Extended Reality Ulysses Demo

Néill O'Dwyer
odwyernc@tcd.ie
V-SENSE, School of Computer Science and Statistics
Trinity College Dublin
Dublin, Ireland

Gareth W. Young
youngga@tcd.ie
V-SENSE, School of Computer Science and Statistics
Trinity College Dublin
Dublin, Ireland

Aljosa Smolic
smolica@tcd.ie
V-SENSE, School of Computer Science and Statistics
Trinity College Dublin
Dublin, Ireland

Figure 1: A screenshot of the user's point of view in Scene 1, 'Telemachus'

ABSTRACT

This demo paper proposes to exhibit the pilot episode of *XR Ulysses*, a creative project investigating the possibilities for live performance using three-dimensional volumetric video (VV) techniques via virtual reality (VR) technologies. *XR Ulysses* is part of a series of innovative performance experiments hybridizing theatre and extended reality (XR) technologies. Conference attendees are invited to don an HMD, embody the character of Stephen Dedalus, and engage Buck Mulligan in the famous opening scene of Joyce's book, situated on the top of the Martello Tower at Sandycove (Dublin). This scene enables individuals to experience a live-action re-enactment of James Joyce's *Ulysses* in VR.

CCS CONCEPTS

• **Applied computing** → **Media arts**.

KEYWORDS

Virtual Reality, Volumetric Video, Extended Reality Performance

IMX '22, June 22–24, 2022, Aveiro, JB, Portugal

ACM ISBN 978-1-4503-9212-9/22/06.
https://doi.org/10.1145/3505284.3532816

ACM Reference Format:
Néill O'Dwyer, Gareth W. Young, and Aljosa Smolic. 2022. Extended Reality Ulysses Demo. In *ACM International Conference on Interactive Media Experiences (IMX '22), June 22–24, 2022, Aveiro, JB, Portugal.* ACM, New York, NY, USA, 3 pages. https://doi.org/10.1145/3505284.3532816

1 INTRODUCTION

The Covid-19 pandemic and the resulting lockdown have occasioned a sociological turn that underscores a profound new emphasis on the need for theatre/performance practitioners to explore the potentialities of digital media to connect with and bring their work to remote, networked audiences [6]. Within this space, the shortcomings of simple videoconferencing/webcasting have become blatantly evident for performance practitioners; therefore, the immersive potential of AR/VR technologies still awaits deep investigations.

XR Ulysses consists of two short scenes: the first is an excerpt from Chapter 1, 'Telemachus' (this first pilot scene was exhibited in the Art Gallery of Siggraph Asia) [4], and the second scene is an excerpt from Chapter 15, 'Circe' (this second scene has not been exhibited anywhere yet).

This creative project investigates new possibilities for the performing arts by employing cutting-edge volumetric video (VV) techniques displayed via VR and AR technologies. The VR application allows audiences from any part of the globe to experience the sites and associated scenes from the story via a VR headset. On the other hand, the AR application will allow audiences to physically

go to those locations and witness dramatic recreations of the scenes by using a mobile phone, tablet, or head-mounted display.

2 TECHNICAL

The techniques used for creating the scene and characters were based on 3D scene reconstruction and volumetric video. They vary between the AR and VR versions because, in AR, you do not need to recreate the scenes, and you use the environment you physically occupy as your scene. This environmental factor means that the staging (mise-en-scène) must be carefully considered because the viewing environment must give meaning and context to the action. On the other hand, VR is a three-dimensional (3D) simulation of the physical world that an avatar can virtually navigate, so the scenic elements must be assembled using 3D software that facilitates world-building – a game engine.

2.1 Static Scene Elements

In the VR version, the static elements (i.e., the scene, props and architecture) are 3D representations of the scenes from the book: the first scene is set on top of a Martello Tower overlooking Dublin Bay, the second scene is set in a period townhouse located in the heart of Georgian Dublin. We used a combination of 3D surface reconstruction processes (called photogrammetry) and 3D modelling software to recreate the virtual architectures. The photogrammetry process involves taking several hundred photographs of the subject from as many possible angles and then feeding the photographs into software, which estimates the camera positions and then calculates the volume of the structure. After the 3D surface has been calculated, the software uses the photos to create textures for the 3D surface, producing a photorealistic 3D simulation of the object. There are many commercial and open-source software offerings available for this process. We used an open-source version called 'Meshroom' by AliceVision.

