

VR Awareness Project

Year 1 Report



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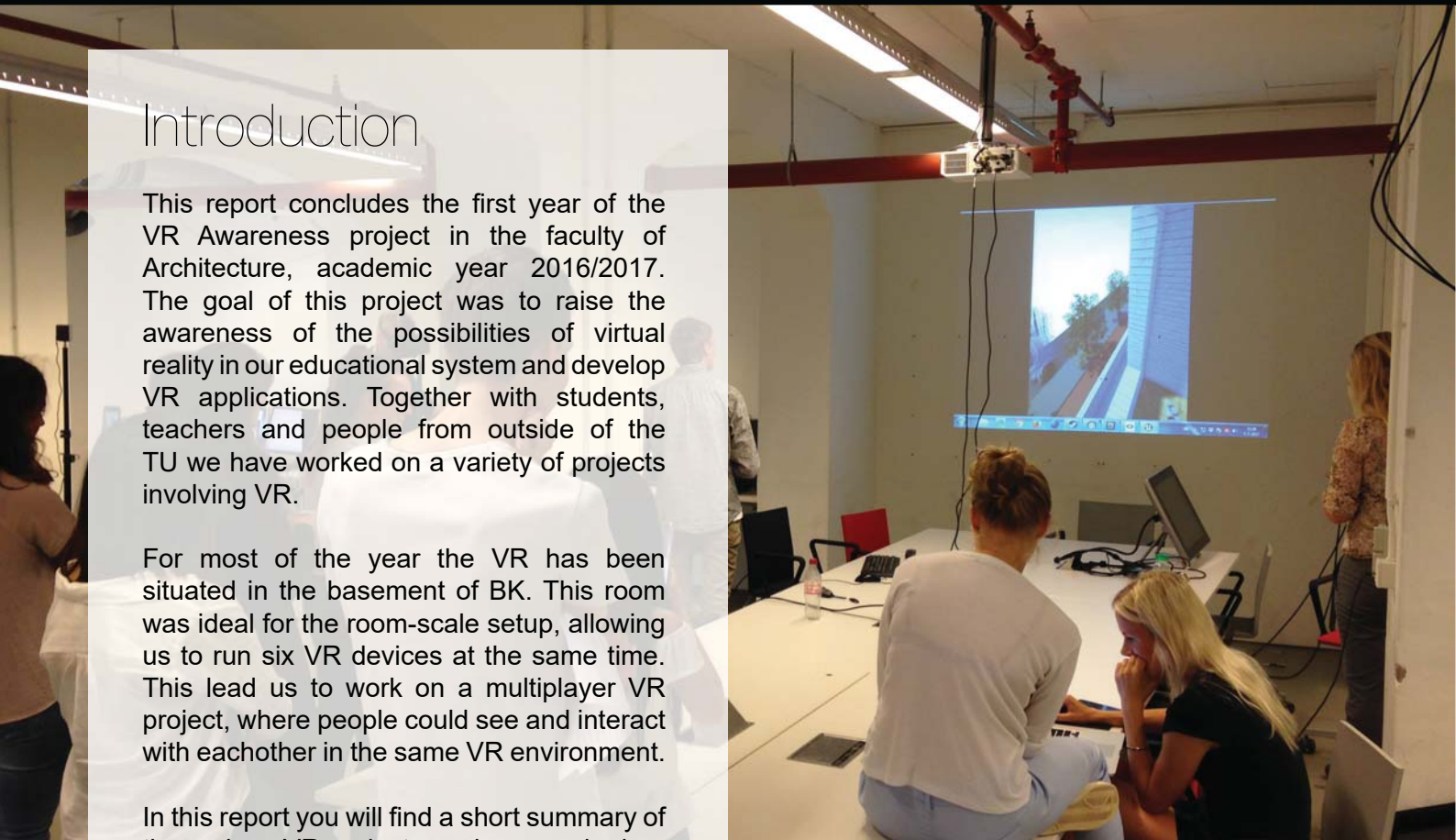
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Introduction

This report concludes the first year of the VR Awareness project in the faculty of Architecture, academic year 2016/2017. The goal of this project was to raise the awareness of the possibilities of virtual reality in our educational system and develop VR applications. Together with students, teachers and people from outside of the TU we have worked on a variety of projects involving VR.

For most of the year the VR has been situated in the basement of BK. This room was ideal for the room-scale setup, allowing us to run six VR devices at the same time. This led us to work on a multiplayer VR project, where people could see and interact with each other in the same VR environment.

In this report you will find a short summary of the various VR projects we have worked on with a selection of photographs and screen captures to illustrate the projects.



VR Lab Architecture



VR BkCityLab

This VR exposition hall is the result of the initial project to experiment with the HTC Vive and how its features can be used in architecture and possibly other fields of work. The model is built from the ground up in the Unreal 4 game engine using Maya for the 3D modeling and Substance for texturing.

Inside this VR environment there are different exhibits where the user can try out different interactions in VR using the motion controllers. In here it's possible to design and build in VR, see models in a technical exploded view, use the motion controllers to draw in 3D space allowing you to make sketches or comments on any model, scale the world around you up or down to experience a design in different scales, and more.

Developing this project was a great learning experience for us to figure out the ins and outs of VR and to give an idea about the possibilities on how to integrate VR into our education.



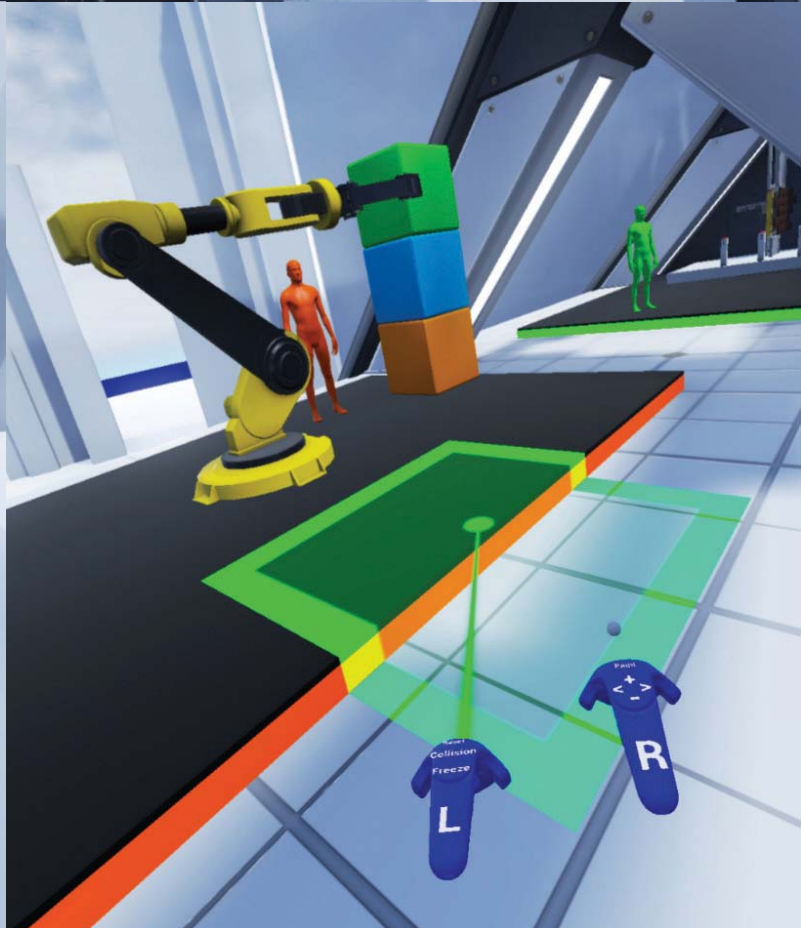
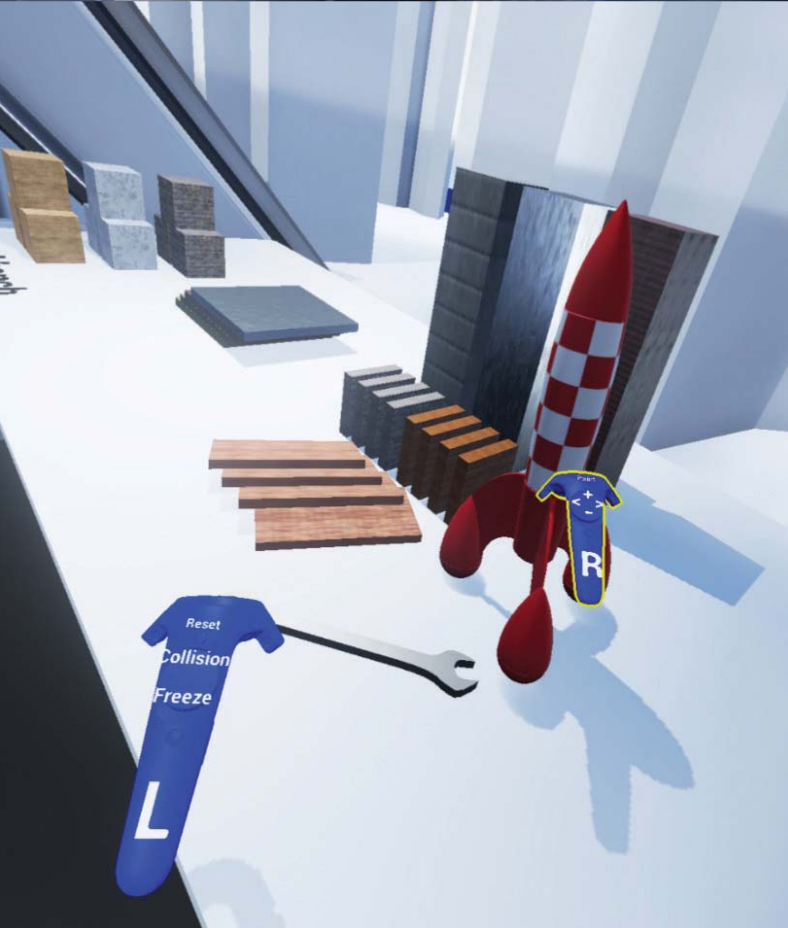
VR BkCityLAB
"Onwards and upwards!"



