Binaural VR

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About

This documentation paper contains the description of the VR project developed by Anton Brams and Homero Ruiz for the course *Critical VR* offered by the Faculty of Media at Bauhaus University of Weimar. The project was developed using VR technologies, the Virtual Reality Lab at the DBL (Digital Bauhaus Lab) and applied theory.

Abstract

VR devices as Oculus Rift, HTC Vive and others are becoming more mainstream in our society. However, even though the propagation of the technology is growing the experience of VR is facing new challenges because of the continue demand for better and more immersive experience for the new products. Thus we conclude that now the challenge is not only to get best graphics or good quality particle effects, but also to touch the rest of the senses that we need to stimulate in our bodies. In this project we are going to connect binaural sounds with a virtual reality for better representation of object physical properties.

Motivation

The virtual reality realm gives us new possibilities to experience new artificial worlds. The contemporary artists can express themselves in new ways to create different immersive environments. As humans, we are use to perceive and construct our reality through multiple channels like sight, sound, touch, smell and proprioception. This knowledge about human physiology can give the artist powerful tools to influence the psychological state while being in the artificial world. So if it comes to mimicking objects from the daily life in

VR, the artist have to consider different properties of objects like textures and light, its motion and corresponding sounds. Because 3D objects consist of vertices and not of a solid matter, the human eye perceives them as empty and weightless. Even if the artist's intention is not to present a photorealistic graphics to the viewer, the scene behaves not immersive enough because the failure of simulation happens not only in one aspect like graphics but in all of them like motion & sound. Our motivation is to merge binaural sound with an animation of 3D objects to stimulate other senses and make these objects more real. We believe that our scene will provide more clues to the viewer about weights and distances of objects.

What is Binaural?
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Binaural recording is a method of recording sound that uses two microphones, built-in a human head dummy with the intent to create a 3D stereo sound sensation for the listener. This approach creates more immersive sound experience with just a stereo system.

Realization
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To prove our concept we setup a scene with moving objects and supported their motion with a corresponded binaural sounds. We use free sources to get assets like 3D objects and sounds. The project was developed using the Unity application and tested at the VR lab.

The scene consists of an opened nature landscape and a bench in very front of it. The viewer need to sit on a chair while using our application. The chair and the bench in our scene is a connection between a real and virtual worlds to stimulate the brain through the tactile channel.