2.2 Dynamic Scene Elements

The dynamic elements (i.e. the characters) are particular to both (the AR & VR) versions of the app, which are the more cutting-edge elements of the project. The characters are fabricated using the process of volumetric video (VV), a recent and growing software innovation that permits the extrapolation of live-action footage to dynamic three-dimensional objects (similar to 3D animated characters). These are compatible with AR and VR environments because they can be viewed from any desired perspective. There is currently no widely available option for this software process because it is highly complicated and involves several post-production stages that have not yet been consolidated into a single piece of software. The intellectual property is still primarily within the domain of computer science research groups and innovative start-up companies. We, at V-SENSE, are championing one method that relies solely on photographic data, whereas other solutions involve depth sensors [7]. This process makes our capture rig and data set more lightweight, but post-production relies more heavily on complicated, processor-intensive computer vision algorithms.

VV technology is disrupting the XR sector because it affords the participation of actors, performers, directors, and theatre/filmmakers in the VR discourse, which computer scientists and animators have conventionally dominated.

2.3 Spatial Audio

Dynamic spatial audio is used to embellish the sense of immersion and give the user the perception of embodying one of the characters in each scene. The user hears the voice of the embodied character in deep, resonant tones, in the same way, a speaker perceives their voice, whereas the voice of the interlocutor is perceived as coming from another source, outside the body; that is, it is subject to 1) direction and 2) distance – ambisonics [2]. The spatial audio toolkits for VR and AR technology can be programmed in such a way that 1) when the user looks away from the character, they perceive the voice as relational, i.e., it appears louder in one ear than in the other, and 2) when the user walks closer to the audio source it appears louder, and when they move further away, it appears quieter. These spatial audio toolkits are also based on cutting-edge technology, which has become deeply significant since its application to MR technologies because it is crucial to the user's sense of immersion in the story world.

3 NOVELTY AND INNOVATION

XR Ulysses is part of a series of creative–cultural experiments investigating questions around the preservation, accessibility, reactivation, and transmissibility of dramatic and literary knowledge in the twenty-first century [3]. Captured using cutting-edge VV techniques, *XR Ulysses* enables 1) audiences from any part of the globe to experience a live-action Bloomsday event in a site-specific 3D simulation via a VR headset and 2) Dublin-based audiences to physically go to the sites in the book and augment the scenes with AR displays.

XR Ulysses is a pioneering interactive narrative that attempts to weave together the geospatially disparate scenes of *Ulysses* into a whole greater than the sum of its parts. It does this by harnessing geospatial data and computer vision data so that the application understands what characters to display and where to place them. The characters accordingly articulate the dialogue specific to the site that the audience occupies. Although there are already some examples of dramatic XR narratives created using volumetric video technology [1, 5, 8], there is very little or no exploitation of the site-specific potentialities offered by platforms that can access geospatial data, i.e., smartphones and AR glasses.

The goal is to suggest new horizons for the performing arts in the context of evolving interactive digital media technologies.

4 EXHIBIT DESCRIPTION

This proposal is to exhibit the VR version of *XR Ulysses* as an installation that uses (dynamic) volumetric video techniques and (static) photogrammetry techniques combined and displayed using a VR HMD. We can also bring a modified version of the AR application on smartphones, tablets, and AR glasses to show visitors the various versions. However, they will not be site-specific; the character can be placed anywhere and resized in a revised version of the AR app.

The artists can supply the laptop for the exhibition. We ask that the conference organizers provide a tethered HMD (e.g. HTC Vive) and associated accessories, but we can transport this equipment in our luggage on the flight if it is not possible. The former is preferable. The following technical requirements are requested from the venue:

- A well-lit interaction space, approximately 4 x 4 meters.
- A large LCD screen or projector and a blank white wall/screen to allow visiting attendees to view the VR content when not wearing the head-mounted display.
- An HTC Vive VR tethered HMD (including base stations and controllers).
- Approximately 8 x 240v electrical sockets: 2 for the exhibition laptop, 1 for the LCD screen/projector, 2 x VR controller chargers, and 2 x miscellaneous.
- A standard table and a suitable chair should be provided.

