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Kreutzberg, Anette; Bohn, Claus

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Bohn & Kreutzberg, February 2014

The Virtual Promenade

Keywords: Virtual Reality; Oculus Rift; Stereoscopy; The Architectural Promenade; City planning; Architectural Representation.

On the 110th floor, a poster, sphinx like, addresses an enigmatic message to the pedestrian who is for an instant transformed into a visionary: It's hard to be down when you're up.
[Michel de Certeau, The Practice of Everyday Life]

Didactic experiments on the potentials of combining conventional and digital modelling of the city experienced in movement.

Abstract

Through a 3 week workshop in March 2014 a group of third year students from The Royal Danish Academy of Fine Arts, School of Architecture will create their own imaginary city based on phenomenological experiments in Copenhagen and an interpretation of these experiences combining conventional and digital modelling. The workshop serves as an education-based research project in which we want to investigate the potentials of working consciously with bodily movement as a generator in the creation of architecture by combining actual experience of the city with conventional model building and digital modelling seen through latest Virtual Reality technologies.

Thus the research question is two-folded: What kind of architecture can we imagine and conjure through movement combining classical tools and methods with newest technology and how do we respond to these new tools and integrate them in the education of future architects?

This paper is therefore likewise divided. The first part is about the city and the architectural tools involved in the workshop. This section is titled Representing the City. The second part is elaborating on the technical aspects of the Virtual Reality technology used. This part is titled Applied Desktop Virtual Reality.

Representing the City

Urban area architecture is often developed as static diagrams, projection drawings, small-scale models and fixed perspectival images in a continuous process from outside and inwards – from master plan to doorknob. This rational approach is communicable and buildable, but often distanced from the actual experience of its built reality; our life and environment is always experienced in an embodied and opaque totality - and always experienced in motion.

If we want to grasp the complex relation between the rational overview and the actual sensation when creating architecture, we need a deliberate use of the means of our investigation; the different

architectural tools and methods lets us understand and represent different and equally important aspects of architecture; from the urban planner's analytical overview to the sensation and atmosphere of the local coffee shop. Movement might here serve as link between the whole and the part, which is why the launching of this experiment begins with phenomenological strolls around various neighbourhoods of Copenhagen. These walks are inspired and organized inspired by Walter Benjamin's notion of the flâneur and the writings of the situationist Guy Debord who wandered the streets of Paris in the fifties.

The four modes of representation

After these initial exercises the workshop is based on effective and low-cost methods and tools available to students in general: conventional model making as both structure models in 1:500 / 1:1000 and as scenographic sets in 1:25 and Sketch-Up for digital modelling. In addition to this, we experiment with a prototype of VR technology which soon will be available and affordable to the general public. Working consciously with these different architectural tools, we will search for their individual potentials and particularly their possibilities as combined ways of approaching a fuller architectural understanding. Which tool serves what purpose?

The following assumptions on the various tools engaged in this workshop will be addressed, tested and challenged:

The Structure Model

The conventional structure model in e.g. 1:1000 in foam or card provides a static, analytical overview. The total of the urban fabric can be read as nodes, landmarks, openings, infrastructure, neighbourhoods etc. from a distant vantage point. Rational understanding of composition and its overall structure is possible. As the voyeur looking at Manhattan from the top of the Empire State Building - as phrased in the beginning by de Certeau – the architect can see the small-scale model from above: “It allows one to read it, to be a solar Eye, looking down like a god.”¹



The Scenographic Set

This kind of model falls short, when dealing with the actual architectural experience; the scale distances us from its “interior”; we look down upon it and have to rely on our imagination when it comes to the actual experience and perceptive experience of the city. The detailing, life, materiality, weight etc. remains vague or unknown. These fundamental aspects of architecture seem more

¹ Certeau, de M. *The Practice of Everyday Life* (Los Angeles: University of California Press, 1988) p.92

appropriate to approach in a bigger scale. The conventional and detailed large-scale model or scenographic sets - in e.g. 1:25 in card or wood - can provide us with good possibilities of examining architectural and sensual experience of the project. It can be made fast and altered spontaneously and is present as physical and haptic object to be touched and discussed in this world.²



The Digital Model

Then again this technique has its limitations. If we want to come close to materiality and detailing, for example, the scale and time required, makes it relevant to use when dealing with single buildings, but not sequences of spaces like a street. It is simply too big and complex to build. This is exactly the immediate strength of the digital model: It has a certain overview as the conventional structure model and the possibility of diving down into it – realizing its perspectival and spatial character. What the ordinary 3D sketch model can't provide though, is the sense of gravity and embedded sensation of reality. It is still experienced flat on a 2D screen.

VR Technology

With Virtual Reality we can approach architecture in real eye height as a total experience with free and realistic movement within the project. This leaves the notion of the Architectural Promenade and Corbusier's saying: "Architecture is circulation"³ an actual possibility while designing. What digital models lack though – even experienced with VR technique, is the haptic and material presence of the bigger scenographic sets.

Hereby the circuit is closed: Each of the mentioned architectural tools has strengths and weaknesses. We want to investigate the haptic, sensational qualities of the city at all scales, and we will seek new ways to combine the conventional and digital models in an effective workflow with added value.

Applied Desktop Virtual Reality

The incredible sense of presence in the Virtual Reality world, with the Oculus Rift head mounted VR googles, pushes boundaries of what is perceived as real. The effect of occluding the real world around you makes the impression of you being surrounded completely by the VR environment. When you turn your head your vision doesn't reach the edge of any screen or visual device, the model is all around you, when you look up you see the sky, when you look down you see the ground and when you turn to look back you realize you are not merely a spectator but you are IN the model.

