Project Overview

In 3D environments, an application’s display size changes based on its scale and position. The resizing of the display frequently occurs with user interaction. As a user moves closer to and further from an application, it's display size will increase and decrease respectively. Another common user interaction is scaling which will resize accordingly. As outlined above, the continuous changing of an application’s size is a prominent occurrence in augmented reality (AR) making the usability of an application at all display sizes critical for the user experience and efficient use of virtual content. In addition to usability, user satisfaction with the application's appearance, for all sizes, is necessary.

A similar challenge has been presented in 2D environments and has largely impacted the designing of web applications. Responsive design is used as an approach to application development, primarily used in web applications, that aims to render applications well for a variety of devices, window or screen sizes. This design methodology prioritizes usability and satisfaction for all display sizes.

The adaptation of an application’s appearance to all display sizes is necessary for user enjoyment and efficient use of augmented space. Therefore, responsive design in augmented reality should aim to create augmented reality applications that are both usable and satisfactory for all display sizes of the application through the implementation of dynamic changes to an application’s appearance depending on its size. Which in turn, allows for more efficient use of virtual space for multiple simultaneous 3D applications in augmented reality.

Initial Implementation

A clock with roman numerals

Description automatically generated with medium confidence A picture containing text, clock, white

Description automatically generated A picture containing text, clock

Description automatically generated

LOD3 LOD2 LOD1

This project will implement responsive design for augmented reality to ensure persistent usability of augmented reality applications and readability of its data for all display sizes. An application’s appearance will be categorized into level of detail (LOD) groups. As shown in the images above, the amount of data increases as the LOD group number increases. The key implementation aspects for this project are the dividing of an application into LOD groups, the smooth transitioning between LOD groups, and the developing of an algorithm to accurately display the LOD based on the application’s position and scale. In terms of legibility for text displayed on an application, the algorithm must also analyze the average font size within a LOD group and its minimum distance of readability.

Sources

S. DiVerdi, T. Hollerer and R. Schreyer, "Level of detail interfaces," Third IEEE and ACM International Symposium on Mixed and Augmented Reality, 2004, pp. 300-301, doi: 10.1109/ISMAR.2004.38.

Grigoris Daskalogrigorakis, Ann McNamara, and Katerina Mania. 2021. Holo-Box: Level-of-Detail Glanceable Interfaces for Augmented Reality. In Special Interest Group on Computer Graphics and Interactive Techniques Conference Posters (SIGGRAPH ’21 Posters), August 09-13, 2021. ACM, New York, NY, USA, 2 pages. https://doi.org/10.1145/3450618.3469175

Grubert, Jens & Langlotz, Tobias & Zollmann, Stefanie & Regenbrecht, Holger. (2016). Towards Pervasive Augmented Reality: Context-Awareness in Augmented Reality. IEEE Transactions on Visualization and Computer Graphics. 23. 1-1. 10.1109/TVCG.2016.2543720.

Furnas, George W. and Benjamin B. Bederson. “Space-scale diagrams: understanding multiscale interfaces.” CHI '95 (1995).

J. Grubert, T. Langlotz, S. Zollmann and H. Regenbrecht, "Towards Pervasive Augmented Reality: Context-Awareness in Augmented Reality," in IEEE Transactions on Visualization and Computer Graphics, vol. 23, no. 6, pp. 1706-1724, 1 June 2017, doi: 10.1109/TVCG.2016.2543720.

David Lindlbauer, Anna Maria Feit, and Otmar Hilliges. 2019. Context-Aware Online Adaptation of Mixed Reality Interfaces. In Proceedings of the 32nd Annual ACM Symposium on User Interface Software and Technology (UIST '19). Association for Computing Machinery, New York, NY, USA, 147–160. DOI:https://doi.org/10.1145/3332165.3347945

Yifei Cheng, Yukang Yan, Xin Yi, Yuanchun Shi, and David Lindlbauer. 2021. SemanticAdapt: Optimization-based Adaptation of Mixed Reality Layouts Leveraging Virtual-Physical Semantic Connections. In The 34th Annual ACM Symposium on User Interface Software and Technology (UIST '21). Association for Computing Machinery, New York, NY, USA, 282–297. DOI:https://doi.org/10.1145/3472749.3474750