Beeing - A nature inspired immersive VR journey designed to enhance public transportation

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ABSTRACT

Climate change, environmental protection and sustainability dominate media and political affairs. The demand for increased use of public transport instead of cars is obvious. Beeing – the nature inspired VR journey is intended to raise awareness of these topics and at the same time create an example for added value for public transportation. Additionally, a prototype for a new content platform is being elaborated, which will also enable future-oriented developments by providing a variety of entertaining content between the train stations. The prototype presented is designed for short distance trains in the metropolitan area of Stuttgart, Germany with an approximate duration of three minutes. The physical conditions of the train ride are reflected in VR. With this special form of customer experience, the user is to be picked-up in the real world, i.e. in the real train, in order to experience a fantastic ride that far exceeds the experience of a normal train ride.

CCS CONCEPTS

• **Applied computing** → **Media arts**; • **Computing methodologies** → **Virtual reality**.

KEYWORDS

virtual reality, immersion

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1 STORY WORLD

The content is intended to address the strong impact of humans on the environment and its ecosystems. Therefore, the macro world around a flower meadow was chosen for the prototype, from whose point of view the disappearance of wild animals and insects is told. In several iterations, it was investigated what complexity of content the viewer can expect in the short time of a commuter train ride in VR. This led to a departure from the approach of telling the events by means of a charactercentric story. Instead, the focus was on the narration of the journey itself. The viewer finds himself on the back of an insect after tFreelahe train disintegrates, which carries him along through a fantastic and ominously dissolving forest of ghosts. The ride ends in a flower meadow, which shows the beauty of nature. The aim is to convey that nature must be preserved so that it can continue to be experienced outside VR in the future.

2 CONTENT CREATION

The entire story world and characters were created in Epics Unreal Engine. Rendering the content in real-time on a mobile device appeared reasonable for dynamic reuse on arbitrary train tracks but also challenging due to hardware limitations. We decided to offline render the content as individuals frames for 360 video creation. Unfortunately screenspace and volumetric effects in combination with 360 images were not supported by the native render capabilities. Therefore we had to rely on using the Nvidia Ansel [Ans 2021] tool which was initially designed for in-game capture. The final

mobile player application is based on Unity. We chose it because we had already gained a lot of experience with this development environment in combination with 360 VR experiences in the past [Zimmermann et al. 2016]. Furthermore, Unity offers a simpler and more optimised development environment when it comes to mobile applications. The native support of GPS, high-resolution 360° video and the slim application size, as well as the possibility of a quick and seamless platform change, makes Unity an ideal development environment for mobile applications [Weber 2015].

3 TECHNICAL CONCEPT

For high quality VR immersion and to avoid motion sickness it was inevitable to match the motion of the virtual train as close as possible to the motion of the real train ride. In a field study we recorded the perception of train motion during the ride, entered via a joystick by blindfolded subjects. By analyzing the recorded data we figured out that changes in speed are perceived much stronger then centrifugal forces acting through curved rails. While subjects could clearly tell when the train accelerated or braked they barely noticed turns and couldn't tell the direction of the curvature most of the time. For that reason a rough virtual reconstruction of the real train track was enough to match the perception of bends. To match speed and especially changes in speed we had to spend some extra effort. Like mentioned before our main media is a pre-rendered 360° video. Since even high frame rate videos suffer from stuttering when slowed down too much, we had to render most of the speed changes that occur during the ride already in the video. To render the adequate camera speed we had to figure out the acceleration characteristics of an average train ride along the particular track section. Since it was not possible within the project to get data directly from the train, we decided to measure it by using the smartphone sensors. We developed an application to log all acceleration and GPS data available during train rides. It turned out GPS position information is not very accurate and reliable but from the recorded g-forces we could derive sufficiently accurate acceleration characteristics. Based on this data the camera was driven to render the stereoscopic 360° video. For fine tuning and compensating slight speed deviations, the video rendered with 50 frames per second, could still be slowed down or accelerated slightly in the final application. This video player application presents the video in a way suitable for VR head mounted displays based on smartphones like the Google-Cardboard. Since the exact course of the route is known, GPS positions received by the smartphone can be projected onto the route and thus the position determination can be refined. The refined position is compared to the progress of the video for slowing it down or speeding it up in order to match.

4 IMMERSIVE AUDIO

The audio concept was designed with two output formats in mind. One general version streamed from a video platform supporting an ambisonics audio mix and the Android player for the actual train ride. The train player supports dedicated audio tracks spatially aligned to individual objects.

A novel approach for the audio production was implemented by transferring spatial metadata from the game engine objects to the audio software and vice versa. There is a reduced, virtual representation of the sound-producing objects within the player application in order to be able to interactively or situationally render the correct soundscape. The position data required for this was derived directly from the underlying animation. This approach enabled the precise mapping of audio to objects and quick adaptation of changes in the spatial alignment. Usually for implementation of spatial audio in Unity we can simply attach audio objects to follow the visual object, but since the visuals were created in Unreal Engine and then transferred to Unity, we did not have the metadata available in Unity. That's why we chose to create a spatial audio mix directly. In this workflow usually one has to manually write automation data for the spatial audio panning tool which is a cumbersome and sometimes not so precise method. So we decided to transfer the positional data of objects relative to the camera view from Unreal. This allowed us to create a very precise spatial audio mix that follows exactly what you see in the picture. We could then easily export the spatial audio mix in different formats including ambisonics for 360° video platforms like YouTube, but also audio objects for the Unity application. These sounds have been combined with a headlocked music track and an atmospheric background track in ambisonics to create an immersive listening experience. The playback speed can also be controlled by the tracking of the train to sync the audio to the visuals.

5 CONCLUSION

While content creation in Unreal comes with many benefits and advantages it has it downsides within an agile development process for prototypical mobile applications. The presented work can be considered as a prototype for providing alike experiences with dynamically created content on individual specifications of any train track. Content would therefore need to be optimized significantly which will likely reduce the overall experience. More precise tracking results could be obtained if given access to the trains specific acceleration and position data.

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