

UNMEDIATED CULTURAL HERITAGE VIA HYVE-3D

Collecting individual and collective narratives with 3D sketching

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Abstract. Cultural heritage is traditionally mediated through institutional bodies that are authorised to broadcast heritage information, whereas new media technologies such as social media platforms continue to enforce individual storytelling and information sharing. Therefore GLAMs (Galleries, Libraries, Archives and Museums) have to cope with a shift of public interest from their services to more accessible, entertaining and democratic engagements available as ‘living’ media. Unmediated cultural heritage is the paramount aim of this work and, in a theoretical sense, a utopia for generation of authenticity or meaning-making. Within the realm of digital heritage, this study explores the nature of engagement with cultural heritage using an innovative means. In this phase of the research, a photogrammetric model of Kashgar’s narrow alleys is deployed in a system, called Hybrid Virtual Environment 3D (Hyve-3D). Via its 3D cursor technology, the concept of unmediated cultural heritage is unfolded through active participation, collaboration and interaction. Thus, in the context of heritage, this research explores a hitherto undocumented frontier of Hyve-3D designated to immersive collaborative 3D sketching.

Keywords. Digital heritage; Hyve-3D; photogrammetry; authenticity; 3D sketching.

1. Introduction

The proponents of unmediated cultural heritage in GLAMs (Galleries, Libraries, Archives and Museums) co-exist with the contemporary advocates

of social inclusion and multiculturalism in the heritage sector (Hall, 1999; Message, 2009a, 2009b; Waterton, 2010). This may be a consequence of decreasing focus on the materiality of heritage canonised since the Renaissance, where the aestheticisation of the past was integral to the appreciation of ruins (Watson and Waterton, 2010).

The idealist guise of heritage has long been attributed to privileged strata and legitimised by institutionalised selection and display processes. In Singer's (1998) words, "the repression of error [i.e. 'glitch', as we refer to in our research] has served as the fulcrum of aesthetic autonomy whenever autonomy has been the standard of aesthetic perfection, and for good reason."

The ambiguous definition of the term 'artefact' as a human-made object, exposes the scope of this paper in the heritage realm. An artefact is seen as an 'error' (i.e. 'glitch') when the object is de-contextualised. However the decentred object creates its own narrative to guide understanding of its value beyond its materiality. In the heritage discourse, this meaning-making process still sits between the representational and the performative-subjectivist approaches (Smith, 2006). The objective is "to explore the nature of the engagement itself; the ragged line between what is represented and what is understood or otherwise experienced as put forward by Watson and Waterton (2010).

Heritage making and heritage narratives have recently been taking different forms, inviting subaltern perspectives such as unmediated cultural heritage. In this context, we see a potential elucidation of its facets through (computer generated) glitches that would not only be a thought provoking item for human-human relations but also initiate a dialogue between the human and the machine that generates them both by malfunction or design. In this respect, this research is an extension of previous work (Norman, 2002; Schnabel et al, 2004; Tang and Gero, 2001) in the heritage context.

This paper alludes to the digital heritage project of 'Augmenting Kashgar' (Schnabel and Aydin, 2015), where the aesthetics of glitches and their contextualisation in cultural heritage making are discussed both theoretically (Aydin and Schnabel, 2016) and practically with comparison to other cases concerned with the 'unexpected-ness' of objects (Aydin et al, 2016).

Here we add a novel facet to the research, relating it to the representational ecosystem as discussed by Dorta and Kinayoglu (2014), by deploying a system called Hybrid Virtual Environment 3D (Hyve-3D) (Dorta et al, 2014; 2016). Hyve-3D was originally developed as a co-design tool and is presented in this research context for the first time as an unmediated cultural heritage environment to present aspects of Kashgar's old town.

In relation to unmediated cultural heritage, we argue that users (in a non-immersive version of the system running on a laptop) may reinstate their

interpretations of Kashgar's heritage with their own models of the ancient town. In this paper we focus on the progress of a spontaneous reconstruction of an unmediated heritage-making through co-reconstruction links as well as individual and collective heritage narratives potentiated and facilitated by the features and functionalities of Hyve-3D.

