http://dx.doi.org/10.14236/ewic/EVA2025.25

Enhancing Informative Storytelling: Virtual environments with Unreal Engine 5 For real-time events

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1. INTRODUCTION

This paper examines the innovative use of Unreal Engine 5 and LED Virtual production (VP) technology to craft visual experiences that enhance live storytelling. A project in collaboration with Target3D Ltd, this project developed the foundation of the TEDxUniversityofGreenwich (TEDxUOG) event where speakers delivered talks, complemented by dynamic 3D environments. This paper explores how real-time environments, rendered digitally, can aid live experiences, and contribute to the immersion of the live audience.
Vital to the success of the project was the seamless integration of tailored virtual backgrounds with themes specific to the speakers' ideas.

In total, there are seven live talks, providing a varied and interesting range of themes and topics. Using Unreal Engine 5 as the main tool to deliver, the team of technical artists and designers were given the opportunity to focus on talks specific to their individual skill sets and use dynamic workflows to allow rapid progress and a feedback loop of critique and fine-tuning between the technical artists, producers, and speakers.
An example of this is Simon Ruffell's talk 'Encounters with Shipibo Ayahuasca ceremonies and ethics', (YouTube Hyperlink) which utilised all workflows and tools available to the technical artists.

2. THE DEVELOPMENT WORFLOW

Ruffell's talk utilised dynamic particle effects, shaders, instanced materials, terrain sculpting, and tessellation, alongside adapted Quixel Megascans, to enable rapid changes to the 3D jungle environment. The aim was to create a visually rich background that evolved in real-time and synchronised with his presentation.

Built in Unreal Engine 5, a highly customisable real-time tool, the setup allowed designers, storytellers, and VP producers to make seamless adjustments during production, rehearsals, and live events. The process began with storytellers, producers, and speakers collaborating to craft a narrative-driven visual journey. Unreal designers assessed feasibility, considering complexity, asset availability, and time constraints, before presenting low-resolution proof-of-concepts for feedback. Through refinement, regarding Ruffel's talk, a jungle environment with three transitions was finalised. Synchronised with the speaker's transcript, the goal was to enhance key topics dynamically and in real time. Designers started the development of environments in Unreal Engine 5. Specifically, in this case, the 3D Jungle environment is tailored to Ruffel's talk. Using Unreal Engine's built-in tools, as well as Quixel Megascans, the initial stages for understanding the composition and layout of the virtual backdrop were realised. Once satisfied with the digital environment, designers were tasked with using Unreal Engine's sequencer system (*Figure 1*) to enable the particle events for the time-specific talking points. The concept was to have the cinematic camera component be animated through the environment to coincide with the triggering of particle events, which aided the themes of Ruffel's talk. Unreal Engine's sequencer allows for this to be set up with minor technical difficulties.

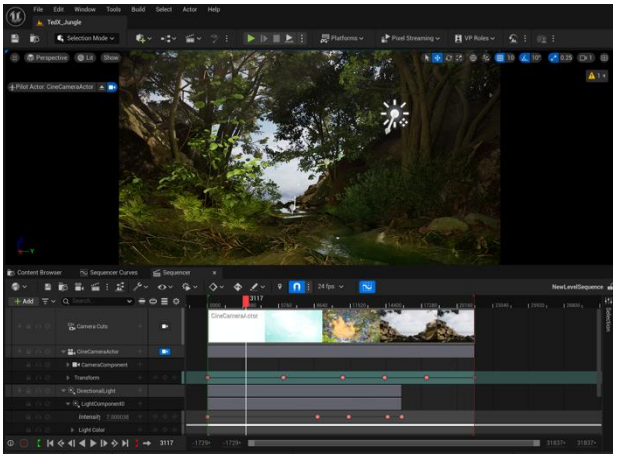

***Figure 1**: Unreal Engine 5 sequencer example.*

After seeing through with production, the designers from the University of Greenwich utilised Unreal Engine's multi-user cloud-based workflow to enable the sharing of these environments with Target3D's VP designers. These environments were evaluated on Target3D's LED wall for scalability and functionality. It is important to note that the physical size of the LED wall will exponentially impact the feasibility of a particular environment depending on the number of transitions and assets being introduced. This is due to the processing power required, and the flicker rate technology of the LED wall. Some environments can only be rendered due to sheer processing power, achievable solely for example, at the Las Vegas Sphere, the largest LED virtual production venue.

