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Virtual and Physical Architectural Atmosphere

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ABSTRACT

This study, of the similarities between the perception of architectural space experienced in physical space conditions and in Virtual Reality, intends to clarify to what extent subjective and objective attributes of architectural space can be conveyed through a direct use of Building Information Models in Virtual Reality. 60 test persons experienced a specific test space as either a physical or a virtual environment, while data from their experiences was collected through a quantitative/qualitative questionnaire. The overall conclusion, from this phase of the study, is that even a simple BIM model through HMD VR can convey rather precise information about both subjective and objective experiences of architectural space, ambience and atmosphere. Next phase of the study will include eye-tracking data from the two scenarios.

Keywords: Perception of Space; Virtual Reality; Head Mounted Display; BIM; Architectural Design

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VIRTUAL AND PHYSICAL ARCHITECTURAL ATMOSPHERE

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Abstract

This study, of the similarities between the perception of architectural space experienced in physical space conditions and in Virtual Reality, intends to clarify to what extend subjective and objective attributes of architectural space can be conveyed through a direct use of Building Information Models in Virtual Reality. 60 test persons experienced a specific test space as either a physical or a virtual environment, while data from their experiences was collected through a quantitative/qualitative questionnaire. The overall conclusion, from this phase of the study, is that even a simple BIM model through HMD VR can convey rather precise information about both subjective and objective experiences of architectural space, ambience and atmosphere. Next phase of the study will include eye-tracking data from the two scenarios.

Keywords: *Perception of Space, Virtual Reality, Head Mounted Display, BIM, Architectural Design.*

1. Introduction

This extended abstract introduces a study of the similarities between the perception of architectural space experienced in “normal” physical space conditions (A) and experienced using Virtual Reality (VR) Head Mounted Display (HMD) technology (B). The examination intends to clarify to what extend subjective and objective attributes of architectural space can be conveyed through a direct use of VR Building Information Modeling (BIM) models. A self-chosen constraint in the experiment dictates that the VR model loads directly from the modelling software to the viewer software without need of conversion through other software. The importance of this, relates to the limitations of time and money in the early architectural design phase, that for the present simply makes the creation of a photorealistic VR environment, as seen e.g. in the gaming industry, unfeasible. The next step in the study will be to include recorded eye tracking data, analyze it, and map it to these results.

2. Literature Review

Leyrer et al. [1] concludes that when designing and creating virtual

environments in which the perception of spatial layout is important, eye height as well as a self-representing avatar should be taken into account to produce the desired perception. While good studies on distance measurement in VR exist [2], the study of architectural space or its ambience in VR have not to our knowledge been carried out before, in similar tests. Mikael Johansson et al. [3] have analyzed existing viewers and developed a prototype VR BIM viewer that we have been able to use in our experiment’s virtual scenario.

3. Research Methods

The experiment was set up using an auditorium at the Royal Danish School of Architecture as the physical location (A) and a BIM model of the same auditorium as the virtual location (B). In the situation A, we define the “normal condition” as a situation where a test person is experiencing a specified existing physical architectural space.

In the situation B, the same architectural space, is presented to the test person through the HMD VR technology Oculus Rift, using a 3D digital architectural building information model. We use a

quantitative/qualitative interview matrix to assess to what extent the perception of space through VR technology holds similarities to the experience under normal, or close to normal, circumstances. In each scenario were used the same two specific locations (using the test person's correct eye-height in the viewer). Here the test persons were asked questions about their perception of the space they were in. First they were asked to describe their experience of the atmosphere of the room with three words, and the experience of the height of the room with one word. Afterwards they were asked 17 questions answerable on a scale from 1-7, and three questions about estimation of depth, width, and height of the room. These questions addressed four different areas of architectural perception: The space itself, lighting, sensation & estimation, and materials. The matrix questionnaire is inspired by C. Melhuish's definition of corpothetics [4] and S. Zeki's work on micro-/macro-consciousness [5]. The results from the two scenarios provided the dataset for comparing the physical and the virtual experience of the room. We used 60 students for the test: 30 for each scenario.

4. Discussion and Conclusion

The result of the study shows high similarity between the two scenarios with a difference of less than 1% in 11 of the 20 questions, 1-2% in 4 of the questions, 2-3% in 2 of the questions. Only three questions had a difference higher than 3 %; respectively 3.4%, 4.1%, and 5.2%. The latter, highest difference, relates to a question about perception of the quality of the materials in the room. This was expected, since this particular quality is presumed difficult to provide through VR vision only. The results related to both lighting and feeling well and safe in the room hold, more surprisingly, a difference below 1%, even though the virtual model did not provide accurate light or any shadows. The results from the open questions about the experience of the

atmosphere in the room are surprisingly close when compared. Thus, the top three of freely chosen words describing the atmosphere in the two scenarios, out of 90 words describing each scenario, were respectively: Bright (67%), Quiet (33%), Open (27%) in the physical and Bright (50%), Open (30%), Empty (17%) in the virtual. The term 'quiet' makes sense in the physical environment, while the VR did not include any audial stimuli. The overall conclusion, from this phase of the study, is that even a simple BIM model through HMD VR can convey rather precise information about both subjective and objective experiences of architectural space, ambience and atmosphere.

5. References

- [1] Markus Leyrer, Sally A. Linkenauger, Heinrich H. Bühlhoff, Uwe Kloos, and Betty Mohler. (2011). The influence of eye height and avatars on egocentric distance estimates in immersive virtual environments, *Proceedings of the ACM SIGGRAPH Symposium on Applied Perception in Graphics and Visualization (APGV '11)*, USA: 67-74.
- [2] Messing, Ross; Durgin, Frank H; Distance perception and the visual horizon in head-mounted displays, *ACM Transactions on Applied Perception (TAP)*, 2, 3, 234-250, 2005, ACM.
- [3] Johansson, M., Roupé, M. och Bosch-Sijtsema, P. (2015), Real-time visualization of building information models (BIM), *Automation in Construction* 54 (2015): pp. 69–82.
- [4] Kester Rattenbury (editor) *This Is Not Architecture* (Routledge, 2002). p. 227.
- [5] Harry Francis Mallgrave, *The Architect's Brain: Neuroscience, Creativity, and Architecture* (Wiley-Blackwell, 2010): pp. 142-171.