The landscape consists of static and dynamic objects. Static objects are **bench**, **fields**, **mountain**, small **forest**, **road**, **clouds** and a **lake** in a middle of a viewport. This static group of objects have a environmental sound by default. It contains a wind and moving grass for the case of an silence gap.The dynamic group consists of a **car**, **plane**, **rocket** and a floating **mysterious object**. The binaural sound playback is static in a spatial domain because it contains the spatial information already. The movement of every dynamic object is synchronized to the acoustical cues from their binaural recordings.
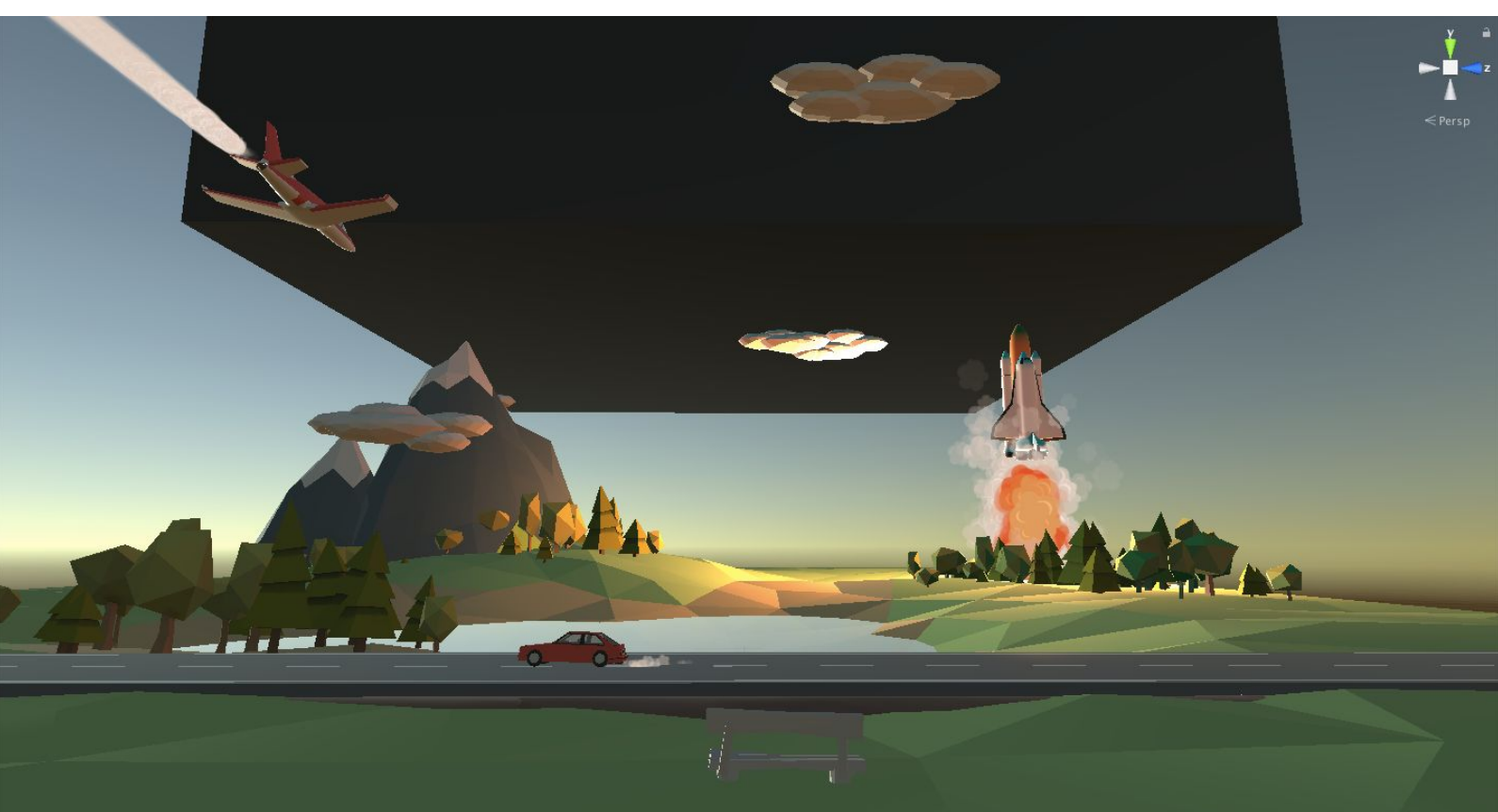
The idea of the mysterious object is to prove the influence of a sound on the perception of an object's weight even if the object doesn't have any particular meaning to a viewer. This object is just an enormous massive black cubus that appears sometimes in a scene with a very low bass sound that should represent a very high weight.

