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Interactive 3D Viewer Interfaces for Virtual Museum Artefacts

Sandra Woolley
Computing and Mathematics
Keele University
Staffordshire, UK
s.i.woolley@keele.ac.uk

Tim Collins
Department of Engineering
Manchester Metropolitan University
Manchester, UK
t.collins@mmu.ac.uk

Erlend Gehlken
Institut für Archäologische Wissenschaften
Goethe-Universität
Frankfurt am Main, Germany
gehlken@em.uni-frankfurt.de

Richard Rhodes
Computing and Mathematics
Keele University
Staffordshire, UK
r.t.rhodes@keele.ac.uk

Mustafa Dhar
Computer Science and Engineering
Medi-Caps University
Indore, India
m4mustafa110@gmail.com

This paper accompanies an Interactions Gallery exhibit of interfaces to 3D artefacts at the 2022 BCS Human-Computer Interaction (HCI) Conference. The exhibit introduces cuneiform, humankind's earliest writing, showing visitors how the cuneiform script evolved over millennia and how web-based 3D viewer interfaces for cuneiform artefacts have evolved much more recently from a progenitor originally demonstrated five years ago at the 2017 BCS HCI Conference Interactions Gallery. Visitors to the exhibit will also see how the 3D viewer interface has been adapted for different purposes and how it continues to evolve in functionality.

Digital heritage, Interfaces for 3D artefacts, Cuneiform tablets

1. BIOGRAPHY

Sandra Woolley, Tim Collins and Erlend Gehlken are three of the founding members of the Virtual Cuneiform Tablet Reconstruction (VCTR) Project: virtualcuneiform.org, an international research collaboration inspired by the ambition to support virtual access to cuneiform artefacts and to reconstruct tablets by joining virtual fragments together (Collins et al. 2014, 2017a,b). Richard Rhodes is a PhD researcher creating engaging virtual reality experiences for cuneiform tablet artefacts and Mustafa Dhar is the 2021 Google Summer of Code intern whose project successfully integrated the VCTR 3D viewer into the 'CDLI' international on-line cuneiform database (Cuneiform Digital Library Initiative).

2. GALLERY EXHIBIT EXPERIENCE

The exhibit invites visitors to explore and interact with ancient clay Mesopotamian cuneiform tablets, humankind's earliest writings dating back 5,000 years and, quite literally, *the* original portable information technology. Impressed in handheld clay tablets with a reed stylus, the cuneiform system of writing remained in use for 3,000 years.

Visitors will have an opportunity to inscribe signs themselves and explore interactive online interfaces to cuneiform tablet artefacts including a 4,000-year-old tablet listing disbursements for King Šarkališarri's visit to Sumer (Cripps 2016, 2019). Visitors can also interact physically with true-size 3D prints of the tablets.

3. EXHIBIT IMAGERY

The exhibit will include visual imagery based on Figure 1 showing how, over millennia, cuneiform script evolved from simple pictograms to a sophisticated system of writing. Visitors can explore interactive interfaces to tablet fragments as shown in Figure 2 which includes the original VCTR 3D viewer (Collins et al. 2017a) inspired by the invitation to provide a demonstration exhibit for the 2017 BCS HCI Conference Interactions Gallery to accompany the paper about the research (Woolley et al. 2017). Visitors can also explore an evolved and adapted educational version of the VCTR 3D viewer that, as shown in Figure 3, reveals alternative 3D model views, as well as the version of the VCTR viewer shown in Figure 4 that was recently integrated by a Google Summer of Code project into the beta release of the CDLI's

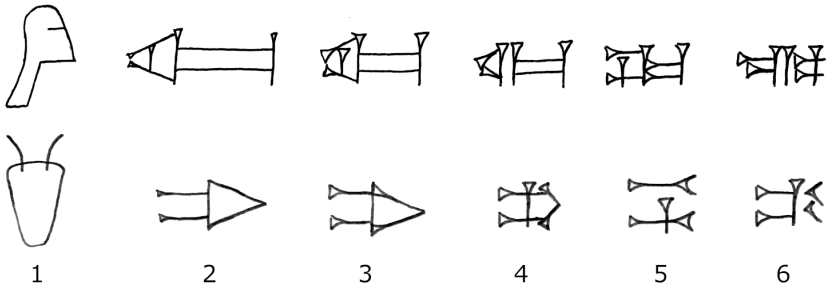

Figure 1: *Evolution of cuneiform signs for head and cattle. See top row the head sign "SAG" and see bottom row the cattle sign "GU". The original pictograms (1) evolved through Classical Sumerian, Old Babylonian, Middle Babylonian and Neo-Babylonian times (2-5) and into Neo-Assyrian (6). (Labat and Malbran-Labat 1963) Image source: https://virtualcuneiform.org/overview.html*