² As addressed by Juhani Pallasmaa in Pallasmaa, J. *The Eyes of the Skin* (West Sussex: Wiley, 2005)

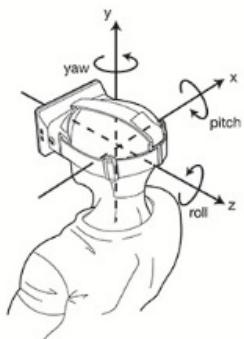
³ Le Corbusier, *Le Corbusier Talks with Students: From the Schools of Architecture* (New York: Princeton Architectural Press, 1999), p. 47.

Virtual Reality Immersion

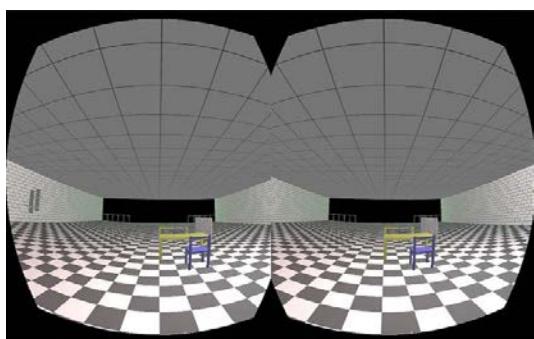
First time experience with the Oculus Rift VR setup can be very overwhelming, you feel totally immersed although the model that you are immersed in might not be very photorealistic or “real”. In our initial tests with 2nd year architecture students investigating an Oculus Demo scene, all test persons reacted by expressing something like: “Wow this is amazing”. The fact that you can actually see large square pixels on the screen due to low resolution seems not to distract or ruin the overall experience.

Technical Setup

The Oculus Rift is a head mounted device with a screen showing two stereoscopic images through optical lenses, connected to a computer as a second screen duplicating the primary screen. The display screen has a resolution of 1280x800 pixels shared between the two eyes. The Oculus Rift hardware includes a gyroscope, accelerometer, and magnetometer. The information from these sensors is combined through a process known as sensor fusion, to determine the orientation of the user’s head in the real world, and to synchronize the user’s virtual perspective in real-time.⁴



The lenses in the Rift magnify the image to provide an increased field of view, but this comes at the expense of creating a pinching distortion of the image. This radially symmetric distortion can be corrected in software by introducing a barrel distortion that cancels it out.



WalkAbout3d is a standalone interactive 3d content viewer capable of showing stereoscopic views and correct pinching distortion. It also works as a plug-in to SketchUp 3d modelling software. Students can investigate their preliminary 3d designs continuously, supporting an iterative design process at their studio desk in a familiar setup, since the stereoscopic features are reached from within SketchUp.

Depth cues and Level of Abstraction

In VR it is possible to realise the city’s perspectival and spatial reality in real scale 1:1 constraining the eye height to match the one of the viewer. Since we measure our surroundings according to our own

⁴ Anthony M, et al., *Oculus VR, SDK Overview Version 0.2.5* (2013)

body and eye height we utilize one of the monocular depth cues; familiar size. Architects are trained in reading 3d from lines only. Walking inside a 3d line drawing, a model without surface detail apart from flat shading is assumed to be sufficient for general observations. Other monocular cues like perspective, occlusion and depth from motion also provide depth information when viewing a scene in VR. Binocular cues (3 dimensional) like stereopsis provide depth information when viewing a scene with both eyes; this is simulated by two virtual cameras set up to match the viewer's interpupillary distance.

Navigation

Navigating in VR with Oculus Rift using keyboard and mouse in initial tests turned out to be quite difficult; only experienced gamers felt comfortable with this setup. A 3d-track ball (3DConnexion SpaceNavigator) proved more intuitive to gamers as well as non-gamers. Aiming at a setup as close to the daily work situation seated at a table as possible, it appeared to be a more convincing experience to be standing up while navigating thus having a physical eye height corresponding to the virtual eye height avoiding double horizon confusion. With no height adjustable tables available though, interacting with the VR environment with keyboard and mouse or 3d-trackball was not very convenient. A wireless X-box 360 game controller proved to be very user-friendly and versatile in this situation, although not a traditional tool of an architect.

Motion Sickness

The exceptional depth cues of foreground, middle ground and background are very vibrant and seem to be exaggerated in combination with the stereoscopic vision inside VR, especially when you experience looking down at something placed lower than your standing ground. When moving forward at a fast pace or looking around vigorously most students experienced some motion sickness or felt uncomfortable. By limiting the forward motion speed and ask students to only look around in slow motion these uncomfortable feelings were almost eliminated. When students got used to navigate in VR these issues seem to diminish, which indicates that you can train the ability to avoid motion sickness.

Crystal Code, the newest development version of the Oculus VR head device, features positional tracking with 3 directions of freedom and a low persistence display promising to almost eliminate motion blur and improving visual stability for a more comfortable experience.

Outcome

The workshop will provide us with an abundance of architectural visions on the city in very different modes of representation: Mapping of the existing city, collages, 3D models and physical models in various scales. Additionally we want to make a short film of the new city as a combination of 3D walk-through and model photographs. All the material will be exhibited publicly after the workshop.

Besides analysing this material and reading it as architectural consequences of the chosen methods, we want to address didactic and technical aspects of the experiment through interviews and observations in the studio: What kind of skills and knowledge do the students obtain? What technical and practical issues may have to be addressed? How can we channel possible answers into our next workshop?