VR BkCityLAB
"Onwards and upwards!"



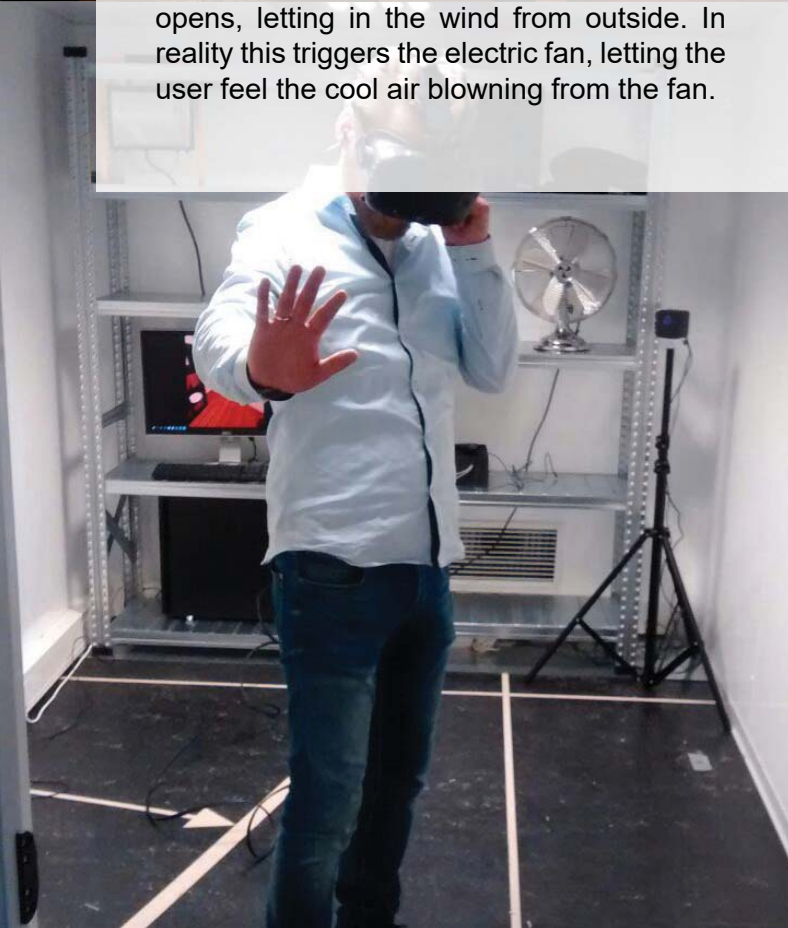
Exploded View



Science Center SenseLab VR

This room was developed for the SenseLab, the new learning exhibit in the Science Center on the TU Delft Campus, in collaboration with Philomena Bluysen. In this environment we have added extra senses to the VR experience. To achieve this we connected an Arduino board to the Unreal Engine, which controls a relay that switches on an electric fan and a 500W construction light.

In the virtual space the user can open the window blinds in the ceiling to let in sunlight, which simultaneously turns on the construction light. When standing directly in the sunlight you can feel the warmth of the high voltage construction light radiating on your body, adding the sense of temperature to VR. Then there is another window that opens, letting in the wind from outside. In reality this triggers the electric fan, letting the user feel the cool air blowing from the fan.





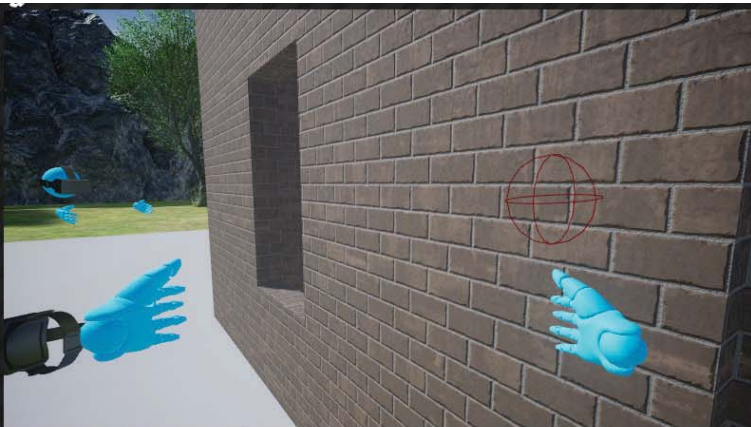
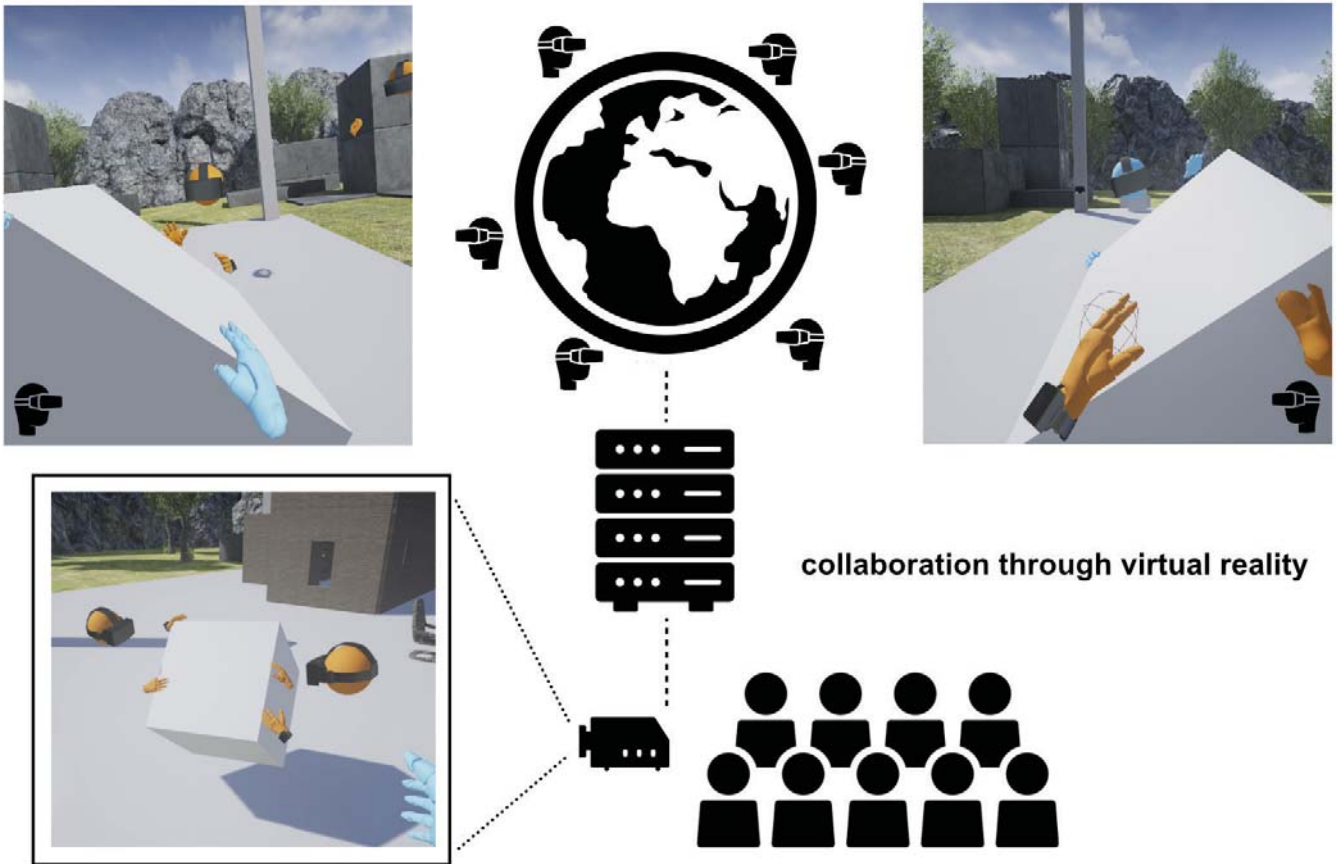
Multi-user VR

One of our current running projects is creating a VR environment that allows multiple people to join in and collaborate together. Connecting over the internet through Steam, users will be able to see and interact with each other in virtual reality. This counters a general idea that VR might be too isolating, because most of the VR applications are still an individual experience.

By having a multi-user VR platform, we could organize online VR lectures and visit places in VR together. Also students would be able to present their designs to their teachers and colleagues, all together in virtual reality. This way everyone can experience the advantages of virtual reality. Teachers can comment on the students' work in VR, by making annotations and comments with the 3D painting tool.