Results

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Our approach with the binaural sound works well. It gives a viewer necessary clues about some properties of the static or moving objects like their distance, mechanical content or weight. This method creates better immersive environmental experience for the viewer.
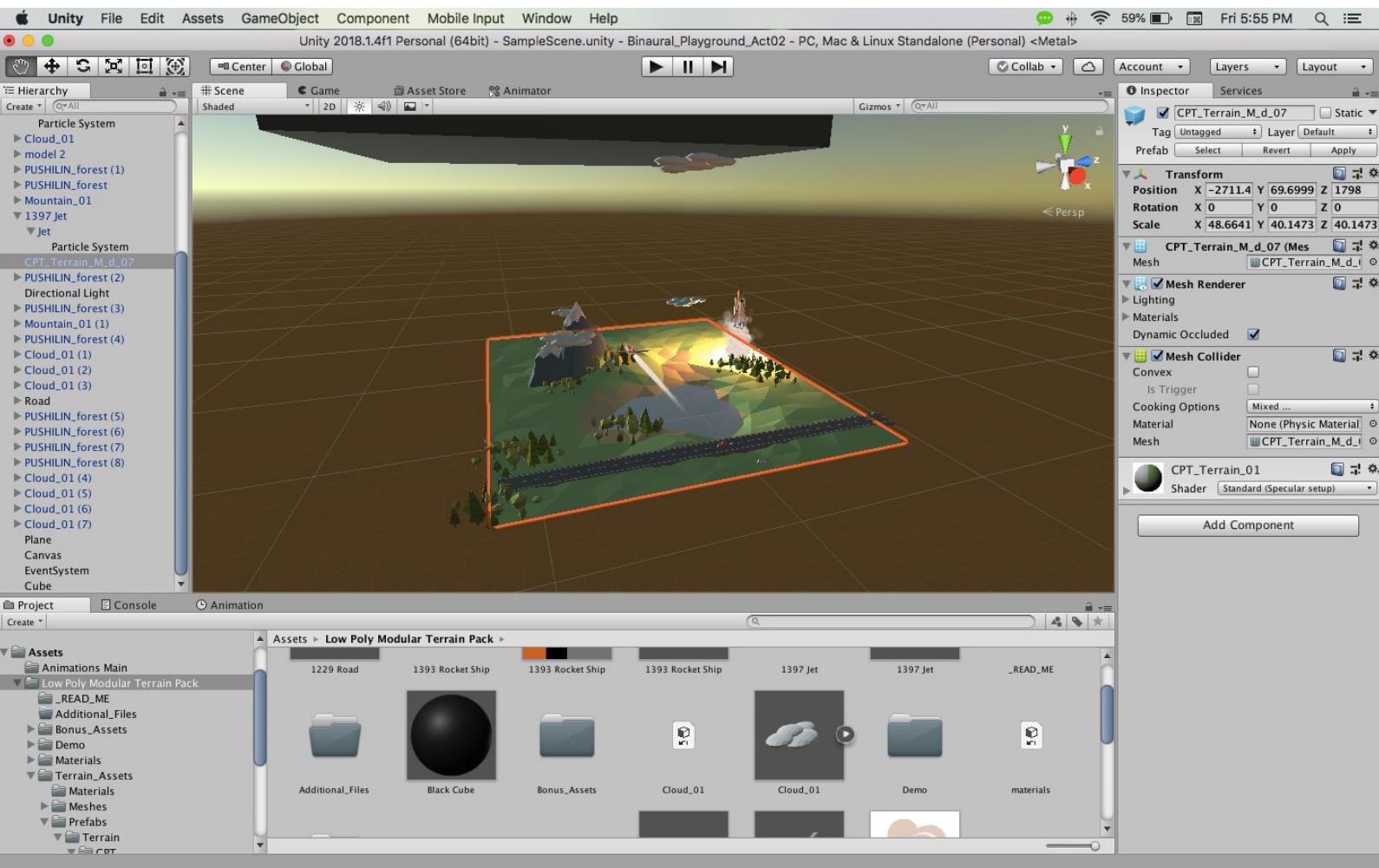
The next stage of this experiment would be the usage of an plugins that creates binaural sound artificially. On one hand it is going to have a little less of the spatial information quality because it was simulated but on other hand it is going to give a full freedom to an artist about an object movement.

