NiwViw: Immersive Analytics Authoring Tool

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Abstract

Immersive analytics uses augmented and virtual reality technologies to better understand and interact with multi-dimensional data within a physical space. NiwView is an application that allows non-technical users to create their own immersive visualizations. NiwView currently supports the iPad, Microsoft HoloLens, and the HTC Vive.

Author Keywords

Immersive analytics, tool, authoring, 3D visualizations

Introduction

Using visualizations to analyze the data that exists within our lives is a very common practice, and becomes more necessary as the amount of data that we collect increases. Many of the data visualization applications today, such as Tableau [1] and Spotfire [2], provide a user-friendly interface that makes it very
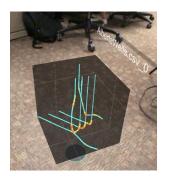
Figure 1. iPad screenshot of the visualization tool within NiwViw.

simple for any user to create dashboards and workspaces. However, these applications are accessed through computer screens, and focus on two-dimensional visualizations. With the release of devices and toolboxes such as the Microsoft HoloLens and Apple ARKit, the technical basis for data analysis within the three-dimensional space became widely available. *Immersive analytics* (IA) is the field that combines analytics and immersive technologies to enhance our insights from multi-dimensional data. A main challenge in creating IA applications is that it takes substantial amounts of programming effort and corresponding skills.

NiwViw is an immersive analytics application that gives the ability to author 3D visualizations to everyone, not just the individuals who can program. The purpose of NiwViw is to *allow for the non-programmer to create immersive visualizations using their own datasets, and experience immersive analytics in their own space*. An example of an IA visualization is shown in Figure 1.

NiwViw currently runs on three devices: Microsoft HoloLens, HTC Vive, and the iPad. The HoloLens provides the ability for users to place their data in their physical world, while interacting and viewing the model in mixed reality. AR generally provides a direct connection from the real world to the virtual object that the user is seeing. The iPad and the HTC Vive are alternate solutions to the HoloLens. Compared to the HoloLens, both devices can handle much more data and rendering at once. By placing data into physical or virtual spaces, IA creates a much different experience of analyzing data than a computer screen provides. Additionally, interactions now occur in a three-dimensional space, greatly changing how users interact

with 3D models and visualizations. Users can walk through and around their data, navigating it by physical movement.

Related Work

Although immersive analytics is a relatively new field, some case-studies and applications have bene published. However, to the best of our knowledge, no other tools exist that allow non-programmers to create immersive visualizations easily.

Colin Ware studied how 3D visualizations are useful to humans, and how we understand spatial awareness much better than in 2D visualizations [3]. It shows that 3D visualizations excel at providing information to the user when the data is naturally spatially mapped, as also shown within John et al.'s study [4]. These results motivate where immersive analytics is useful and why it may be an interesting research direction.

The two most similar applications to NiwViw are IBM's Immersive Insights [5] and Carmo et al.'s prototype of an environment with three-dimensional scatter plots [6]. Immersive Insights was a research project within IBM which used Jupyter to code the visualization, and then be able to view it on the Microsoft HoloLens. While the user could hover over a point using the cursor to view more information, there were performance issues in all the demos shown. Similarily, Donalek et al. also created a prototype displaying 3D visualizations, but in virtual reality as opposed to mixed reality on the HoloLens [7]. These applications lack the ability to enable non-technical users build their own experiences, and it is the void that NiwViw fills.
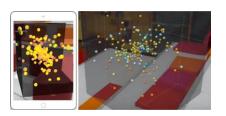
Figure 2. Both images show the same dataset with slightly different color and size choices assigned to the graphs. The left shows the visualization on an iPad, and the right is a screen shot through the HoloLens.

Figure 3. User interface on iPad for NiwViw.

NiwViw

The purpose of NiwViw is to enable non-programmers to design and create their own 3D visualizations within a physical space.

Capabilities

NiwViw is driven primarily by research and industry experiences as provided by our users. We use their feedback to explore additional functionality and ensure that people have no issues with the usability of the application. While we provide support for the HoloLens and the HTC Vive, most users will use the iPad to create their immersive visualizations. Hence, our focus is developing the iPad user interface and interactions. Figure 3 shows the iPad user interface for creating immersive visualizations. NiwViw provides the ability to:e visual

- Create 2D and 3D scatter plots and bar charts within an immersive environment, as shown in Figure 2.
- Create 3D maps with data mapped directly on scatter plot visualizations.
- Provides a histogram of data when an attribute is assigned to an axis.
- Create multiple immersive graphs within a workspace.

Interactions on iPad

After loading in a dataset, all of the dataset's attributes will appear in the left-hand column. There is an individual panel for each visual variable supported – x, y, z, color, and size. The attributes on the left hand column can be moved into each panel to assign that column to the visual variable. After an attribute is dragged on, a histogram shows how the attribute values are currently distributed in the dataset. The user interfaces to adapt to continuous columns versus discrete columns. Lastly, the size of the data points can be changed.

In a workspace, users can load in multiple datasets, or create different graphs with the same dataset. This workspace is saved onto the user's Google Drive, and can be retrieved and edited again. Initial user feedback shows that NiwViw is easy to use, and approachable for first-time users.

There are many applications on the iPad that deal with repositioning, rotating and scaling objects. These applications de-facto established an interaction vocabulary that iPad users know. For improved usability, we maintained this vocabulary within the 3D space of our application, although some of the two-

dimensional interactions do not translate directly into three-dimensions. This is a point of interest to explore as more users provide feedback to our application. A user uses a single finger to reposition visualizations, and two fingers can either be used to rotate or scale the object.

Conclusion and Future Work

This paper outlines NiwViw, an immersive analytics tool that allows non-programmers creating visualizations that they can place within their physical space. NiwViw's focus is on data that is inherently three-dimensional, since they are easier to understand when using augmented or virtual reality. Our authoring environment is inspired by Tableau's design, and is changed based on the feedback that we receive from users.

Our future work includes gathering additional user feedback, as well implementing different chart types that could make sense within the physical space. We view our application as a stepping-stone technology that allows users to explore their data with immersive technologies, and empowers non-technical users to view their data in a different light. Please visit https://niwviw.com for more information regarding our tool.

Acknowledgements

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