Please see the exhibition plan below for a visualisation.

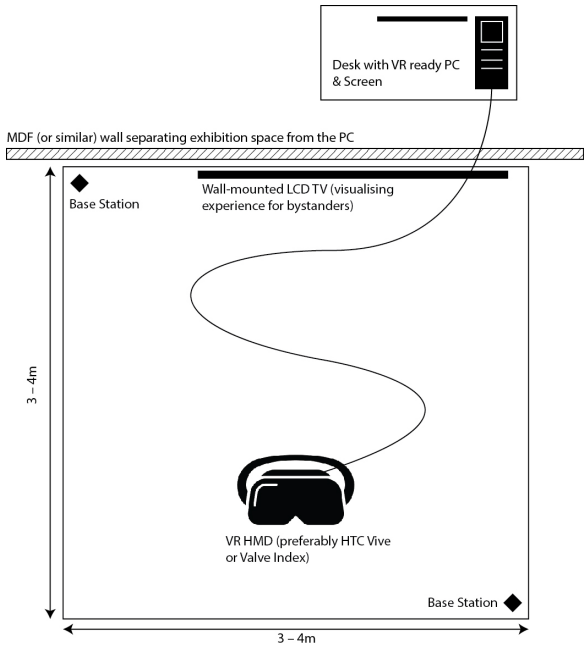

Figure 2: Proposed exhibition floor plan

ACKNOWLEDGMENTS

This publication has emanated from research conducted with the financial support of Science Foundation Ireland (SFI), under Grant Number 15/RP/2776, and the Irish Research Council under Award Number 17266.

REFERENCES

[1] Nonny de la Peña. 2001. *Home Page.* Emblematic. Retrieved April 25, 2022 from https://emblematicgroup.com

[2] Roger K Furness. 1990. Ambisonics-an overview. In *Audio Engineering Society Conference: 8th International Conference: The Sound of Audio.* Audio Engineering Society, Washington D.C, 1 pages.

[3] Néill O'Dwyer and Nicholas Johnson. 2019. Exploring volumetric video and narrative through Samuel Beckett's Play. *International Journal of Performance Arts and Digital Media* 15, 1 (2019), 53–69. https://doi.org/10.1080/14794713.2019.1567243 arXiv:https://doi.org/10.1080/14794713.2019.1567243

[4] Neill O'Dwyer, Gareth W. Young, Aljosa Smolic, Matthew Moynihan, and Paul O'Hanrahan. 2021. Mixed Reality Ulysses. In *SIGGRAPH Asia 2021 Art Gallery* (Tokyo, Japan) *(SA '21).* Association for Computing Machinery, New York, NY, USA, Article 9, 1 pages. https://doi.org/10.1145/3476123.3487880

[5] Néill O'Dwyer, Nicholas Johnson, Enda Bates, Rafael Pagés, Jan Ondřej, Konstantinos Amplianitis, David Monaghan, and Aljoša Smolic. 2021. Samuel Beckett in Virtual Reality: Exploring Narrative Using Free Viewpoint Video. *Leonardo* 54, 2 (04 2021), 166–171. https://doi.org/10.1162/leon_a_01721 arXiv:https://direct.mit.edu/leon/article-pdf/54/2/166/1910822/leon_a_01721.pdf

[6] Néill O'Dwyer, Gareth W. Young, and Aljosa Smolic. 2022. XR Ulysses: addressing the disappointment of cancelled site-specific re-enactments of Joycean literary cultural heritage on Bloomsday. *International Journal of Performance Arts and Digital Media* 0, 0 (2022), 1–19. https://doi.org/10.1080/14794713.2022.2031801 arXiv:https://doi.org/10.1080/14794713.2022.2031801

[7] Rafael Pagés, Konstantinos Amplianitis, David S. Monaghan, Jan Ondrej, and Aljoscha Smolic. 2018. Affordable Content Creation for Free-Viewpoint Video and VR/AR Applications. *Journal of Visual Communication and Image Representation* 53 (2018), 192–201. https://doi.org/10.1016/j.jvcir.2018.03.012

[8] Start VR. 2001. *Home page.* Start VR. Retrieved 04.25.2022 from https://startvr.co/project/awake/