On the Use of Mixed Reality Environments to Evaluate Interaction with Light

Vassilis-Javed Khan[1], Martin Walker[1], Dzmitry Aliakseyeu[2], and Jon Mason[2]

[1] NHTV Breda University of Applied Sciences, Academy of Digital Entertainment, Mgr. Hopmansstraat 1, 4817 JT Breda, The Netherlands
{khan.j,walker.m}@nhtv.nl
[2] Philips Research Europe, Human Interaction & Experiences group, High Tech Campus 34, room 5.029 5656 AE Eindhoven, The Netherlands
{dzmitry.aliakseyeu,jon.mason}@philips.com

Abstract. This position paper presents a proposal for evaluating interaction with light in a mixed reality setup. Current processes of designing and testing new forms of user interaction (UI) for controlling lighting are long and end up being restricted in actually testing a small number of possible interactions. Apart from the apparent advantage of overcoming testing a small number of potential interactions, the advantages of a simulated environment lie in the fact that such an environment is fully controllable and adaptable to the researchers' needs. Finally, we sketch potential challenges of using a mixed reality setup for evaluating interaction with light.

Keywords: Lighting, User Interaction, Mixed Reality.

1 Introduction

Over the last few years, there has been a gradual transition towards computer-generated imagery being utilized to replace conventional photography. This has been accelerated in part by financial / budget restrictions forcing marketing departments to adopt more frugal approaches to their sales strategies, coupled with the increase in overall quality and affordability of advanced 3D rendering software and hardware

Typical industries that have long since used computer image visualization such as architecture and automotive design are now broadening into sectors such as furniture design and interior decor/design, as well as lighting design. This is largely due to the affordability and accessibility to high quality photo-realistic imagery. Once the reserve of larger organizations that had the budget for high-end hardware and software, not to mention access to skilled staff to operate such software, 3D software is now becoming a household product. Applications such as Google SketchUp, and various game engine level editors allow for free tools and information to the masses, and as the software evolves, it becomes ever more user friendly and “high level”.

R. Wichert, K. Van Laerhoven, J. Gelissen (Eds.): AmI 2011 Workshops, CCIS 277, pp. 45–48, 2012.

The cost and logistics of creating a photographic “set” of a kitchen, bathroom, office etc. are drastically higher than that of commissioning 3D images. Coupled with the benefit that 3D scenes are easily interchangeable and editable. The photorealistic quality offered by the latest software makes it difficult to visually discern the real from the virtual.

Moreover, the current process of designing and testing new forms of user interaction (UI) for controlling lighting is a long procedure of 6 to 12 months. The final manageable number of ideas can vary from 3 to 15 but inherently such filtration will inevitably mean the dismissal of many other ideas. The few short-listed solutions will then be built and tested with end users in a controlled and realistic environment. The main flaw of this approach is that after a number of months there is user feedback on only one or two different UI concepts. Moreover this approach limits what can be tested since some concepts, for example, include new forms of luminaries that would be simply impossible to evaluate in real settings.

In the few research studies that focused on evaluating user interaction with light, the setup of the study included lab studies in which participants interacted with light through a PDA [2], as well as lab studies which used a projector to imitate different light parameters and settings with a touch UI and a physical handle [4]. Another type of setup was reflecting upon a video of different light designs [3].

This position paper presents a proposal for evaluating interaction with light in a mixed reality setup.

2 Proposed Method

We propose an alternative approach for testing UI for lighting. This approach is via virtual prototyping, where the test environment is not physical but a virtual (pre-rendered) environment in form of a picture, animation or interactive 3D space. When assessing a new UI, the tested interface itself is as important as the output that this interface is driving or influencing. Users must not only understand the input device but also recognize the output and feedback from this interaction.

The advantages of a simulated environment lie in the fact that such an environment is fully controllable and adaptable to the researchers' needs. It is perfectly suited for experimental research where researchers need to control the environment while at the same time be able to observe and meticulously record observations and participant responses [1].

Our initial plan is to design and undertake a comparative user study between at least two different environments (real environment, virtual replica of the real environment). For this purpose we are currently busy implementing a virtual environment with a number of different light settings. An initial 3D rendering of the environment can be seen in Figure 1. This virtual environment is based on an existing physical one, which would enable us to conduct validation studies.

Fig. 1. Virtual representation of the existing lab. Participants will be asked to evaluate interacting with light in both the virtual and the actual lab.

2.1 Existing Setup

In our lab at NHTV Breda University of Applied Sciences we have developed a CAVE (Cave Automated Virtual Environment). A simulated 3D model of the living room of Philips Research's Experience Lab has been modelled in Maya and rendered in OGRE. This 3D model is projected in 4 rear- projection screens (each 3.6 meters wide by 2.6 meters high.

Our lab in equipped with a Microsoft Kinect that tracks the participants' head and limbs. In that way participants can move within the real space while the perspective of the 3D model is corrected, in real-time, according to the actual angle of viewing. In essence, the participant acts as a "human joystick", whereby the virtual camera will move in the direction the user is stepping, relative to the CAVE's center. In contrast with head-mounted displays, the CAVE does not block out the physical world, which offers the opportunity to use physical objects and the representation of the participant's own physical body. In this particular case it gives us the possibility to use gestures, an actual smartphone, or tablet device to actually control interaction with the virtual light sources.

2.2 Challenges

The virtual environments NHTV has been developing offers an immersive experience based on panoramic computer generated imagery. There are however immediate and obvious drawbacks.

To obtain photo-realistic results, we have adopted to create pre-rendered "still" images. The use of real-time graphics is an option, but at the cost of visual quality, which is paramount for a highly realistic lighting scenario. Such effects as high quality global illumination, caustic reflections, high quality shadowing is still much more realistic in pre-rendered images. Nevertheless, this will change in the near future as the advances in real-time engines and hardware advances.

Other restrictions we perceive are those of the physical environment of the CAVE. In reality a large contributor to the global illumination of any given room is light that is reflected from the ceiling. The CAVE requires an "open top" to allow for placement of the projection equipment.

Acknowledgments. NHTV authors would like to express their gratitude to the financial sponsor: the Dutch Ministry of Education, Culture and Science (OCW), RAAK scheme (project RAAK Pro). NHTV authors would also like to extend their gratitude to research director Dr. Hans Bouwknegt and to colleagues Dr. Koos Nuijten and Nils Deslé as well as to IGAD & IMEM colleagues and students for their work in creating the existing laboratory setup.

References

1. Dubois, E., Gray, P., Nigay, L. (eds.): The Engineering of Mixed Reality Systems. Human-Computer Interaction (2010), doi:10.1007/978-1- 84882-733-2_1
2. Lucero, A., Lashina, T., Terken, J.: Reducing Complexity of Interaction with Advanced Bathroom Lighting at Home. I-COM, Oldenbourg 5(1), 34–40 (2006)
3. Ross, P.R., Overbeeke, C.J., Wensveen, S.A.G., Hummels, C.C.M.: A transformational approach to interactive lighting system design. In: de Kort, Y., IJsselsteijn, W., Smolders, K., Vogels, I., Aarts, M., Tenner, A. (eds.) Proceedings Experiencing Light 2009 International Conference on the Effects of Light on Wellbeing, Eindhoven, The Netherlands, October 26-27, pp. 129–136. Eindhoven University of Technology, Eindhoven (2010)
4. van Boerdonk, K., Mason, J., Aliakseyeu, D.: User Interface for Task Lighting in Open Office. In: Proceedings of the Workshop on User Interaction Techniques for Future Lighting Systems (in conjunction with Interact), pp. 23–27 (2011)