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Cinematography in the Metaverse: Exploring the Lighting Education on a Soundstage

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Abstract

Lighting education is a foundational component of cinematography education. However, there is still a lack of knowledge on the design of a VR system for teaching cinematography. In this work, we present our VR soundstage system for instructors and learners to emulate cinematography lighting in virtual scenarios and then evaluate it from five aspects in the user study. Qualitative and quantitative feedback in our user study shows promising results. We further discuss the benefits of the approach and opportunities for future research.

Index Terms: Human-centered computing—Human computer interaction (HCI)—Interaction paradigms—Virtual reality

1 Introduction

Many art institutes do not have expensive soundstages for traditional cinematography lessons. In order to help students to manipulate the lighting in traditional cinematography, teachers will use slides talks or video presentations to finish the lessons instead of using the soundstages. In addition, even if a soundstage is accessible inside the school, students must undergo a lengthy booking and waiting period before they may utilize it. Physical soundstages require manpower for a great deal of heavy lifting, which adds extra time and effort to the learning process. Moreover, since every student is different and learning about lighting requires repeated observation and practice, physical soundstages cannot meet their personalized learning needs. Then, migrating physical setups to virtual experiences is a potential solution driven by metaverse initiatives [1]. The metaverse can provide diversified functions and venues such as mathematics , physics , and chemistry , similar to our physical worlds, and users could gain immersive experiences through mobile headsets. However, there is still a lack of knowledge on how to educate lighting in VR cinematography. Inspired by previous work [2–5], we aim to integrate lighting education and VR to explore the design of a VR system for teaching cinematography. Therefore, we present a virtual reality solution for lighting education on a computer-mediated soundstage including a set of system design considerations (see Fig. 1).

2 Method

We implemented the virtual soundstage using Unity, a common 3D game engine for building VR applications. We adapted the light model from Unity for light simulation. We used Unity Multiplayer Networking for networking between different users. A local server is hosted, and a join code is generated and provided to users to join using Meta Quest 2. Unity Multiplayer Networking enabled the application to transfer spatial information of different virtual objects and world data to all users for synchronization. Models including the soundstage, the large LED display, objects in the kitchen, lights, and the camera were built using Blender. Fig. 2 shows how to use the VR device's equivalent of the virtual soundstage.

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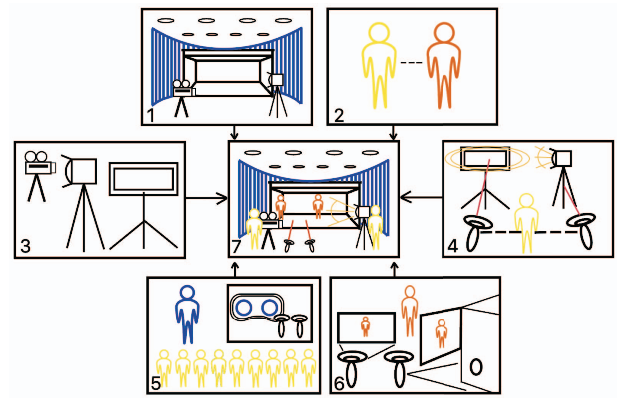

Figure 1: A pictorial description of our system. Picture 1 (P1) and P2 present the *Lighting on Scenes and Characters*. P3 illustrates the *Lighting Control Design*. P4 describes the *Auxiliary Visual Cues of Lighting*. P5 and P6 refer to the *Collaborative Design for Cinematography*. P7 gives an overview of the *Art Mirror System*.

3 Evaluation

To evaluate the usefulness and usability of our virtual soundstage, we conducted a user study with 16 participants including eight teachers (2 females, $Age_{mean} = 34$) and eight students (5 females, $Age_{mean} = 19$).

Protocol. Our user studies were conducted face-to-face in the field, with each participant group needing to complete a 40-minute experiment followed by an interview. Each experiment is one teacher to one student. The whole experiment was videotaped with authorization and user consent. Meanwhile, users were encouraged to think aloud during the experiment. During the user study, the teacher would work with the student on the virtual soundstage for teaching and learning in a one-on-one manner to finish a foundational lighting lesson. A lesson outline are available in the supplementary materials. After the lighting lesson and post interview, we distributed a questionnaire of thirteen questions that covered five topics: usability[1], sense of agency, realism, presence, and collaboration. Each question employs a seven-point scale. The first topic reflects the usability of our system, while the other four topic questions are commonly asked in virtual reality studies.

Results. Generally, from the perspective of 8 teacher users (T1-T8), all of they agreed using *Art Mirror* can improve soundstage teaching efficiency. T1, who had nine years teaching experience on cinematography commented that *"This system is very efficient and convenient, and I am satisfied with the lighting effects and experimental results achieved during the teaching process."* T3 also pointed out that *"The virtual soundstage allows for more possibilities than the real one."* From the perspective of 8 student users (S1-S8),