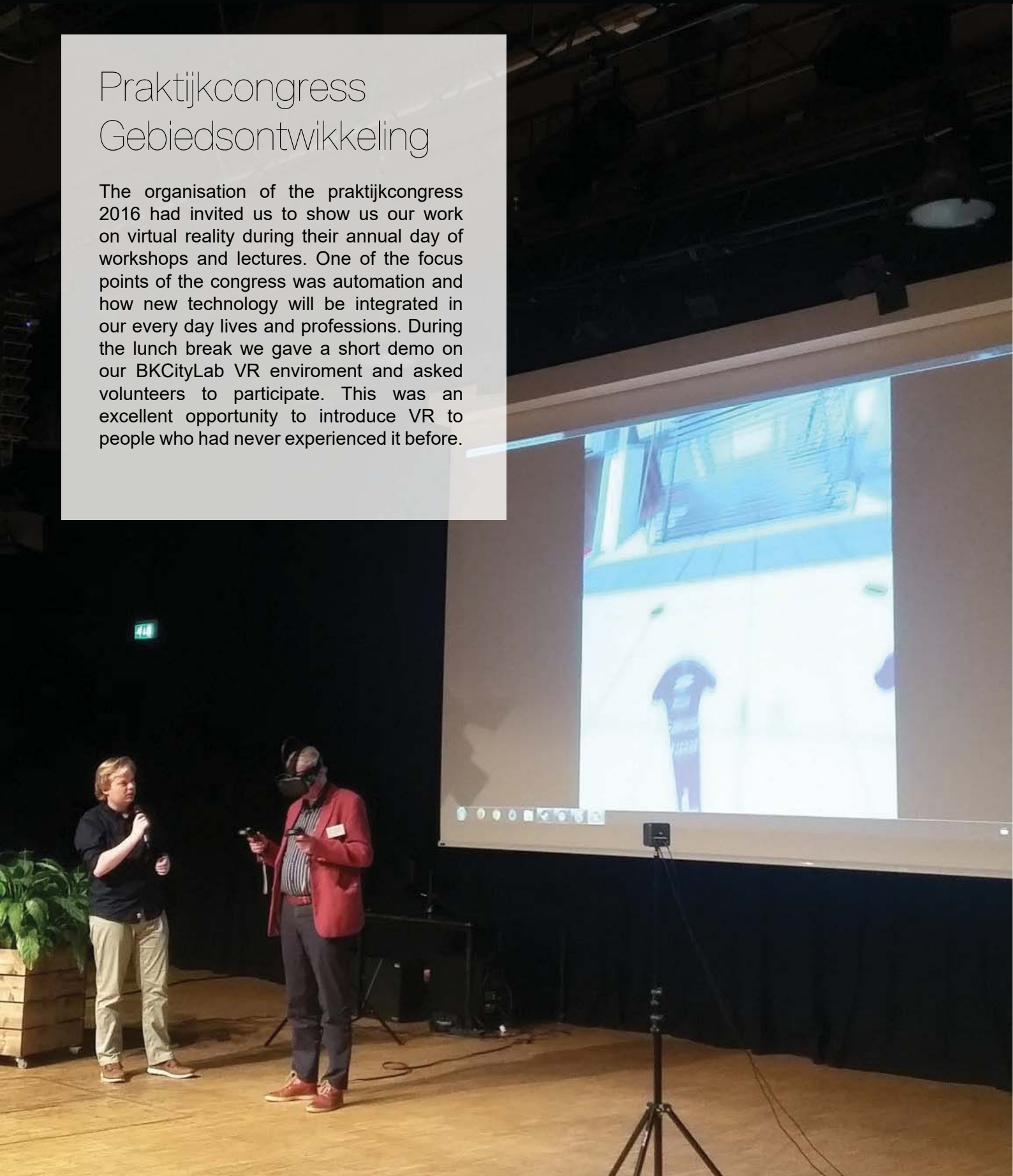
This project will continue development in the upcoming year.





Praktijkcongress Gebiedsontwikkeling

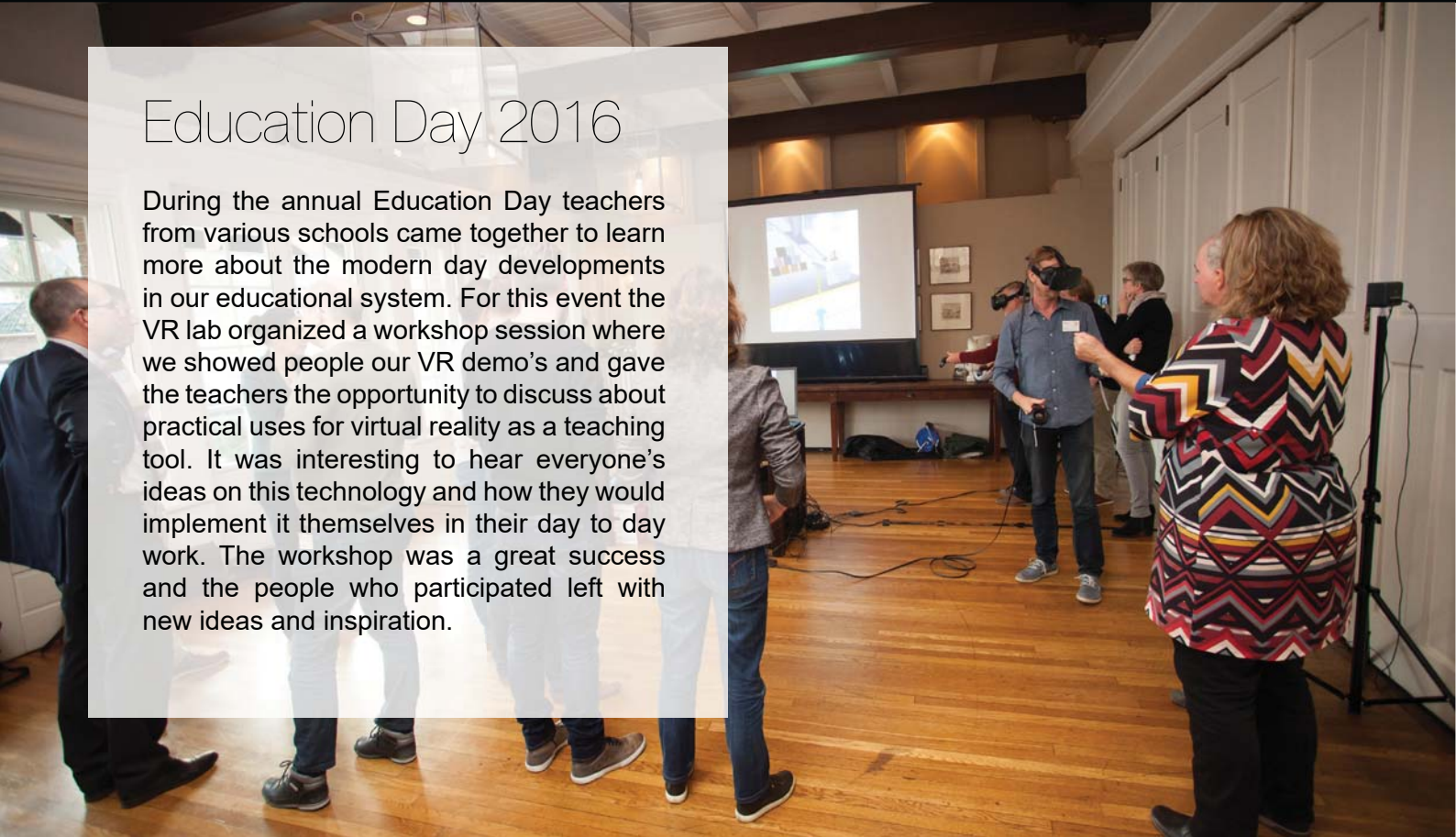
The organisation of the praktijkcongress 2016 had invited us to show us our work on virtual reality during their annual day of workshops and lectures. One of the focus points of the congress was automation and how new technology will be integrated in our every day lives and professions. During the lunch break we gave a short demo on our BKCityLab VR environment and asked volunteers to participate. This was an excellent opportunity to introduce VR to people who had never experienced it before.





Education Day 2016

During the annual Education Day teachers from various schools came together to learn more about the modern day developments in our educational system. For this event the VR lab organized a workshop session where we showed people our VR demo's and gave the teachers the opportunity to discuss about practical uses for virtual reality as a teaching tool. It was interesting to hear everyone's ideas on this technology and how they would implement it themselves in their day to day work. The workshop was a great success and the people who participated left with new ideas and inspiration.





International Festival of Technology

The International Festival of Technology (IFoT) is an annual event taking place in Delft where people from all over the world can attend to and get a peek into the new technologies of different fields of activity.

For this event we were asked by a group of students to assist them with a workshop where they would make a virtual reality experience of their own design. During a number of weeks the students got together and came up with a VR experience where people would get a glimpse of life in the future.

The VR attraction was very popular at the event and people were waiting in line all day to get a turn.





Workshop & Seminar City of Realities

City of Realities was an interactive workshop, organized by KNOB (Koninklijke Nederlandse Oudheidkundige Bond), 4TU. Bouw and CLICKNL to make a roadmap for VR and AR in the historical built environment.

The day consisted out of a morning and afternoon of workshops, with in the evening a seminar with presentations by people from outside of the TU who also use virtual- and augmented reality in their office.

The day was a great success and everyone left inspired by all the different ideas and looks into other people's work with VR and AR.



