The creation of ‘Uvira’s Pot’, a virtual reality puzzle to promote engagement with archaeological research.

Hardy, Kristine
kristine.hardy@anu.edu.au
School of Archaeology, Australian National University, Australia

Virtual reality (VR) applications have the potential for users to experience recreations or aspects of past times, and thus make archaeological research more understandable and engaging to students and non-academics. VR equipment such as the Quest, consists of a headset, which immerses the user in a scene, and hand controllers, which enable the user to manipulate virtual objects.

3D digital models of past artefacts, buildings and sites, are being produced in increasing numbers and have important roles in documentation, conservation and as reference collections (European Commission 2022; Markiewicz 2022). Databases, such as Sketchfab and MorphoSource, allow users to explore and, in a limited way, manipulate these models via a web-interface (Flynn 2019; Spelitz 2020).

Ideally artefact models, whether ‘realistic’ or ‘symbolic’ should convey information about community that created or used the original (Champion 2021). VR has allowed for displaying models in virtual museums, but also in simulated past environments, such as an Egyptian tomb, Catalhoyuk or prehistoric cave (Cassidy et al. 2019; Lucarelli / Johnston 2022; Morgan 2009; García-Bustos et al. 2022). However, VR has the potential for further user engagement through the use of puzzles that incorporate archaeological concepts. Digital games have been shown to increase user interest in past times, such as ancient Greece (Houghton 2021; Politopoulos / Mol 2021) and many users are more likely to spend time with a VR model if they have a challenge to solve (Balabanian / Shahrabi 2022). One type of puzzle that occurs in archaeological research is vessel refitting. The concept is very similar to the 3D ‘jigsaw’ puzzles in the VR applications, ‘Puzzling Places’ and ‘Art Salad’ (Mariotto 2022).

We present a workflow to create websites that allow VR users to recreate broken ceramic vessels and learn about its creation in a surrounding photo gallery.

1.) Create 3D models. Models can be made with photogrammetry (Rahaman 2021) or laser scanning (Fragkos et al. 2018; Spelitz 2020). Models with accurate measurements are crucial if the vessel pieces are to fit together. While laser scanners are better at measurements, their image textures are often inferior. Alternatively, digitally “break” a scanned vessel (in Blender). The Polycam iPhone application creates suitable models. Importantly consider copyright and community ownership issues when digitising (Dennis 2021; Morgan 2022).

2.) Re-topologise models. Smaller asset sizes are critical for VR and web applications. Reduce the number of model polygons (in Metashape).

3.) Make information panels. Images with photographs and text should be created (in Designer, Powerpoint) with lengths and widths of pixel numbers that are a power of two.

4.) Create scene in three.js (or react-three-fiber). Three.js is a javascript library for using 3D objects in websites. Scenes consist of lights, cameras and objects (models including planes for images). The examples for use with VR can be altered to import models, and make them movable with the VR controllers. This is more easily achieved than in games engines such as Unity or Unreal Engine, but implementing ‘physics’ for complex models, so that the sherds do not overlap, is not easily achievable. Three.js can also be used to make other simple games, such as those where the user has to match artefacts to their place of origin.

5.) Add an audio recording. (Optional).

6.) Deploy. Websites can be deployed using services such as Vercel or Github pages. Preferably sites should be archived as well, ideally with full metadata. Many archeologically related digital applications have short lives and become inaccessible to later researchers (Champion 2021).

This application (uviras-pot.vercel.app), uses a vessel made by Uvira, an Agarabi speaker from the Eastern Highlands of Papua New Guinea (PNG). The Agarabi are the only PNG highlanders to make pottery (Watson 1993). Creation of the vessel was documented in 1987 by Chris Ballard and recently these notes and photographs were prepared for academic publication (Hardy et al. 2023). ‘Uvira’s Pot’ was created as an experiment in conveying this research to a non-academic audience. It is hoped that as VR use becomes more widespread, this audience will include the Agarabi community.

In conclusion, this project shows that VR websites made to convey archaeological research in an easily accessible way to the general public, can be created with minimal JavaScript experience, using phone-made photogrammetry models and the three.js library. The use of three.js and a website delivery, does impose restrictions on asset sizes. However, the ability of users to manipulate models and solve puzzles, has the potential to increase their engagement with heritage models and their appreciation for and understanding of archaeological research.

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