“Same Scene, Different Designs?”: How Lighting Simulation Shapes Exhibition Lighting Design in Virtual Reality

M2– Human-Computer Interaction (2026/2027)

Internship period: 02/03/2027–31/08/2027

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Keywords:
Human-Computer Interaction, Virtual Reality, Lighting Simulation, Lighting Design.

Context and Background

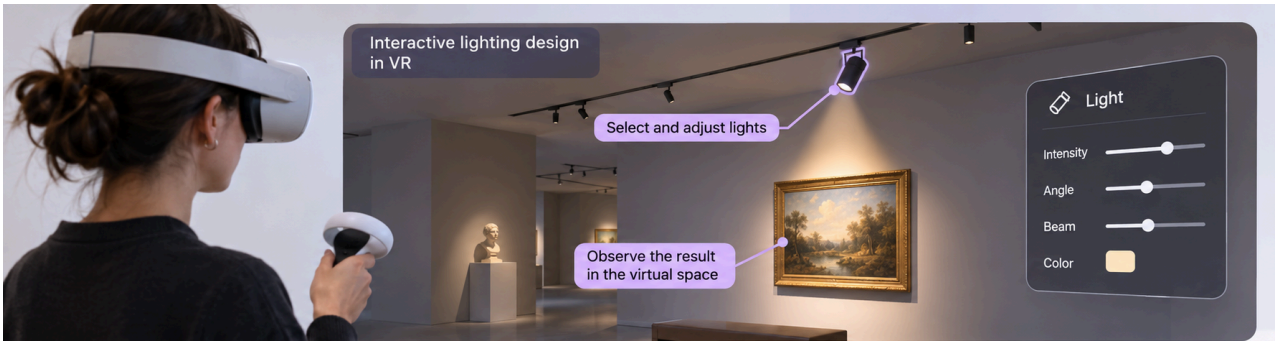

Figure 1: Conceptual illustration of interactive exhibition lighting design in VR.

This internship is part of MuseoXR, an ANR-funded research project investigating new tools for collaborative exhibition lighting design.

Lighting plays an important role in how artworks are presented and how people experience exhibition spaces. Virtual Reality (VR) allows designers to experiment with lighting at full scale, move through an exhibition, and observe its effects from different viewpoints. However, the appearance of a lighting configuration depends on how light is simulated. Different rendering techniques and approximations can produce different shadows, reflections, and indirect illumination, potentially influencing how users adjust and evaluate their designs.

Karlík et al. [2014] investigated how different approaches to simulating light, particularly direct and global illumination, influence novices’ performance and workflows during lighting-design tasks on a desktop computer. More recently, Scorpio et al. [2025] found that lighting professionals consider accurate light distribution important in VR and believe realistic lighting can influence design decisions. However, how different lighting simulation methods affect users' lighting-design decisions and workflows in immersive VR has received limited experimental attention.

Objectives and Research Question

At the ARAI team, we are developing interactive lighting simulation tools that provide a foundation for investigating this question.

How do different lighting simulation methods affect the way novices design and evaluate lighting in Virtual Reality?

Methodology

The internship will explore lighting design in virtual exhibitions, where participants can manipulate luminaires and observe the resulting illumination from within the environment.

The study may examine factors such as matching accuracy, completion time, lighting configurations, interaction patterns, perceived difficulty, and satisfaction with the results. The exact experimental tasks and lighting simulation conditions will be defined during the internship, with possible tasks including reproducing reference lighting, creating designs inspired by examples, and freely designing lighting configurations.

The intern will:

- Review research on lighting design, illumination simulation, and interaction in VR.
- Develop or adapt an immersive lighting-design environment supporting interactive lighting adjustments and different illumination models.
- Design and conduct user experiments investigating lighting-design tasks and workflows.
- Analyze participants' performance, lighting configurations, interactions, and feedback.

Project Originality and Implication

The results will contribute to understanding how lighting simulation influences the design process in immersive environments and inform the development of VR tools for exhibition lighting design.

Relevant Skills to Have

- Background in Human-Computer Interaction, interaction design, or experimental research.
- Interest in designing and conducting user studies.
- Experience with Unity, Unreal Engine, or similar 3D development tools.
- Familiarity with quantitative data analysis is a plus.
- Basic understanding of computer graphics and lighting simulation is appreciated.
- Good communication skills in English.

Expected Outcome

A VR lighting-design prototype, a user study, and an analysis of how different illumination simulation methods influence lighting-design decisions and workflows.

Master Internship Application

We are looking for a Master's student to join this project. Please send your CV, Bachelor's and Master's transcripts of records, and a motivation letter to francesco.dettori@universite-paris-saclay.fr.

References

[Karlík, 2014] Karlík, O., Růžička, M., Gassenbauer, V., Pellacini, F., & Křivánek, J. (2014). Toward Evaluating the Usefulness of Global Illumination for Novices in Lighting Design Tasks. IEEE Transactions on Visualization and Computer Graphics, 20(6), 944–954.

[Scorpio, 2025] Scorpio, M., Bladowski, A., Geisler-Moroder, D., Martyniuk-Pęczek, J., Sibilio, S., Pfluger, R., & Sokół, N. (2025). Virtual reality in lighting design: Insights from academia and an international survey among professionals. Journal of Building Engineering, 102, 112036.