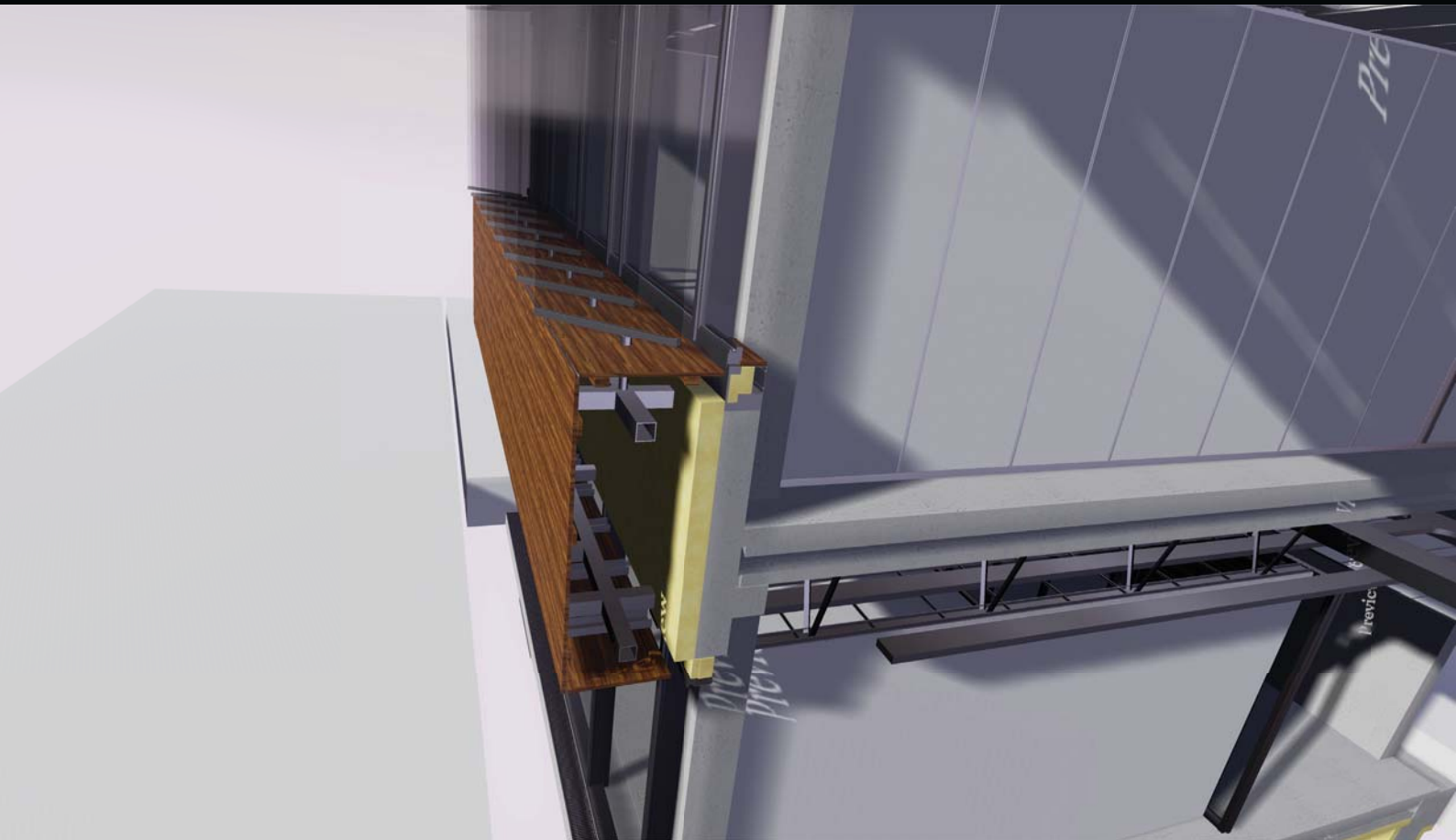


BK3TE4 - VR Pilot

This bachelor pilot course was run by Frank Schnater and was an experiment to see how VR could be used as a tool in bachelor education. The students made a technical design for an office building or school, modeled in Rhino. This model was imported into Unreal so it could be viewed in VR.

When viewing the designs in VR it is possible to move around the building and grow or shrink the viewer, so every part of the design could be closely evaluated. This lead the students to notice their faults in their technical detailing much quicker, since their buildings could be experienced in a 1:1 scale stereoscopic view.

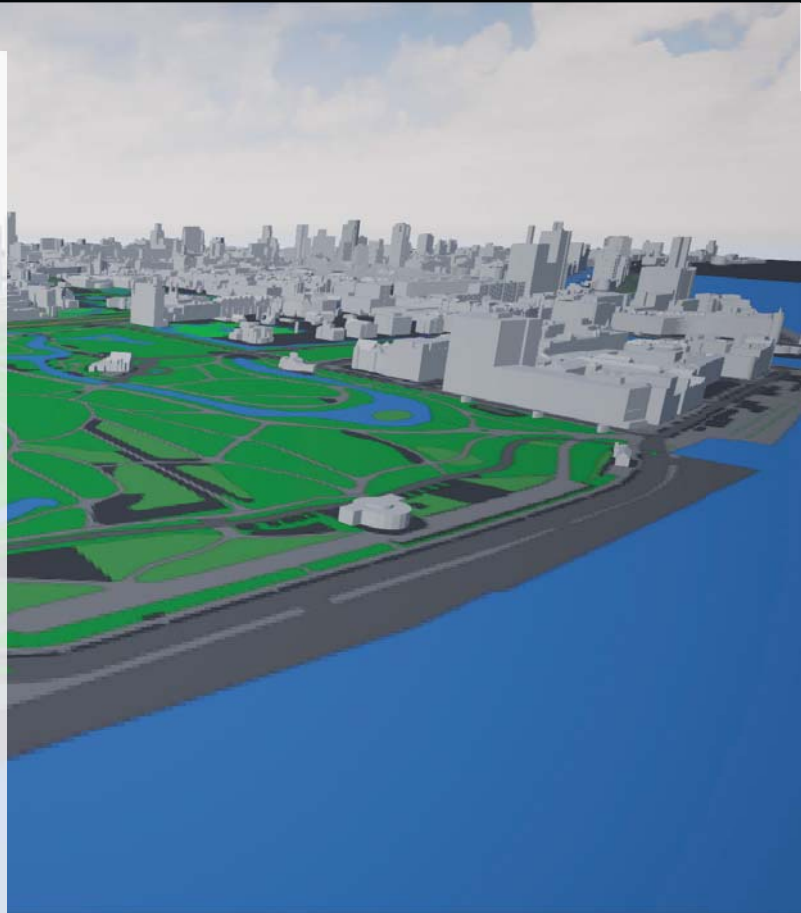




ON3 - GeoDesign

For the students of BK3ON3, GeoDesign, we made a VR model of the Hoboken area in Rotterdam. In this model the students can move around in human scale, and with the pull of the trigger they can scale themselves up to become a giant, making the city become a miniature. This allows the student to explore the area from different perspectives and scales. During the design process students will be able to place their own design into this model and evaluate it in VR.

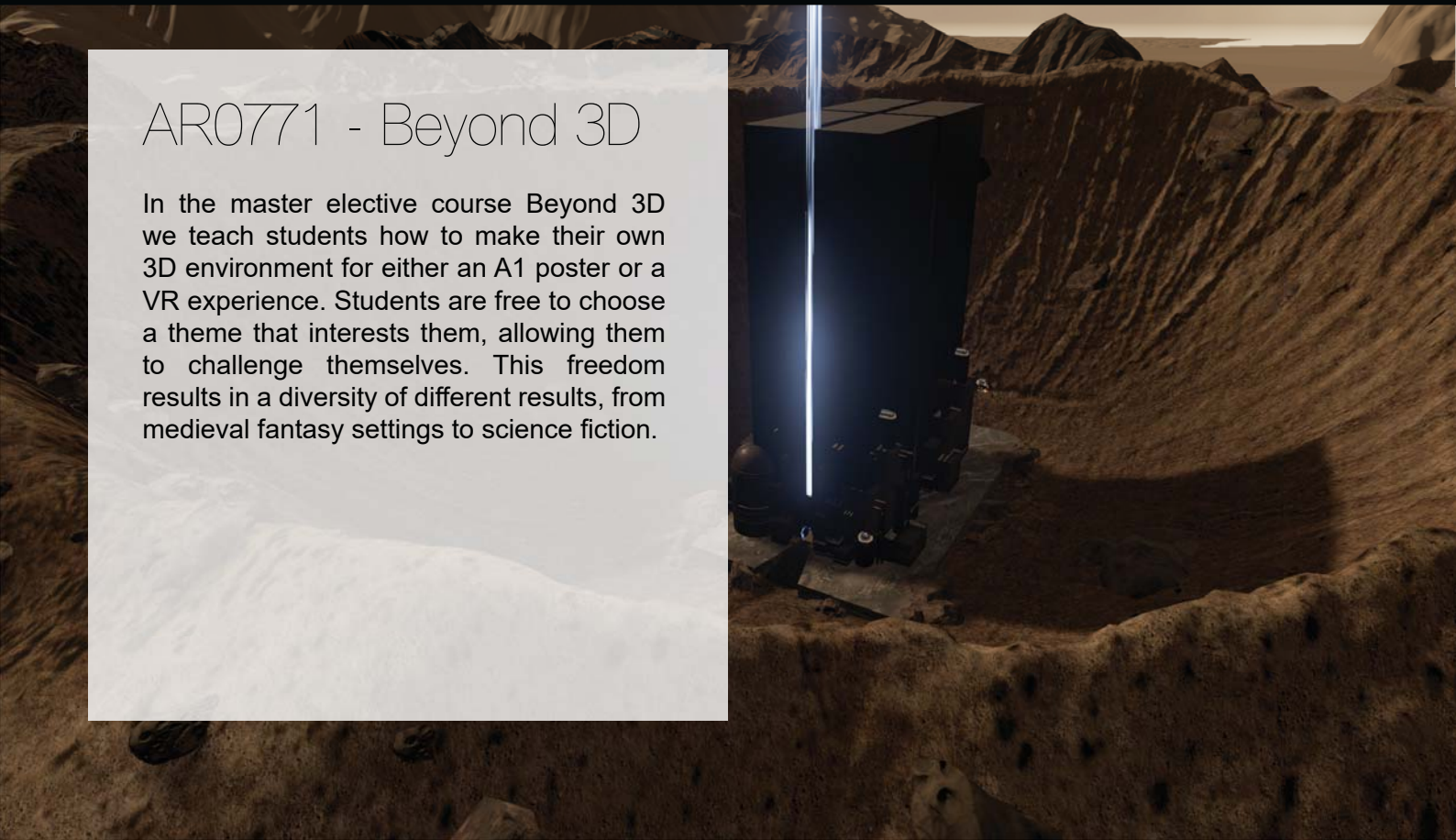
After that the students made their own designs and added those to the existing urban VR environment. That way people could experience their designs in the proper context. These designs were also presented in VR to the teachers and later publicly in the Oranje Zaal.





AR0771 - Beyond 3D

In the master elective course Beyond 3D we teach students how to make their own 3D environment for either an A1 poster or a VR experience. Students are free to choose a theme that interests them, allowing them to challenge themselves. This freedom results in a diversity of different results, from medieval fantasy settings to science fiction.





Luis Emilio Lopez

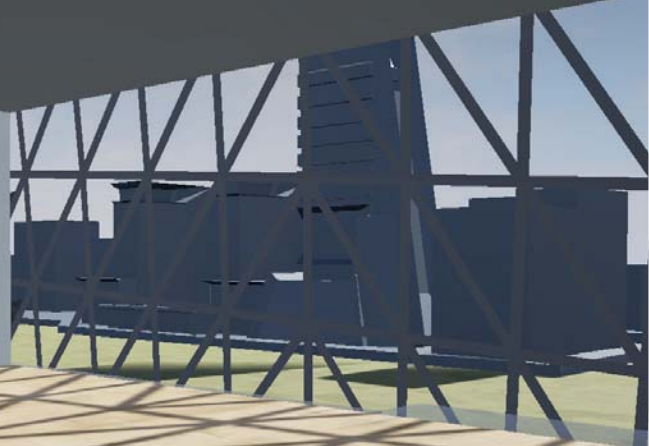
This student graduation project visualizes a daylight analysis and the design of a facade shading. This design for a shading was used on the facade of a case study project, the Esplanade Opera House in Singapore.