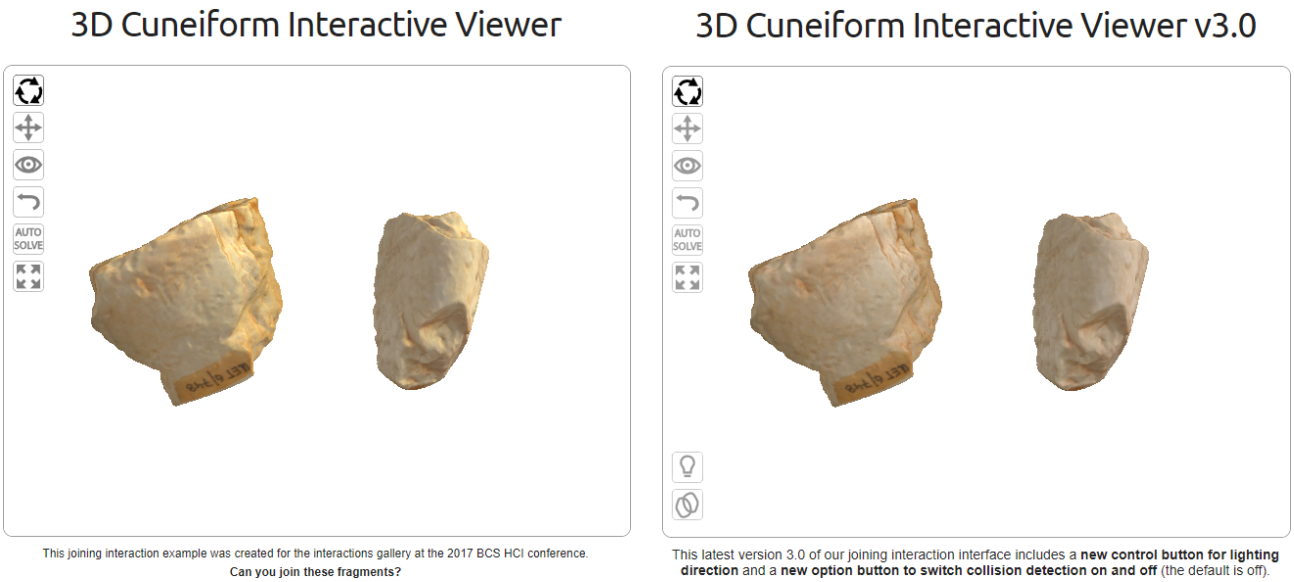

Figure 2: *The original 3D viewer interface (left) created for the 2017 BCS Human-Computer Interaction Conference Interactions Gallery, https://virtualcuneiform.org/interaction.html, and Version 3.0 (right) with interface options for lighting control and collision detection, https://virtualcuneiform.org/interaction3.html. The cuneiform tablet fragments presented are held on study loan at the British Museum*[*]*.*

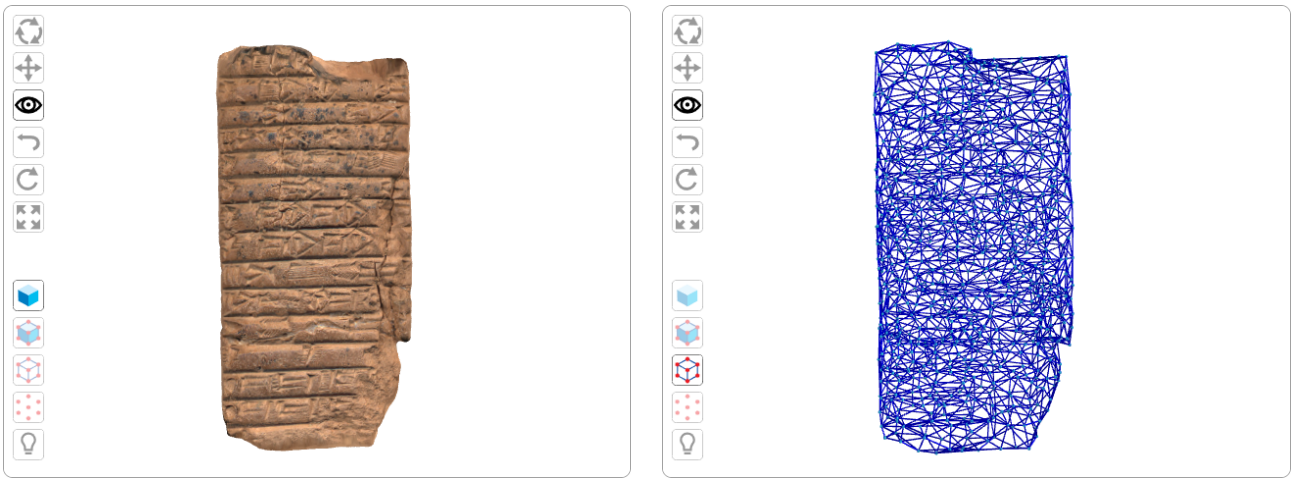

Figure 3: *An alternative educational version of the VCTR interface showing (left) photo-realistic rendering and (right) a down-sampled wireframe model. 3D scan courtesy of National Museums Liverpool (World Museum)*[**]