2.1 Learning

One of the main objectives for Ruffel's environment was to enable an animated experience that would captivate an audience through triggered events, following specific timestamps in Ruffel's talk. During the rehearsal stages designers discovered that due to the real-world tracking of a physical camera element *(Figure 2)*, controlled by a camera operator, designers were unable to freely animate the movement of the in-engine camera as well as allow tracking of a physical camera. The digital elements would have positioning errors in-engine if the physical camera was not perfectly synchronised with the digital counterpart. Upon reflection and evaluation post-event, designers sought ways to overcome this. One of the ways to do so is by instead moving the environment around the tracked camera element. That way the camera operator can physically control the camera both physically and digitally, meanwhile the designers can craft creative event sequences that are thematic and exciting for the audience.

***Figure 2:** A demonstration of the physical camera being tracked with the digital camera in Unreal Engine 5.*

Optimisation was a challenge for the whole production, the scalability of the project in a conceptual sense, as well as a practical sense, was something that the team had to 'jump in the deep end' to find out. During the rehearsal day, Target3D's team worked alongside the University of Greenwich designers to pool knowledge together to create a robust, seamless experience. Several optimisations had to be made, and one of the largest sacrifices was disabling Unreal Engine 5's tessellation console commands. Due to the engine version used, tessellation in Unreal Engine 5 was in an unstable state and only enabled through in-editor console commands. This was a gamble to include in the pre-rehearsal stages as designers later found out, due to the visual bugs caused, as well as the processing power required for an LED screen of that size and resolution causing framerate concerns which were crucial for the LED wall to sync with the physical cameras.

Each talk had a unique digital space, meaning designers did not always rely on terrain tools or meshes. Gregory Brown's talk (https://youtu.be/i7ZelwLJu0g?si=F55JAtrrJYNAhiVo&t=128) featured a supernova explosion and a black hole consuming a star, created entirely using Unreal Engine 5's Niagara particle systems and shaders. The black hole was built with a custom C++ shader, combined with the material-node-editor, which was modified to control refraction, emission, and other parameters. The supernova's explosion effect used a Niagara particle system along a spline to simulate movement. During rehearsals, production identified camera movement conflicts, particularly with the black hole's parallax effect, which required changes too expensive in regard to the schedule to rectify. The method to solve the conflict with camera movement in combination with the 3D environment would be to use the environment itself as a component which would be animated along a spline that acts as a rail for the scene to move along, rather than animating the camera component to follow a set route. Therefore, dissolving the issues relating to tracked camera element conflicts.

Additionally, the Niagara system's visuals did not display as expected, likely due to camera tracking issues between digital and physical elements. The core environment was retained to meet deadlines, with camera adjustments made to minimise visual inconsistencies.

Early testing and iteration were crucial in identifying technical constraints while preserving creative intent. Understanding software and hardware limitations helped mitigate unexpected challenges, while adaptive design ensured visual consistency in dynamic environments. Cross-disciplinary collaboration and ongoing evaluation allowed for real-time adjustments, ensuring a seamless production experience.

2.2 Feasibility and Application

Epic Games has created a conduit, Unreal Engine 5, for smaller productions and independent developers to craft world-class media with modest budgets and resources. The workflows employed by the designers in this experience used various high-end and low-end hardware rigs, all equally being able to achieve a well-received outcome due to the workflows utilised and the collaboration involved. Combining Unreal Engine 5 with industry-standard tools, like Autodesk Maya, Zbrush, or open-source software like Blender, allows a pathway for creators of all levels to develop experiences through Unreal Engine and technology like Target3D's LED stage. This flexibility in the design process benefits those who want to tell stories in a way that was previously more exclusive to access.

2.3 Conclusion

The project overall demonstrated the potential of digital environments, in live experiences, bridging the gap between the physical and virtual worlds. Creating immersive spaces for the audience accompanied by visually enriched narratives allowed a deeper connection between the speakers and their viewers, illustrating how technology can progress storytelling methods in live settings without requiring budgets previously exclusive to larger-scale productions.

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