Two rooms of this building were recreated in VR and the shading design was applied to it to see what the effect was of the daylight into these rooms. With button inputs on the controller it is possible to switch between different variations of the shading design to see the changes of the light and shadow in real time and what this does to the room.

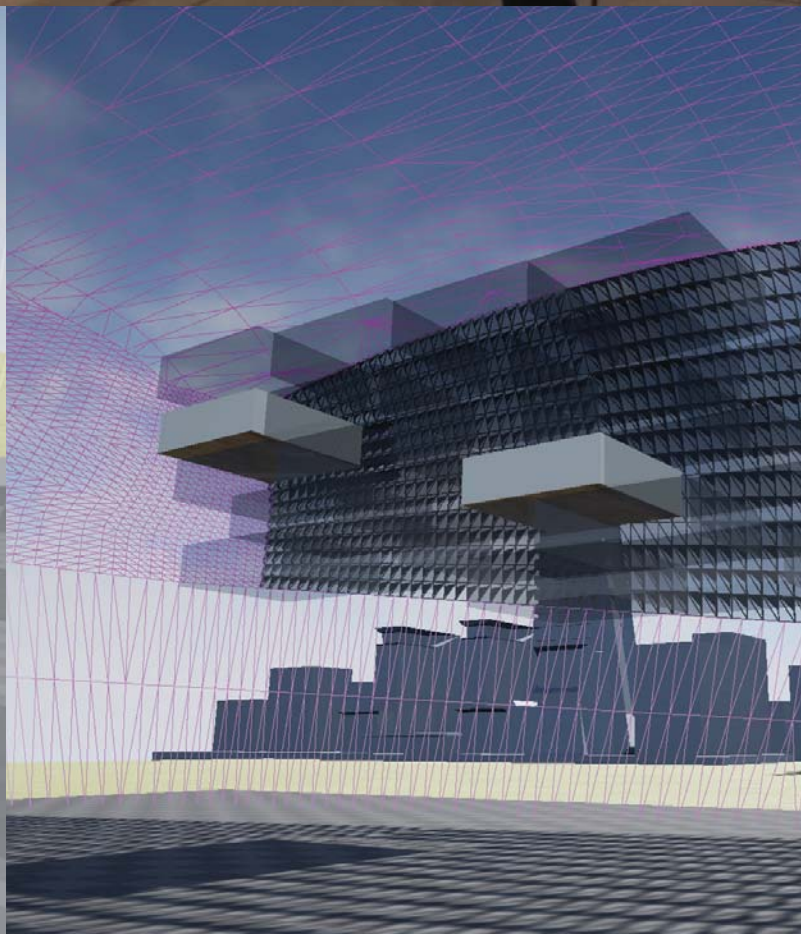
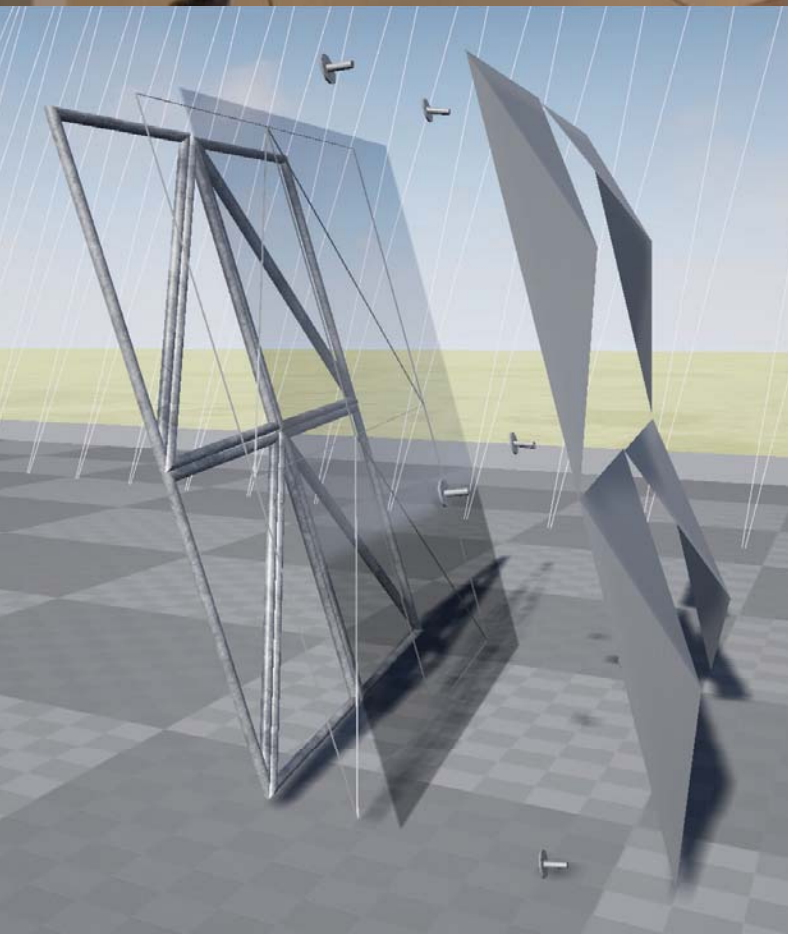
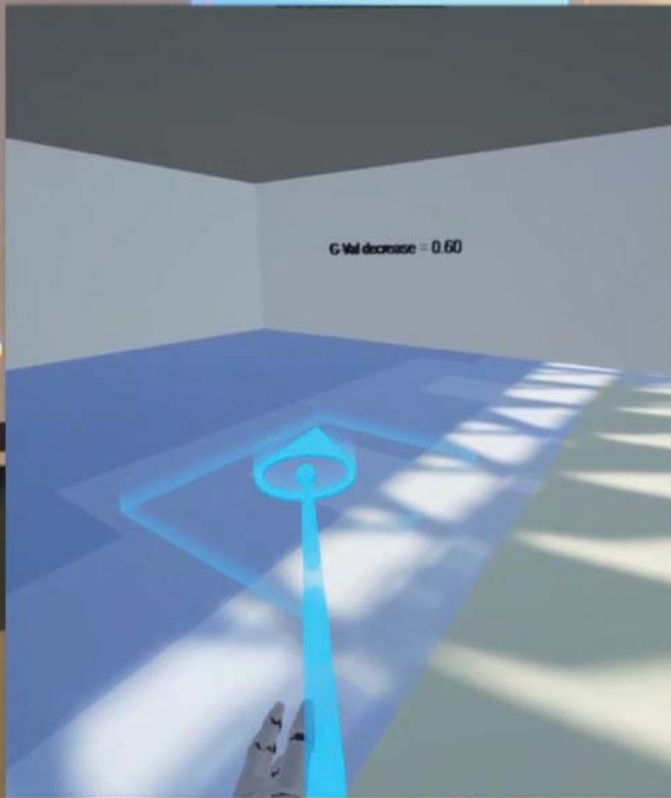
In addition an exploded view is made of the facade to give a better understanding of the construction of the building.



