled in the UK. The second dataset is the Average Happiness for Twitter score, available on hedonometer.org, from the Computational Story Lab, from the University of Vermont.

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2 Related Work

The use of XR-based visualizations has increased in the past few years, driven by the emergence of affordable and versatile interfaces [5]. In turn, this generated interest in using XR in analytics, with research flavours, such as immersive analytics [4] building on this notion. Many researchers have been investigating this space, with efforts ranging from investigation on the use of XR in analytical scenarios [1], and in the field assessments of immersive analytics [7], to toolkits that produce immersive experiences [2,3,6]. If anything, the COVID-19 pandemic has highlighted the need for remote, collaborative environments. Inevitably, the prospect of using XR worlds, where we can be with friends and colleagues, interact, socialise, study, or even explore data, is stronger than ever. With this work we utilise the platform-agnostic nature of Web-based VR experiences [2], and explore how easy it is to share them for impromptu evaluations and analysis.

3 Visualization Prototypes

We visualize these data sets using emerging, open-standards Web technologies and libraries, including A-Frame, WebVR/XR and D3.js. A-Frame allows the creation of VR experiences, built on top of HTML. In addition, it is a powerful entity-component system (ECS) that provides a declarative, extensible, and composable structure to Three.js, a popular JavaScript 3D library, and supports WebVR/XR. WebVR/XR is a group of standards which support browser-based rendering of 3D scenes in hardware designed for XR (e.g., HMDs), as well as desktops and handheld devices.

In the presented prototype, D3.js is used to bind data to A-Frame DOM elements, such as boxes and cylinders. Additional props, such as guide panels, text and filtering buttons are build with A-Frame. A cursor component is used to highlight elements in the VR scene, which in turn get highlighted and present textual information. The visualizations comprise of two 3D barcharts and a storytelling board. One of the barcharts depicts the Hedomometer scores for the period between January and July 2020. In Figure 1, we highlight two dates where dips in public mood are observed: a) March, 12th which marks the escalation of the pandemic in the US, and b) May, 31st, which marks the days of the police brutality protests (inset picture). The other visualization, shown in Fig. (b), depicts a breakdown of vehicle traffic, broken down quarterly and by vehicle type. Data can be filtered using buttons, attached on a plane, and selected via the cursor component. In particular for the traffic data, we have created an animated depiction, using different models for each vehicle type (car, light-commercial vehicles (LCV) and heavy-goods vehicles (HGV). The travel distance of each truck is based on the total distance travelled in each quarter, Fig.(b). In Fig.(b), we compare the fourth quarter of 2019, with the first quarters of 2020 and 2018, to indicate the overall reduction of travel, per vehicle type.

4 User Feedback

The visualizations were hosted online on Github Pages and then shared with a convenience sample of seven users, of Bangor University's services personnel, researchers and students. We asked them to offer their opinion in an open-ended way, highlighting (if any) one positive and one negative aspect of each visualization. Overall, users found these visualizations *"interesting, but not easier to use than* [traditional] *2D visualizations"*. Some highlighted