[1]http://www.measuringux.com/SUS.pdf

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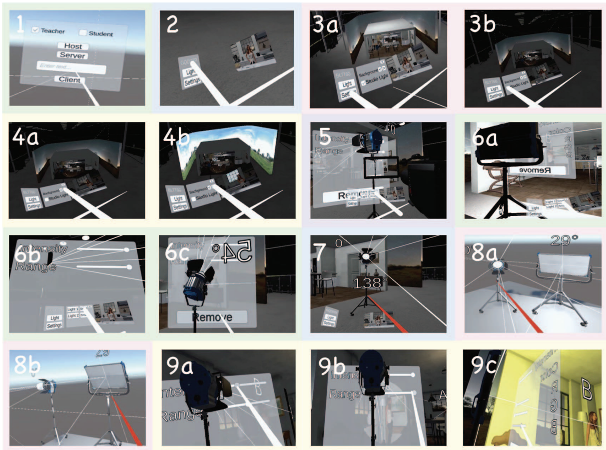

Figure 2: The virtual soundstage experiences to instructors and learners: (1) Login Pages (input names and roles); (2) Invitation codes and settings; (3) Soundstage lighting control, e.g., (3a) switching on the light; (3b) switching off the light; (4) Change of LED backdrop from a scene (4a) to another (4b); (5) Camera (calling or revoking the camera by pressing the button on the right-hand controller); (6) Adding or Removal of lights, e.g., (6a) the user's right-hand taps on the left-hand panel to control the lighting devices (two types, four configurations); (6b) When the users move closer to the lighting devices, the panel will appear, or vice versa; (6c) Removal of lighting devices; (7) Adjusting the position of lighting devices by ray-casting pointing to its supporting legs and performing a drag-and-drop; (8a) Adjusting the height of lighting devices by ray-casting pointing to its body and performing vertical movements (pointing upward/downward); (8b) Adjusting the angle of lighting devices by ray-casting pointing to its lamp and performing rotational movements by controlling the joystick on the headset's controller. (9) Changes of light intensity and range from (9a) to (9b); as well as (9c) Color (RGB).

all of them lauded the usability of *Art Mirror* as easy to learn and use. S2 praised that *"This virtual soundstage is interesting and fun, the scene is very real."* S7 noted that *"Art Mirror makes it simple to adjust the angle of all lights, allowing easy lights movement."*

As shown in Figure 3, we present our result in terms of usability, realism, presence, sense of agency, and (multi-user) collaboration. All related questionnaires and the rating result are provided in the supplementary materials.

User Feedback. According to feedback in the retrospective interview, we discuss the the design implications of realism and quantitative measurements for lighting education. First, **strike a balance between realism and functionality for learning effectiveness.** In a learning environment supported by virtual reality (VR), it is essential to consider the extent to which realism can aid teaching and learning depending on the scenario and the unique application. As a result of our study, we have revealed that the requirement for realism is counterintuitive. We found that instead of excessively seeking realism, we have to strike a balance between realism and functionality, and consider the relaxation of physical constraints for facilitating collaboration among users, such as allowing the users to walk through the walls to enhance the efficiency of the user's activities in the virtual soundstage. Second, **visualize quantitative measurements for lighting learning.** The auxiliary lines in the virtual soundstage serve as an important visual cue of reflecting the lighting effects. We treat this as an opening of quantitatively delivering the cinematography education scenarios. With the assistance of the auxiliary line in the virtual soundstage, the system can present the quantified results to the angle and range of the light. The outcomes shed light on applying other novel approaches for teaching lighting in which learners and instructors achieved enhanced

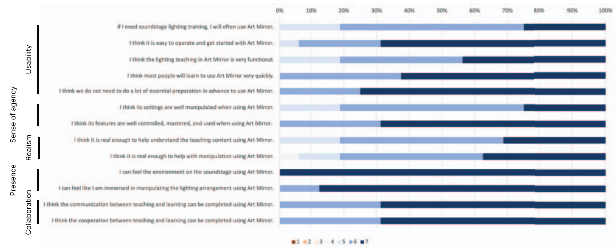

Figure 3: This figure shows the ratings of the participants on usability, realism, presence, sense of agency, and collaboration. (1 = Strongly disagree, 7 = Strongly agree)

communication of lighting education. Meanwhile, participants suggested that we should provide selective pop-ups based on the user context and accentuate the annotation of lighting areas when the lighting effects encounter a new material to adjust the properties of auxiliary lines. Moreover, our system can serve as a playground for introducing the effects of lamp power to the lighting distance.

In summary, the design of visualizing quantitative measurements by auxiliary lines in lighting effects for cinematography education not only helps novice learners acquire the basic concepts, such as the relationships among light ranges, angles, and distance, but also improves the communication between the instructors and students and teaching efficiency by this quantitative education.

4 Opportunities & Future Work

Based on user feedback, we reflect on opportunities for future research. First, we intend to add new scenarios and lighting accessories to the library to enrich the variety of material and modeling options. Second, since lighting education often involves collaboration among multiple learners and their instructors, enabling many users to work together may be useful and convenient. Our system can be extended to facilitate collaboration among learners and instructors in diversified scenarios, albeit our current evaluation only contains a kitchen scenario. It is worthwhile to note that the virtual soundstage can potentially adapt to other collaborative scenarios among learners and instructors. It is often feasible for the instructor to establish a virtual assignment for numerous individuals to work together.

5 Conclusion

This work explores how to support cinematography for lighting education on a virtual soundstage in the metaverse era. Through our evaluation with sixteen participants, Our system is easy to use and realistic, characterized by flexible environments and a strong sense of presence, which supports collaboration between instructors and learners in cinematography education. Our results demonstrate our system is usable and useful for cinematography lighting education, which sheds light on the design of VR cinematography education.

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