G-Val decrease = 0.70



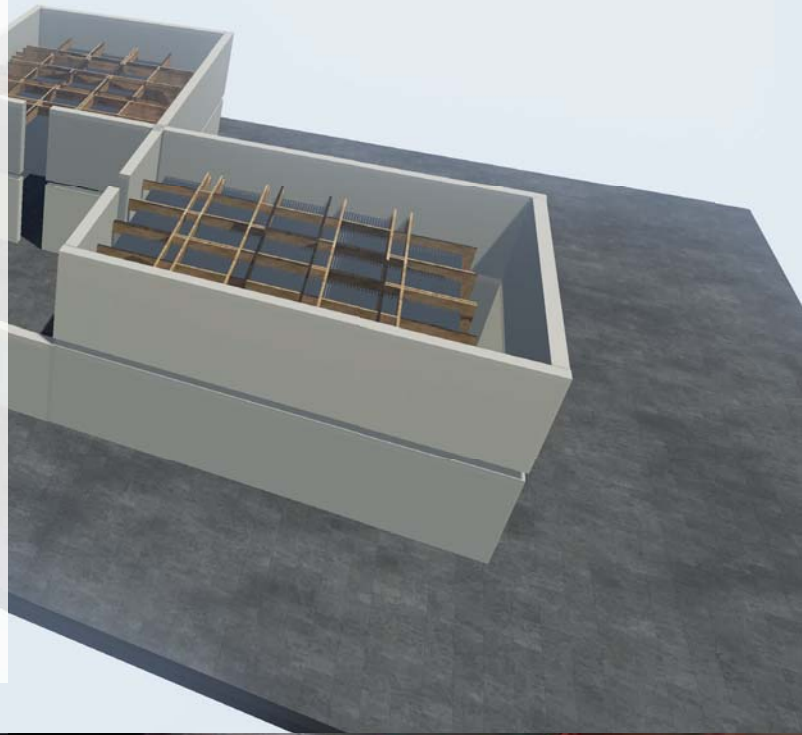
Graduation Project

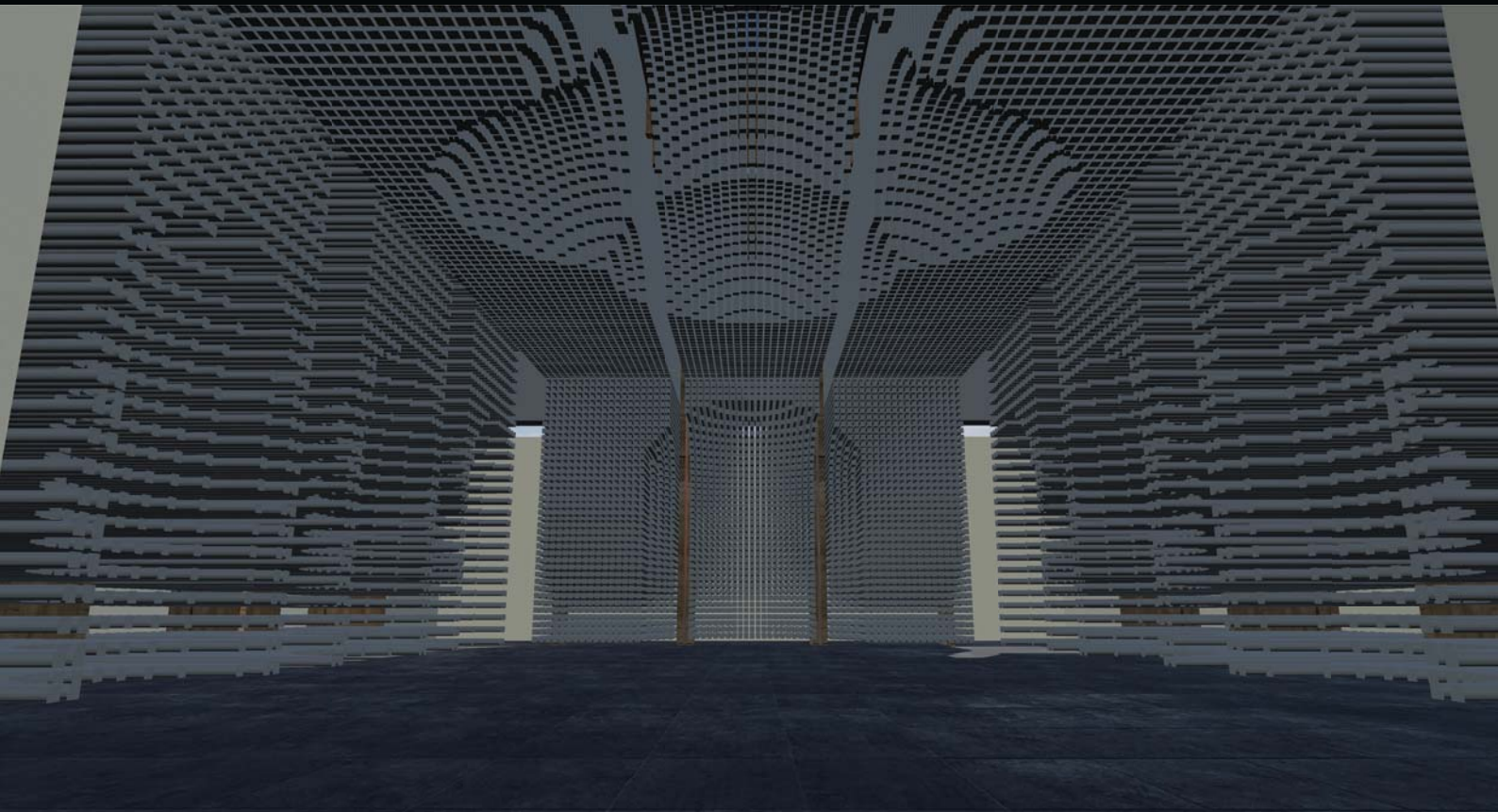


Alexis Ierides

For Alexis' graduation project VR was used as a medium to simulate the experience of acoustics in different spaces. Three different building designs were made with each their own sound properties. In an external application audio fragments were created with a unique reverberation time, that fits the sound absorption of the room.

When entering the each room in VR, the sound clip starts playing (the "I Have a Dream" speech by Martin Luther King) that matches the acoustics of the room. This results in a convincing experience of the room and it's sound properties. Out of these experiments a final design was chosen to further develop.





Sven Volkers

Sven used VR in his graduation project for the Dutch Housing studio. The location of the project is Kattenburg in the harbour area in Amsterdam. The assignment was to make a housing building for at least 617 homes. To accomplish this task and to improve the design on a human scale, Sven used VR to test the building on a 1:1 scale. By testing daylight and perspectives in VR he was able to accurately experience the changes he made in the design. His project was done in Revit, using the VR plugin Enscape. This plugin allows Revit users to view their projects in virtual reality with relative ease.





Rianne Duindam

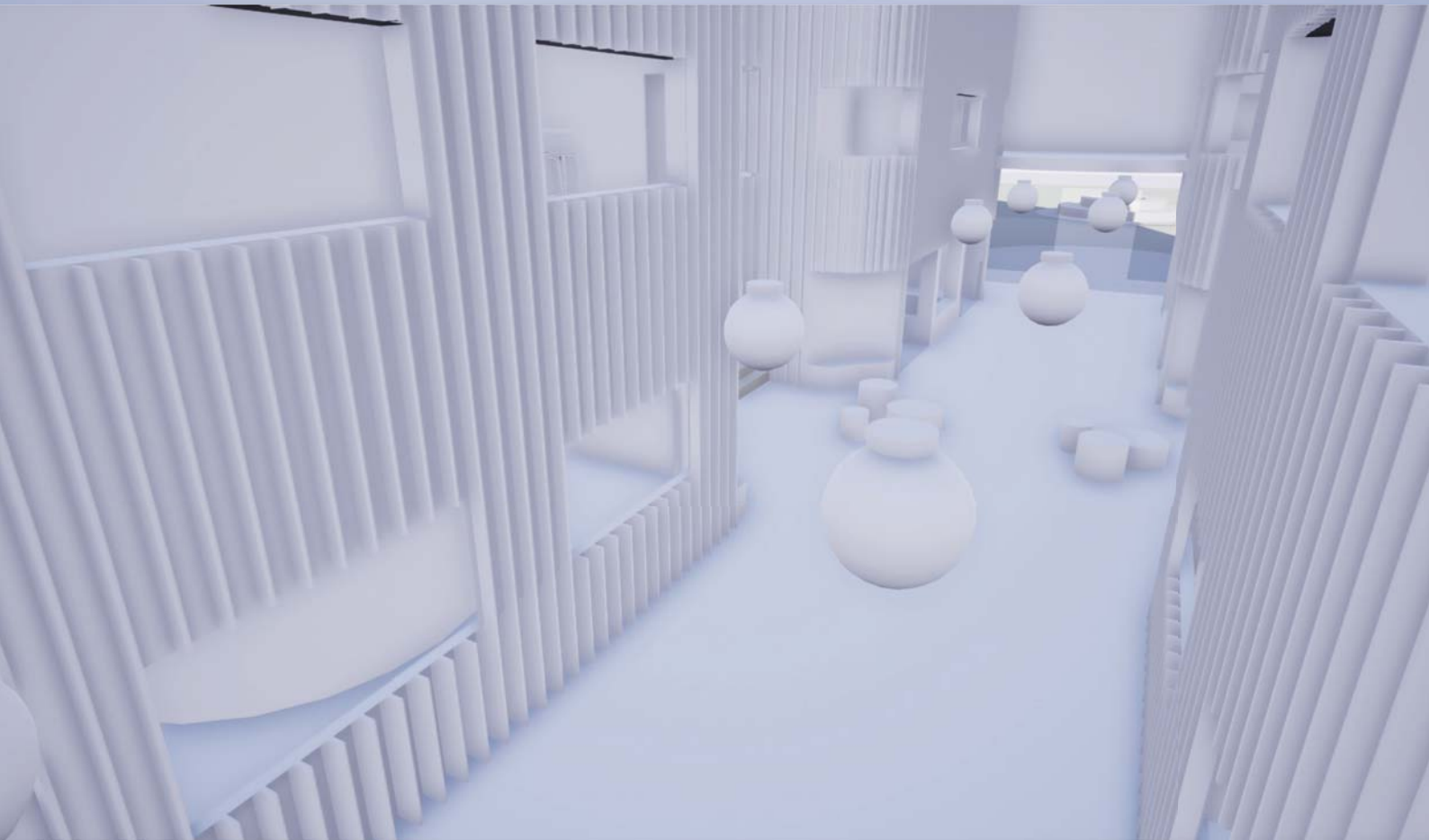
Rianne recreated the office building in virtual reality, where she was doing her graduation internship at the time. The design firm was rebuilt in Unreal, as an experiment to evaluate the value of VR as a presentation tool. For the outside environment a panorama photo of the actual location was used to put the building in its proper context.