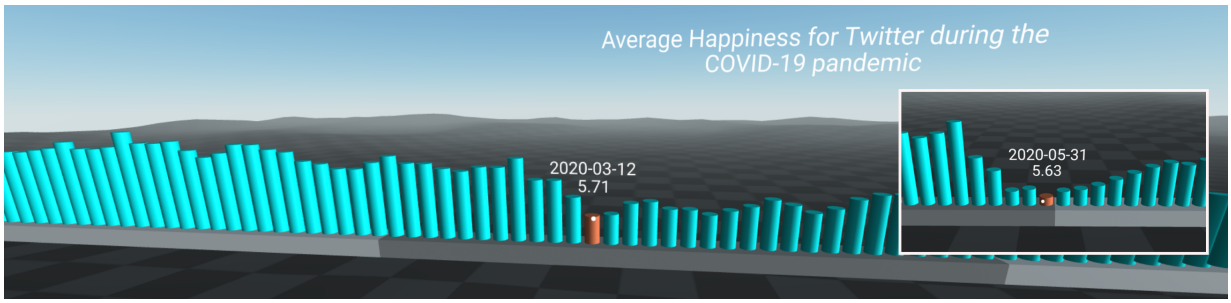
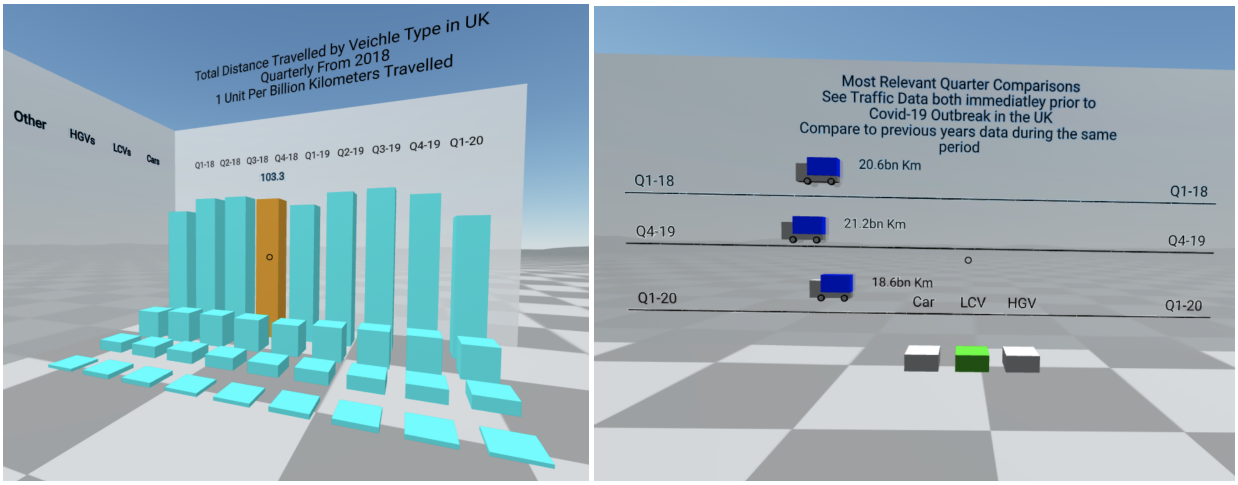


Figure 1: One of the demos, used in our impromptu evaluation, depicting the average happiness recorded by the Hedonometer.org. The visualization is a simple bar-chart, built with A-Frame, and D3.js. Two dates where dips in public mood are observed: a) March, 12th which marks the escalation of the pandemic in the US (suspension of the NBA season, actor Tom Hanks tests positive, stock market falls), and b) May, 31st, during the days of the police brutality protests (inset picture).



(a) (b)

Figure 2: UK traffic data visualizations in VR. In (a), a barchart depicts the traffic levels per vehicle type, per quarter. In (b), different vehicle models are animated based on the total travelled distance. In this case we see the LCV model. All visualizations done with A-Frame and D3.js.

that *"the Average Happiness 3D barchart was simpler"*, when compared to the traffic barchart (Fig.2a), due to the latter's multi-axis properties. As the storyboard and the traffic barcharts are in the same world, some users found having to turn and walk from one to the other an interesting and positive interactive feature. Most people liked the vehicle animation storyboard, finding it *"playful"* and *"cool"*, and felt this type of depictions, where data is mapped into a physical dimension, were well suited for VR. Almost all users reported that the cursor was tricky to use and more advanced selection mechanisms (e.g., via laser pointers) would be preferable. Likewise, all users found accessing VR on their browser compelling and novel. Only two users, with prior experience in using Web-based VR, tried to explain these visualizations on their smartphones, using the WebXR functionality and capabilities.

5 Discussion and Conclusion

This paper presents an impromptu evaluation of simple immersive analytic experiences, which present data related to the COVID-19 pandemic, and are built with Web technologies. The presented depictions were used to gauge the opinion of users, on the use of VR for simple data presentation and analysis tasks. Users overall found the use of VR, such as the presented depictions compelling but not better than traditional 2D depictions. However, most commented favourably on the use of the storyboard, indicating that the notions of storytelling and the visual embodiment of data-related objects, with familiar depictions are well suited to immersive data visualizations.

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