

A Demonstration of Cultural Heritage Re-enactment: Volumetric Depiction of Sibylla Merian

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Abstract

This demo presents the "Sibylla Merian" case study, part of the LoGaCulture project, which investigates the use of volumetric filmed characters to enhance cultural heritage (CH) experiences through head-mounted augmented reality (AR) environments. Utilizing state-of-the-art volumetric video (VV) techniques, the case study aims to create immersive and interactive exhibits by integrating human hologram figures into three-dimensional spaces, bringing historical narratives to life with the authenticity of live actors' performances. By capturing these performances and adapting them for 3D virtual spaces, the case study seeks to enhance both the realism and emotional engagement of AR experiences and connection to history. Additionally, this work evaluates the feasibility and limitations of the current tools available for such advanced applications.

CCS concepts

• Human-centered computing → Mixed / augmented reality; Human computer interaction (HCI)

1. Introduction

The ongoing work of our "Sibylla Merian" case study explores the application and feasibility of volumetric video (VV) in immersive augmented reality (AR) environments to enhance the presentation and interpretation of historical characters. This case study is part of the broader LoGaCulture project, which unites European academics in digital locative experiences to investigate how innovative locative games can benefit European society through its cultural heritage sites. The project focuses on integrating advanced digital technologies with cultural heritage to create engaging, educational, and sustainable experiences.

This case study is to be set in a natural history museum, exploring possible content for immersive augmented reality applications. With the goal of integrating the "Human" in an immersive 3D space, and having a demonstrator that utilizes volumetric filmed humans, we sought a historical character that could represent a natural science theme relevant to the area. Maria Sibylla Merian (1647–1717) was a pioneering German naturalist, entomologist, and scientific illustrator born in Frankfurt. She is best known for her detailed and accurate observations and illustrations of insects and plants, particularly focusing on the metamorphosis of butterflies [Lof18].

2. Related work

Previous studies have highlighted the potential of volumetric video (VV) and augmented reality (AR) in various applications. The impact of VV on user presence has been examined, demonstrating

how VV can significantly enhance the feeling of presence in AR storytelling, thereby improving user engagement and emotional connection to the narrative [BKS23]. Kusumawati (2022) demonstrated VV's use in educational AR apps, significantly enhancing spatial learning and user interaction through 3D models and quizzes [Kus22]. Smolic et al. (2022) emphasized VV's role in creating immersive XR experiences, showcasing innovative storytelling and user engagement, while noting technical challenges in real-time integration [SAM*22]. Zerman et al. (2021) analyzed user behavior with VV in AR, revealing a preference for frontal viewpoints, and stressed the need for adaptive systems to optimize engagement [ZKS21]. Zerman et al. (2020) further explored VV in cultural heritage AR applications, finding that VV enhances user experience and engagement, though platform-specific differences necessitate further investigation [ZOYS20]. O'Dwyer et al. (2021) focused on VV's ability to enrich storytelling in cultural heritage, highlighting the importance of scalability and cost-effectiveness for broader implementation [OZY*21]. The "SPIRIT" project by Spierling and Coors (2014) provided a foundational example of AR's potential in creating engaging historical narratives through interactive holographic characters [SC14].

3. Research gap

Despite advancements, significant gaps remain in the long-term engagement and sustainability of AR and VV applications in cultural heritage. Previous studies have shown that VV and AR enhance user engagement and storytelling, but more research is

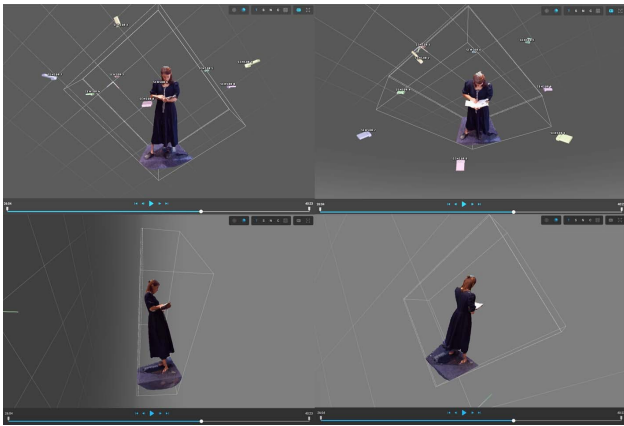


Figure 1: During production, screen shots from the depthkit program demonstrating the actress playing sibylla Merian's character and the set up for the capture with 9 Sensors.

needed on the long-term impacts on user engagement and learning outcomes [ZKS21], [OZY*21]. Additionally, the scalability and cost-effectiveness of VV applications in diverse cultural heritage settings are underexplored [OZY*21], [SAM*22].

The "Sibylla Merian" case study seeks to address these gaps by examining how VV can be used to create immersive and sustainable CH experiences, and how capturing live actor performances can enhance the emotional resonance and authenticity of these experiences within AR. Moreover, the use of devices such as the HoloLens, combined with the large data volumes inherent to VV, presents a challenging aspect that must be explored. This includes investigating how to adapt these tools to achieve a smooth and playable immersive 3D virtual space that effectively integrates VV characters.

4. Demo description

The "Sibylla Merian" case study uses volumetric filming to create human hologram figures for head-mounted AR applications at cultural heritage sites. A first use scenario, developed with the Senckenberg Museum, employs nine Azure Kinect sensors, inspired by the state-of-the-art Zero Space studio from Scatter [Sca24]. These captures are processed using the Depthkit program; the 3D scenes are designed and customized in Unity for the HoloLens

The demo features a young Sibylla Merian in her everyday life, observing and drawing insects. This setup allows audiences to engage with her history through holographic representations of her character in an interactive storytelling experience.

The ongoing work will present the first prototype of the "Sibylla Merian" AR application. In this immersive demonstration, participants can interact with a volumetric video hologram of a young Sibylla Merian. In the scene, Sibylla is depicted drawing a caterpillar, offering a unique experience through the use of a HoloLens. This prototype showcases the potential of VV to



Figure 2: Images captured from various perspectives, showcasing the user's point of view through the HoloLens. These pictures provide a visual representation of the immersive experience as seen through the AR device, highlighting different angles and interactions within the "Sibylla Merian" application.



Figure 3: A user wearing the HoloLens, actively engaging with and interacting with the VV of Sibylla Merian.

bringing historical figures and moments to life in an immersive virtual 3D space.

We will provide the HoloLens for the demonstration. To ensure hygiene and safety, especially given that multiple individuals will be using the device, we will bring a UV light sterilizer to sanitize the HoloLens between uses.

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