Conclusion

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Just as a computer needs different types of sensors to be able to read and process the information in our reality, also the human being needs the correct input and output signals to be able to process the reality that is happening inside the
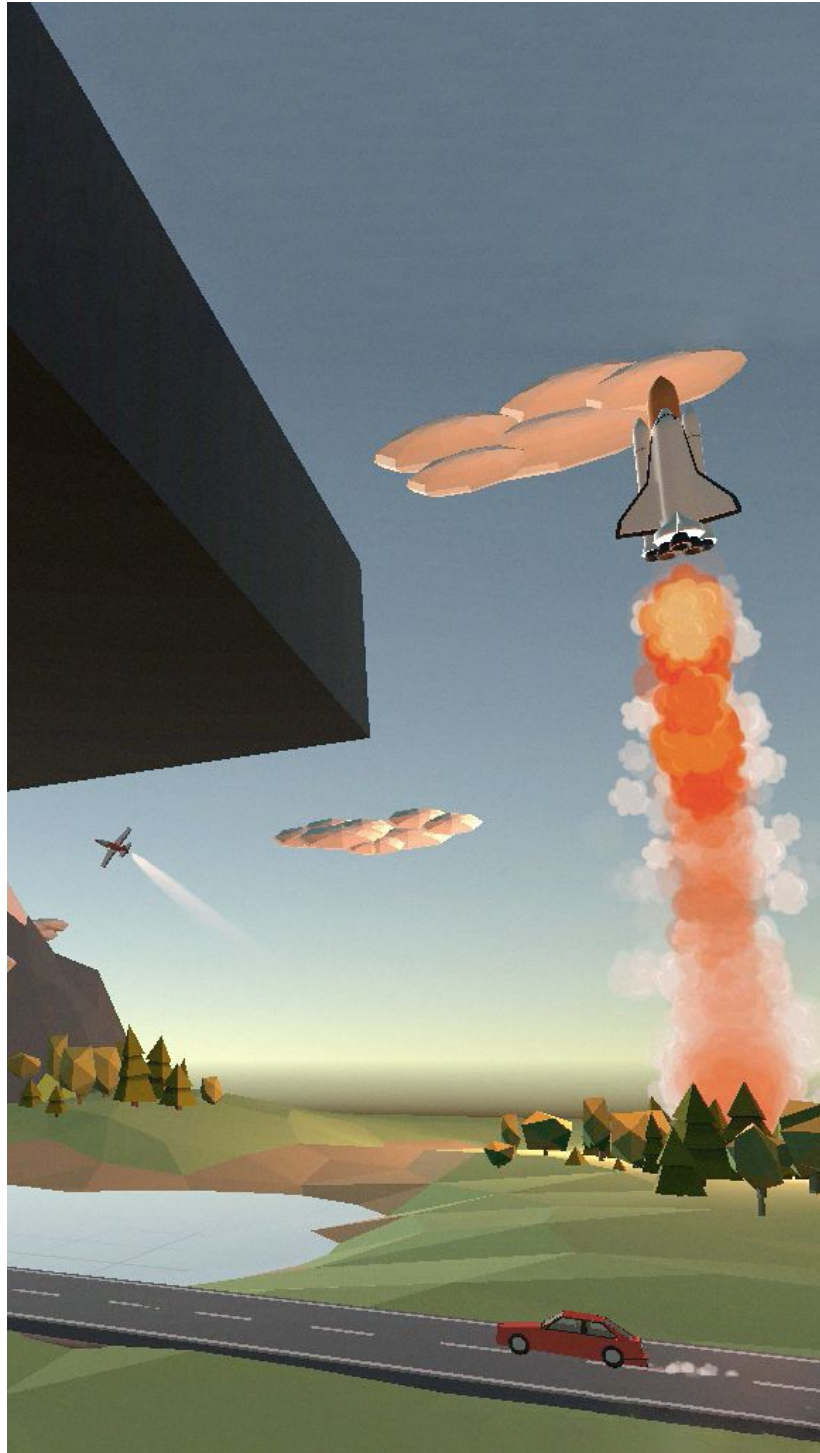
computer. In this way, our sense are the bridge that allow us to comprehend the reality, and this VR must take as reference the real stimulations that we have in our daily life. We believe that in the closer future the artist and engineers will be able to produce hardware and software that allow our brains to perceive the virtual reality as the real one.

References

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Sounds

Free Sound Library	https://freesound.org/
Rocket Sound	The Incredible Sounds of the Falcon Heavy Launch (Binaural Audio Immersion) - Smarter Every day 189 https://www.youtube.com/watch?v=ImoQqN yRL8Y&t=230s

3D Models

Free Model Library	https://poly.google.com/
BM Double Skew Car	VR Voyagers under a CC-BY license
Clouds	Google Poly under a CC-BY license
Forest	Google Poly under a CC-BY license
Garden bench	Frank Lynam under a CC-BY license
Jet	Google Poly under a CC-BY license
Mountain	Google Poly under a CC-BY license
Rocket Ship	Google Poly under a CC-BY license
Road	Google Poly under a CC-BY license
Low Poly Modular Terrain Pack	LMHPoly by Justinas Telksnys from Unity Asset Store

In case that you need a copy on the Unity file please don't hesitate to contact the authors of the project.