We implemented the virtual soundstage using Unity, a common 3D game engine for building VR applications. 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 the soundstage, the large LED display, objects in the kitchen, lights, 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.

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 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 including a set of system design considerations (see Fig. 1).

INDEX TERMS: Human-centered computing—Human computer interaction (HCI)—Interaction paradigms—Virtual reality

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, Agemean = 34) and eight students (5 females, Agemean = 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 video taped 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 lighting in a one-on-one manner to finish a foundational lighting lesson. A lesson outline is available in the supplementary materials. After the lighting lesson and post interview, we distributed a questionnaire of thirteen questions that covered five topics: usability1, 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 topics are commonly asked in virtual reality studies.

Results. Generally, from the perspective of 8 teacher users (T1-T8), all of them 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),

1http://www.measuringux.com/SUS.pdf
As a result of our study, we have revealed that the requirement for All related questionnaires and the rating result are provided in the (9a) to (9b); as well as (9c) Color (RGB).

The auxiliary lines in the virtual soundstage serve as an important visual cue of reflecting quantitative measurements for lighting education. First, interview, we discuss the the design implications of realism and outcomes shed light on applying other novel approaches for teaching lighting effects. We treat this as an opening of quantitatively measuring 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.

References