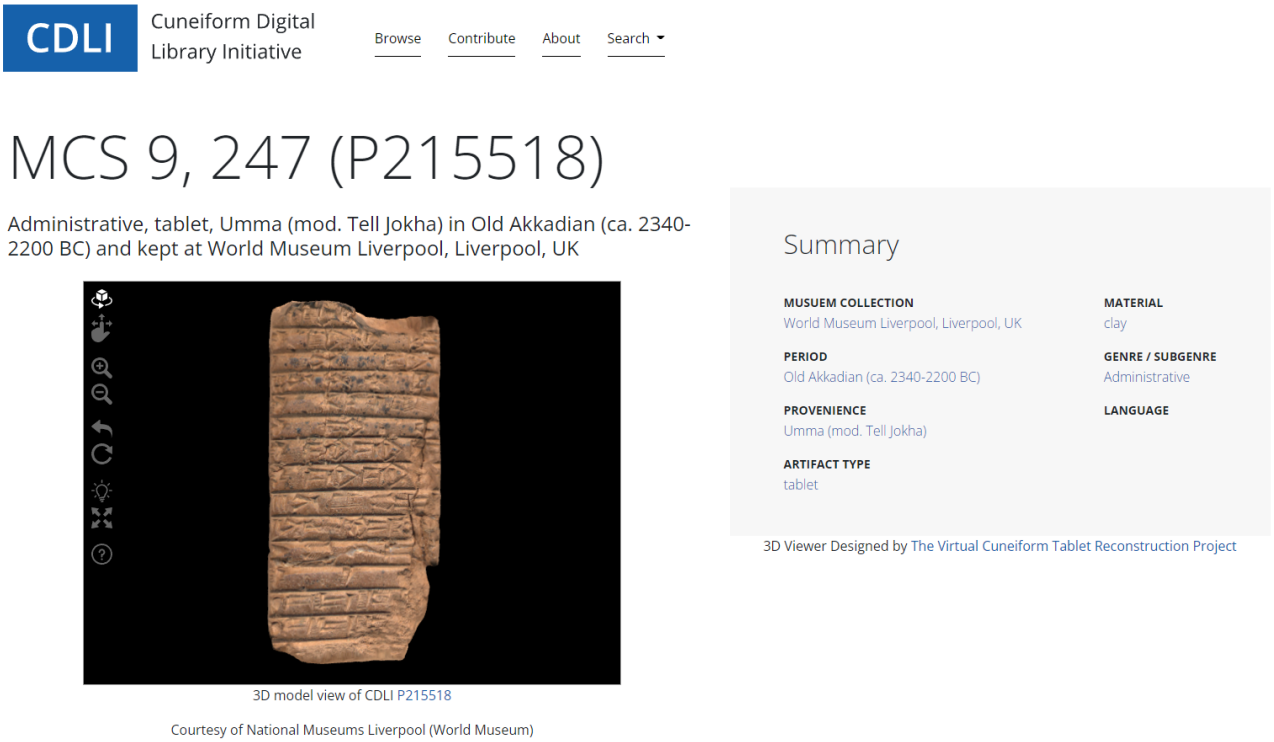

Figure 4: *Split-view screenshot of the CDLI 2022 beta implementation of the responsive mode VCTR 3D viewer*

Figure 5: *True-size 3D prints of the cuneiform tablet, https:// virtualcuneiform.org/ tellohModels.html*

international cuneiform database. The tablet shown in these interface examples and in the physical true-size prints (Figure 5) was inscribed over 4,000 years ago in the 'Old Akkadian' period: the period circa 2340-2200 BCE. The tablet's digital record can be found in the CDLI with the ID P215518. Inscribed on front (obverse) and back (reverse) as well as along one side, the writing on this tablet tells us that the King's entourage will need to take lentils, chickpeas, barley, milk, cheese, cumin, dates, raisins, figs and more (Cripps 2016).

Visitors will be invited to share suggestions and opinions about the interfaces and about future support of annotations (Homburg et al. 2022), measurement tools (Champion and Rahaman 2020) and artefact-specific functionality. For example, support for rotational functionality that makes it easy to display obverse and reverse cuneiform tablet writing flipped vertically, so that text is correctly oriented according to the conventional flow of the script.

4. RESEARCH RATIONALE

Museums often display only a fraction of their holdings. For example, large national museums may display only 1-5% of their holdings with very many artefacts rarely, if ever, displayed in the limited public exhibition spaces. When artefacts are on display in public galleries it can often be difficult to provide all around views of their surfaces or provide supporting contextual information. Small and less colourful artefacts, like clay cuneiform

tablets, can be overlooked and their significance and fascinating histories can be left uncommunicated (Woolley et al. 2021). Beyond a few examples (Gansell 2018; Pietroszek et al. 2021), there have been relatively few Assyriological realisations of digital or virtual reality projects (Hanes 2020; Sahala 2021) compared to those depicting Egyptian and Roman civilisations. Our research aims to inform and create connected, accessible and engaging virtual and augmented reality experiences for cuneiform tablets for scholars and citizens (Woolley et al. 2020), recognising both the opportunities and challenges associated with the adoption of tools and technologies (Woolley and Collins 2021; Hall et al. 2021).

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