

Large-Scale Outdoor Augmented Reality

Final Year Project (PFE 2024 - 2025) - Master 2 IIS

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Context

The Bivwac team at Inria studies how to convey data through immersive visualization experiences. When there is a need to explain large-magnitude data, it seems particularly interesting to use large-scale virtual objects. Placing these objects within physical environments using augmented reality (AR) can further help people relate to the objects and the values they convey (see Figures 1 and 2).



Figure 1: Photomontage showing the amount of material displaced and emitted to manufacture all smartphones in Paris. Source: Fig 13 from [1].



Figure 2: A 430-meter bar from a chart of government spendings, displayed in AR. Walking its full length takes 7 min. Source: [2], [3].

However, rendering large-scale virtual objects in AR is technically challenging, especially outdoors. For example, due to the technical difficulty of rendering the large-scale waste accumulation of Figure 1, our team mocked up the visualization using a photomontage (see discussion in [1], Section 7.3). However, rendering such waste accumulations—or similar infographics [4]—in AR could be interesting. More recently, our team successfully prototyped a large-scale bar chart visualization on a Meta Quest device (see Figure 2), but the Guardian system could only be partially disabled, leading to frequent warning messages that the user has exited the safety zone (see discussion in [3], Section 4.3).

Technology is progressing rapidly, and it is likely that technological solutions exist—or will soon exist—for rendering large-scale AR content outdoors. Recent research projects have demonstrated systems showing large-scale city-wide AR content [5], [6]. However, we do not have a clear picture of what is possible today, what are the capabilities of different solutions, and how robust they are.

Objectives

The goal of the project is to get a better understanding of current challenges and opportunities of large-scale outdoor augmented reality, for human-computer interaction and visualization research.

As part of this project, the students will be expected to:

1. Write a concise state-of-the-art overview. Because large-scale AR technologies are evolving rapidly, this overview should clarify what is currently possible, outline the main technical approaches with their key trade-offs, and list currently available tools and libraries.
2. Prototype a large-scale AR demo showing a data visualization that is ideally concrete [1] and situated [7]. The demo will rely on existing technologies and software libraries as much as possible.

The choice of technologies will be informed by the state-of-the-art survey. Open technologies like [Godot](#) are preferred, but their use is not mandatory if there are other constraints.

3. In collaboration with the advisor, select a specific technical challenge or limitation either encountered during the development or anticipated before the development, and address it through targeted software engineering work.

The students will be advised by [Pierre Dragicevic](#), researcher in the [Bivwac](#) team. They will be given the opportunity to talk to other students from the team involved in related projects, such as [Aymeric Ferron](#), who prototyped the system shown in Figure 2 as part of his PhD thesis, [Léana Petiot](#), who created the photomontage in Figure 1 along with other photomontages as part of her M1 internship, [Leni Yang](#), a post-doc working on related topics, and other permanent members. A head-mounted AR device may be available for use in this project, but availability is not guaranteed. The students are therefore advised to anticipate the absence of specialized AR equipment, for example by investigating what can be implemented on a smartphone.

Bibliography

- [1] A. Assor, A. Prouzeau, P. Dragicevic, and M. Hachet, “Augmented reality waste accumulation visualizations,” *ACM Journal on Computing and Sustainable Societies*, vol. 2, no. 2, pp. 1–29, 2024, [Online]. Available: <https://hal.science/hal-03907474v4/document>
- [2] A. Ferron, “Video – AROM - Proofs of Concept (Version 2).” Accessed: Jan. 07, 2026. [Online]. Available: <https://www.youtube.com/watch?v=n4Ez9DwukOQ>
- [3] A. Ferron, Y. Jansen, and M. Hachet, “AROM: Rambling Along Data in Augmented Reality to Explore Large Order of Magnitude Values,” in *Workshop on Visualization for Communication at the 2025 IEEE Visualization Conference*, 2025. [Online]. Available: <https://hal.science/hal-05224602/document>
- [4] Carbon Visuals, “Carbon Visuals – All projects.” Accessed: Jan. 07, 2026. [Online]. Available: <https://www.carbonvisuals.com/all>
- [5] A.-L. Zhou, L. Xi, and K. Zhang, “Mixed or Misperceived Reality? Flusserian Media Freedom through Surreal Me,” in *Proceedings of the Nineteenth International Conference on Tangible, Embedded, and Embodied Interaction*, 2025, pp. 1–9. [Online]. Available: <https://arxiv.org/abs/2410.12171>
- [6] A.-L. Zhou, “Video – Surrealism Me.” Accessed: Jan. 07, 2026. [Online]. Available: <https://www.youtube.com/watch?v=JpXIPmZLEnk>
- [7] W. Willett, Y. Jansen, and P. Dragicevic, “Embedded data representations,” *IEEE transactions on visualization and computer graphics*, vol. 23, no. 1, pp. 461–470, 2016, [Online]. Available: <https://inria.hal.science/hal-01377901/document>