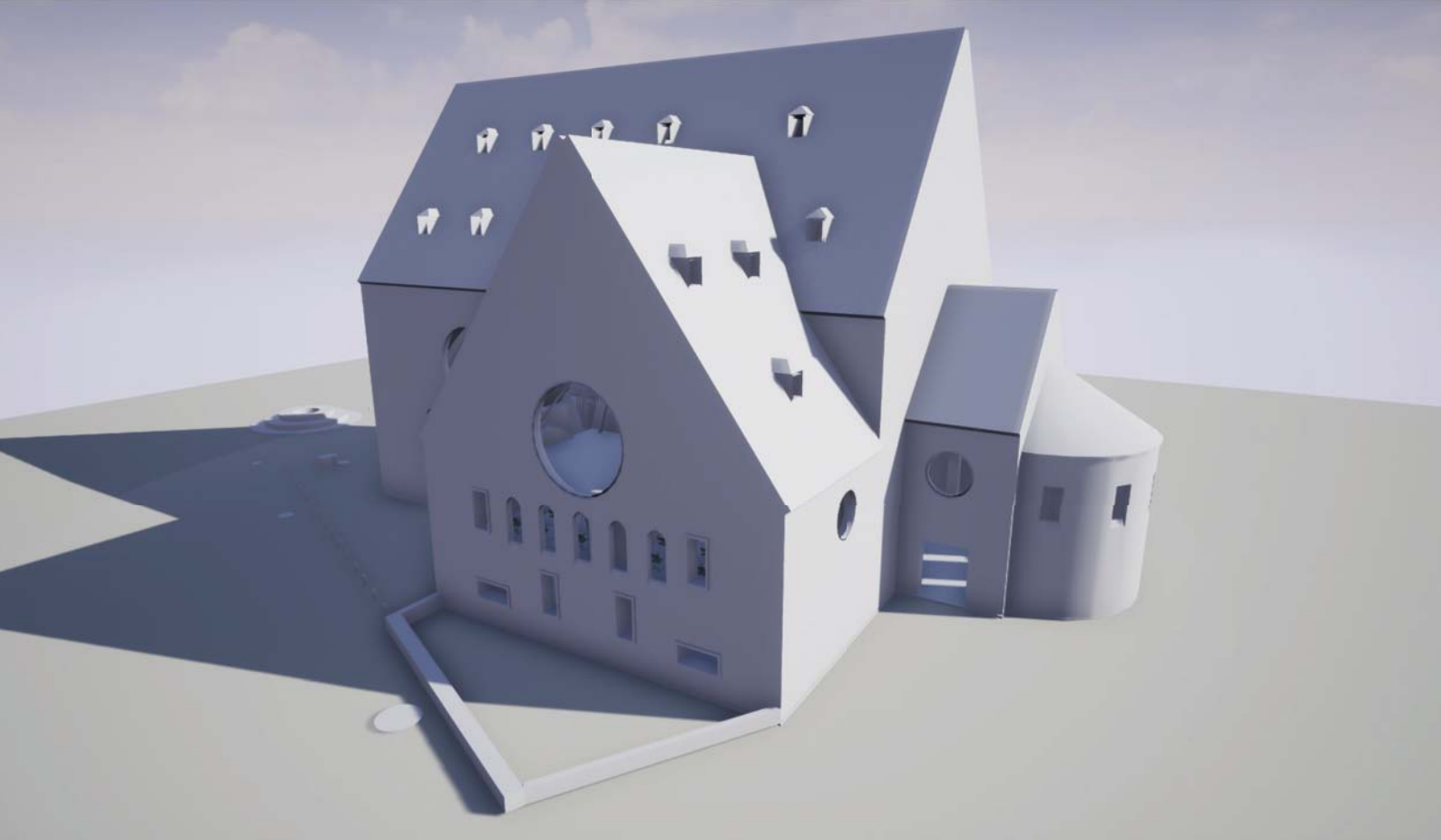




Emma Noordman

Emma used VR to visualize her redesign of an existing church to a school for the Explorelab graduation studio. This is an abstract visualisation of the project, using a Sketchup model as its source. Interesting is that with very little alterations, an abstract model like this can be set up in VR and will be very useful to get an idea of the scale of the project, despite the lack of materialisation.





Thysia Kleijwegt

Thysia graduated in the Management department of Architecture. Her research concludes a study to understand the way in which the spatial quality of a learning environment supports the learning activities of working independently, and the collaboration of pupils working in groups. Part of this research was a survey amongst teachers, pupils and parents.

This survey has been visualized into a VR experience. The participant in the VR classroom environment holds a virtual tablet that controls the different aspects of the room. By browsing through categories the participant can choose between different environmental options, for example types of facade windows, having an urban or green outside environment, different types of tables, ceiling height, inner walls and toggling smaller furniture. The power of VR in this survey lies in the instant change of the way a user experiences the alterations in the environment. Smaller windows and table dividers make the space a lot tighter and secluded, while a glass facade and removing the inner walls opens up the space allowing for interactions with other people.





Ruben Hanssen

For Ruben the main premise of his graduation research was to use VR for design purposes instead of using it solely as a visualisation method. With his research entitled 'VRbanism: Assessing Virtual Reality as an Urban Design Tool' he investigated whether it is possible to use VR as a design tool in urban development. Together with Stefan van der Spek and Paul de Ruiter we helped Ruben discover the uses of virtual reality. VR allows designers to literally enter their design, allowing them to experience the environment in stereoscopic 3D. The effect of the change on your design by doing alterations in VR will be seen in real time, allowing you to quickly iterate between different options. Ruben used these techniques to come up with three design proposals, which he designed and explained using virtual reality.





Liviu Paicu

"If I have to sum up in one sentence my graduation project "HAV-MUHA: The Future of Sustainable Cuban Aviation" I would say it is: The creation of a "sustainable" international air hub in the Caribbean region. The aspect of sustainability having multiple implications not only obvious ones such as electricity or carbon footprint but also social, economic and cultural.

The task of the project became very complex very fast. Because, besides designing new airways, taxiways and aprons, phasing the construction and researching the economic feasibility I also had to make sure that the airport became the cultural gate to Cuba and a symbol of their identity. As we all know it is quite hard to experience space in a two dimensional environment. This is why we make physical models. Unfortunately, at the moment that my design reached its full size and scale, of 1 km by 500 m, it was very hard for me to work within the realm of scales models, I needed to experience the design on a 1:1 scale. This is why I turned to the tools provided by the Virtual Reality environment. With the help of our faculty VR Lab led by Arno Freeke and Arend-Jan Krooneman, I was able to place an immense amount of CAD information in Virtual Reality, the entire airport design. Then at certain phasing moments, I used the VR model in order to design and make certain geometrical and material changes. Most of the time I was doing these changes alone, nevertheless, at some points I also did this together with my tutors. While they were experiencing my design in VR, they could point out certain areas/details that needed to be tackled. In this way, I used VR not only for my final presentation but also as a tool for design."



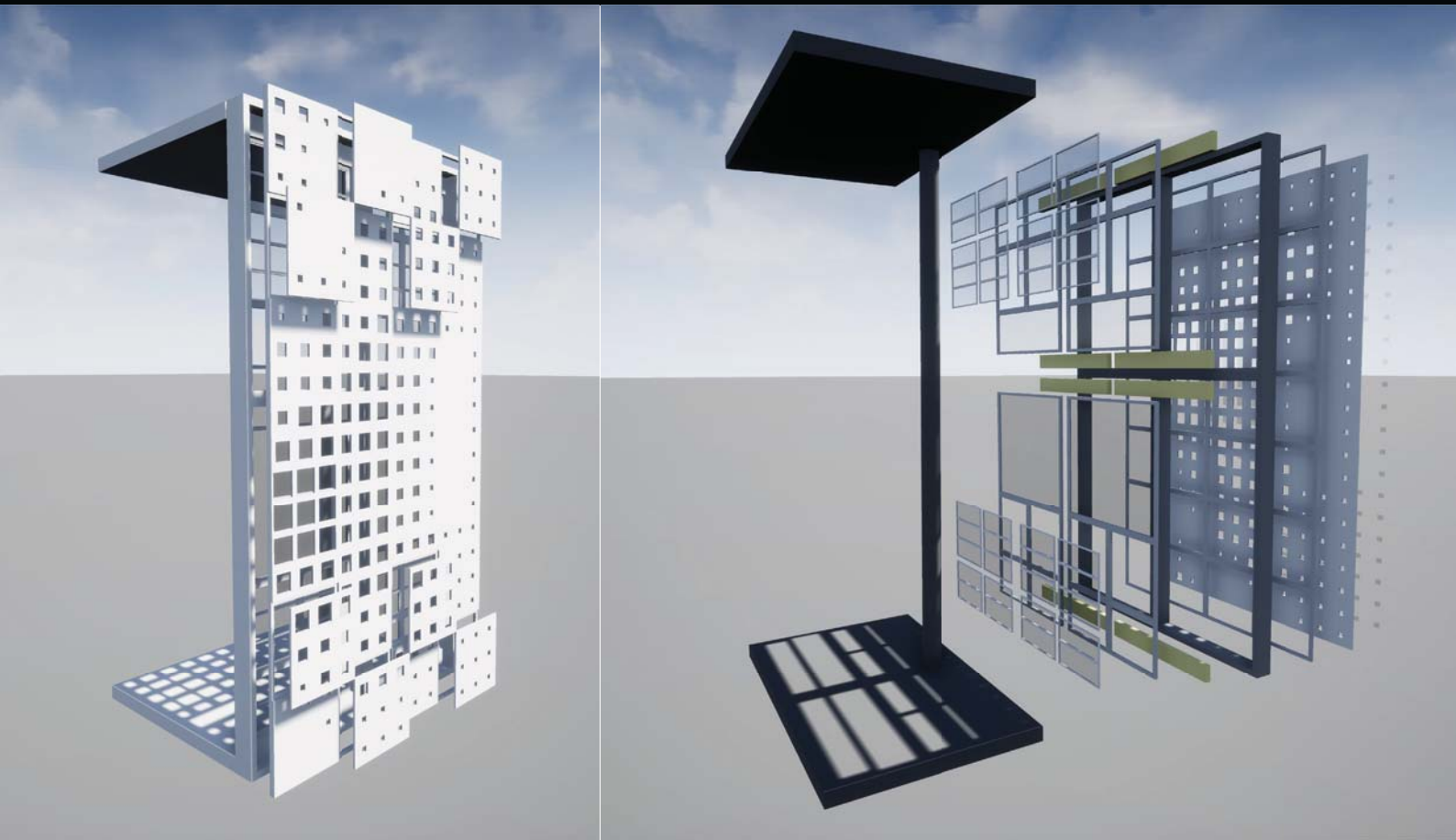


Maria Alexiou

“In order to limit the exorbitant energy consumption by the use of mechanical heating and cooling systems, several buildings are trying to adopt a heat storage system as a part of the energy system of the building. However, there are also passive systems that perform independently from the building’s energy system and store heat in alternative ways. More specifically, an efficient way to achieve thermal energy storage is the use of phase change materials (PCMs) in the building construction. PCMs offer a high thermal storage density with a moderate temperature variation, and have attracted growing attention due to their important role in achieving energy conservation in lightweight buildings while maintaining thermal comfort. Research in this area has resulted in findings, which depict a significant plummet in temperature variations whilst maintaining desirable thermal comfort. Despite these findings, only a few research projects deal with the implementation of PCMs in the façade system, as a method to enhance the visual and the thermal comfort of the indoor environment of the buildings. This paper summarises previous works on latent thermal energy storage in building applications, covering PCMs, the current building applications and their thermal performance. It also provides new innovative ideas on integrating PCM in the building envelope, as well as on their impact on the visual and the thermal quality of the indoor space.

During the P5 presentation the mechanical concept was visualized in a VR model where the user can switch between different seasons and day and nighttime, to see how the facade adjusts itself to the changing climate.”