2. Project "Augmenting Kashgar"

This is a design research project in the field of digital heritage, which ties together architecture, history, virtual reality and game design. The project is built upon the concept of 'The Museum of Gamers' (Aydin and Schnabel, 2016) where three key pleasures of cyber-space are investigated; immersion, agency and transformation (Murray, 1998).

While the use of Hyve-3D for co-design aspects has been evaluated in another publication (Dorta et al, 2016), this paper investigates the direct link that sketching with its 3D cursors provides between users and meaningful experiences in the making of cultural heritage.

2.1. PHOTOGRAMETRIC MODELLING

The availability of open source/access applications dedicated to modelling encourages laypersons' engagement in an operation, which historically has been computationally expensive or complex. A free *Autodesk* App, called *Momento*, allows easy generation of 3D digital models by 'scanning' the operator's vicinity.

Kashgar's maze-like street network is first modelled in *Autodesk Recap* (Figure 1). Resulting geometries may create 'holes' or glitches where the algorithm confronts a hard task, e.g. discrepancy in overlapping photos uploaded. This kind of error can be alleviated by *Memento's* patching function that directly optimizes an average piece of mesh based on neighbouring polygons around the hole. Other functions of *Memento* include basic manipulation of the geometry, e.g. decimating the number of polygons or smoothing, pushing and pulling parts of the mesh.

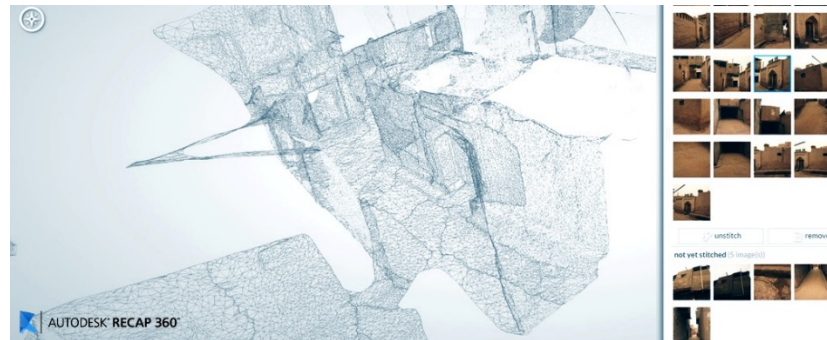


Figure 1. Screenshot of a piece of raw Kashgar model in Autodesk Recap.

During all geometrical operations in *Recap* and *Memento*, the texture is automatically mapped on the surface. However, unless exported as FBX, a proprietary format owned by *Autodesk*, other export options, e.g. OBJ may cause detachment of textures in other modelling software (Figure 2). Nevertheless OBJ files were successfully used importing Kashgar's photogrammetric models into Hyve-3D.

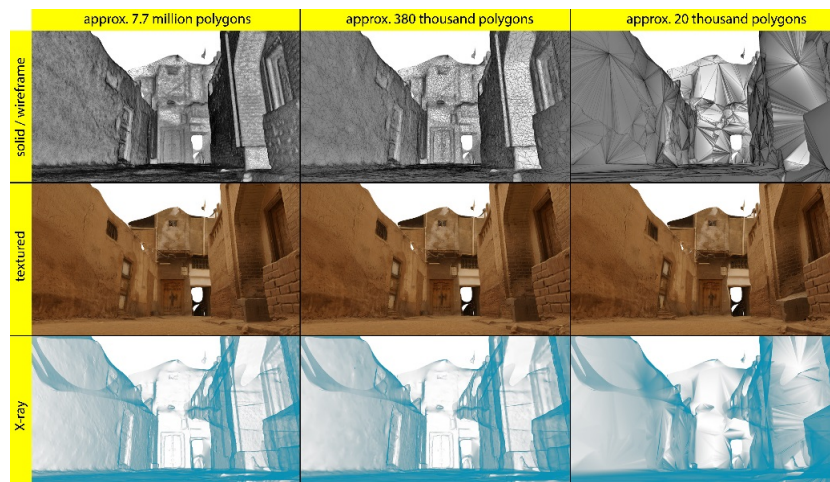


Figure 2. Successive decimation of polygons in Memento by 95% from left column to right.