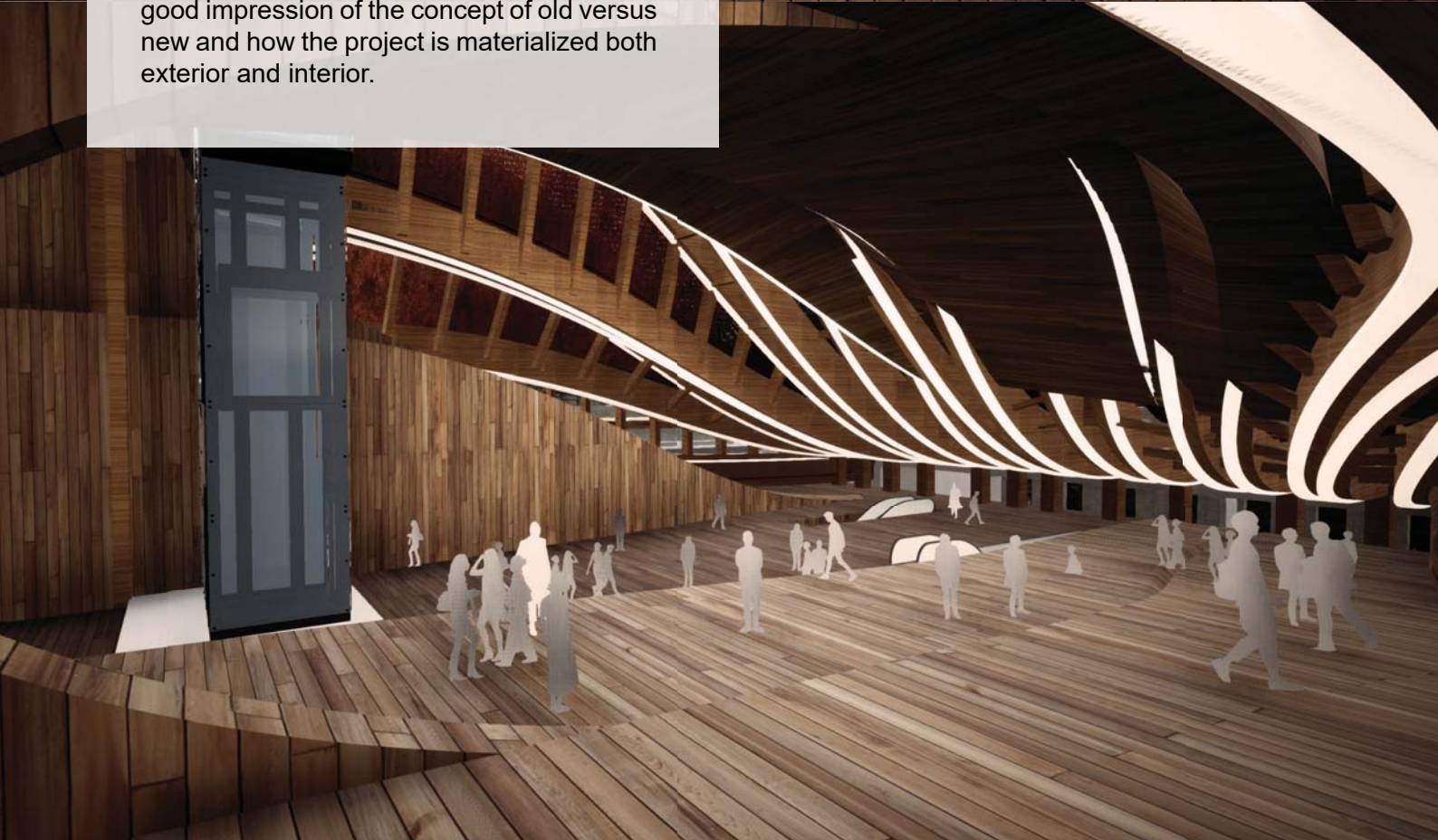




Deyan Saev

“Abstraction plays a central role, as both a language and an essential tool for design. However, because it can be vague, confusing, and even paradoxical at times the process of abstraction is rarely explicitly investigated in architectural education. As a result, inexperienced architects often do not have a clear idea of what abstraction is, or how to best use it. The following research sets out to address this problem by proposing a simple, yet comprehensive teaching model that would aid beginner architecture students in their understanding and use of abstraction. The designed extension for the national library of Bulgaria is an example of the proposed teaching model and the described abstraction process applied and tested on an architectural project.”

The design was visualized in VR to give a good impression of the concept of old versus new and how the project is materialized both exterior and interior.



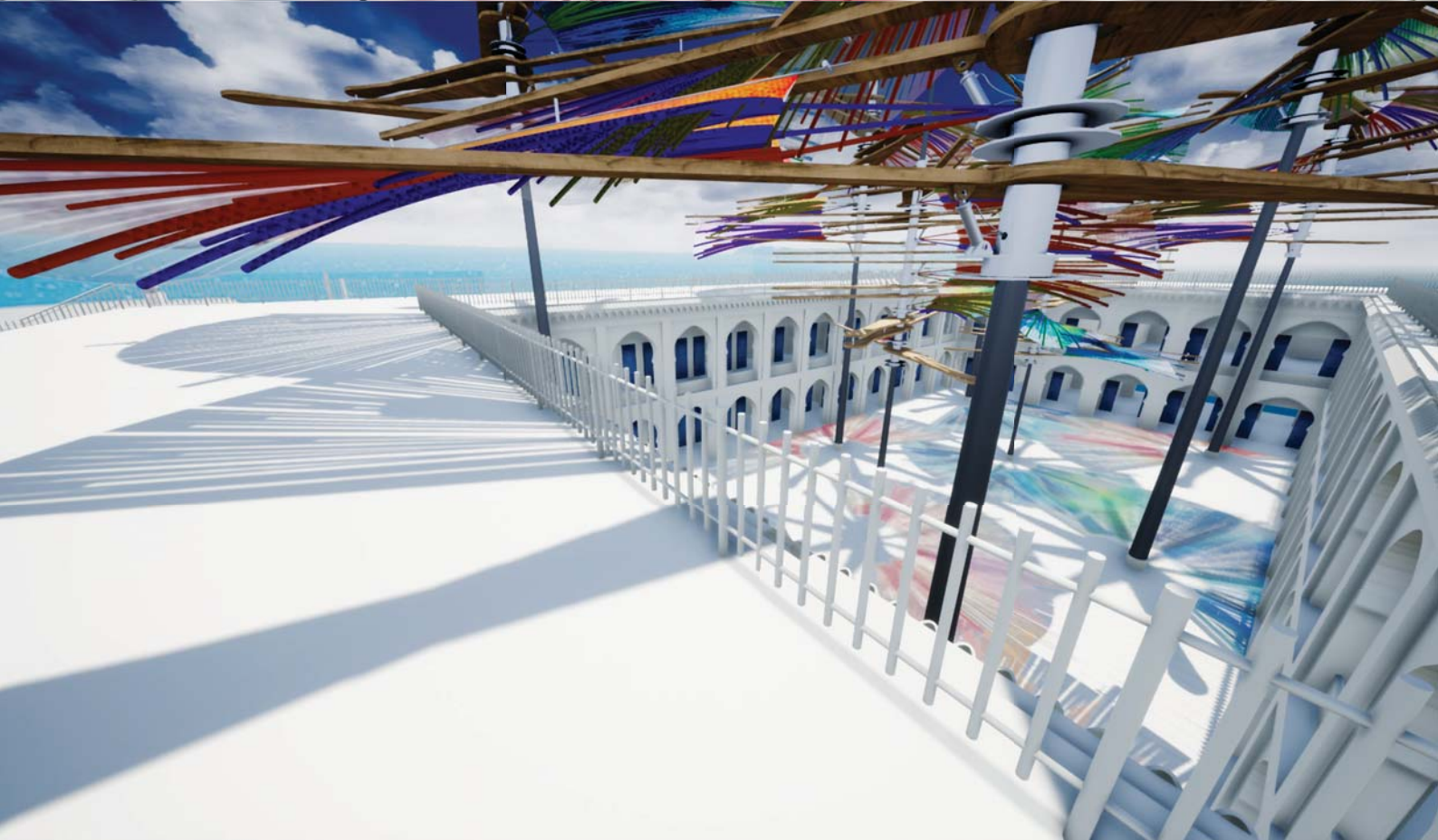
Graduation Project



Anisa Nachett

“In this work, a study into the weaver’s of Tangier is carried out. A first-hand investigation takes place in order to reveal the weaver’s main challenges, their desires and therefore the interventions that a hypothetical association should consider in order to revive the craft. Further fieldwork, looks into the aspirations of the Moroccan youth and why they are not interested in traditional craft, as well as into the potential for collaboration with modern designers. Two case studies in which a traditional craft was revived and introduced into the modern market are looked into: the World of Weaving enterprise of Tanzania and Harris Tweed, in the Outer Hebrides of Scotland. In a crossanalysis, these case studies indicate the importance of 3 main aspects of the trade: the brand, the access to the market and the access to supplies. With the knowledge acquired throughout the fieldwork and with the indications given by the case studies, a series of considerations are suggested for the hypothetical association. These considerations are based on the level of centralisation that this association could develop with regards to the 3 aspects.”

VR was used as a method to visualize the mechanics of the design and the way the colors blend during a sunny day. People can walk through the courtyard and experience the actual scale and dynamic movement.



IO Lighting Design Villa Savoye

Students for the Faculty Industrial Design have designed a lighting plan for Corbusier's Villa Savoye. Together with professor Sylvia Pont we assisted the student group with realising this design in VR.





Conclusion

This year we continued further developed on the Virtual Reality program. Together with the faculty, we started the VR Awareness project that has run from the beginning of this Academic year. The goal was to show students, teachers, and researchers what virtual reality can mean for their fields that they work in. We can say that the awareness program was a success. We have run pilot programs in several bachelor courses and together with the department TOI, we have run the Virtual Reality track in the master course Beyond 3D. Also we run several workshops and helped a lot of graduate students with Virtual Reality within their projects.

We are now in development of a multi-player VR experience. This is a huge goal that we are concentrating on. Together with your teacher or fellow students you can take a walk, look, interact, changing components and collaborate together in a Virtual world. The alpha version of this program is already working and is being used and tested within some cases. At the beginning of this academic year, we started with one VR set. Now at the end of this year, we have 6 Virtual Reality machines running in the VR-LAB. The Faculty has assigned a space on the ground floor for the VR-LAB. People can work there in their projects and ask for support if needed.

This was a great year. A lot of people were helped at the VR-LAB. We made new advances in VR technology and we managed to setup a full VR-lab in one year time.

On to a new academic year!