Additionally it should be noted that the photographs of Kashgar were taken at different times and in different environmental conditions such as cloudy days with evenly distributed light or sunny days that brighten white surfaces excessively, causing parts of geometry to be unrecognised by the algorithm and thus creating random black holes. These are errors that are revealed in textures and other misalignments caused in the photogrammetric

process, which necessitate consideration of the glitch aesthetics mentioned in the introduction.

2.2. IMPORTING MODELS INTO HYVE-3D

After the photogrammetric process, the model can be directly imported into Hyve-3D as an OBJ file. However, optimizing the polygon mesh allows for smoother real-time interaction and remote collaboration within the system. This can be done during the photogrammetric modelling but it is advisable to test the decimation in order to achieve the level, which is optimal for the purpose of the exercise.

3. A representational ecosystem for cultural heritage making

Hyve-3D is an immersive design and visualization system that allows collaborative and real-time sketching in 3D without the need for headsets. The Hyve-3D setup allows shared interactions with 3D models inside an immersive environment without necessitating a complex graphical user interface. The visualization technique uses an anamorphic *trompe-l'oeil* projection onto a spherical concave screen.

This concave screen is sufficiently spacious to accept several inhabitants simultaneously, thus enabling user engagement in both real and virtual collaboration (Figure 3). Hyve-3D also works in a non-immersive mode using desktop computers or laptops. It allows export of the design interactions as 3D sketches to any 3D modelling software as 3D vectors (DXF format). The technical aspects and functions of Hyve-3D are explained in detail by Dorta et al (2014; 2016).

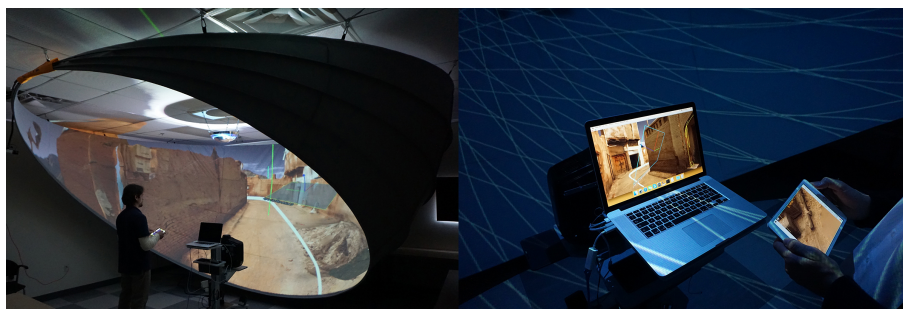


Figure 3. Hyve-3D, immersive (left) and non-immersive (right) settings.

Sections 3.1 to 3.3 below show how Hyve-3D can serve as a platform for an unmediated cultural heritage. Thus the following distinct properties and

functions of the system are noted as specifically relevant and add value to the realm of digital heritage.

3.1 THE 3D CURSOR

Hyve-3D permits active virtual engagement via its 3D cursors (Figure 4). A key feature is that every user has a handheld tablet with 3D cursor, which allows them to interact with the model displayed in the virtual environment. Navigation occurs through tablet movements and common multi-touch gestures; every user possesses a control plane that can be positioned anywhere within the virtual world in order to generate sketches or annotations and display orthogonal views of the 3D scene, in addition to the shared immersive view surrounding the users.

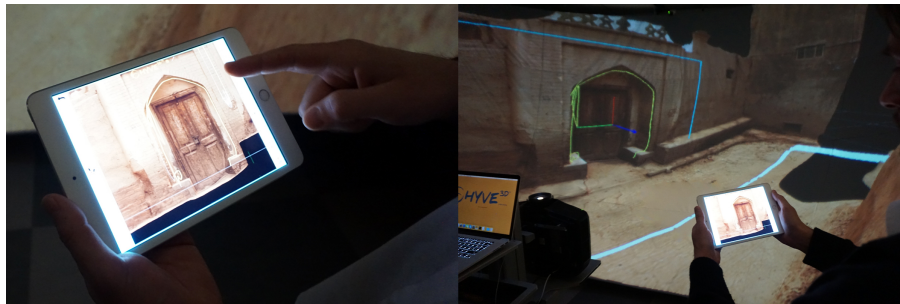


Figure 4. User experiencing 3D navigation while sketching on orthogonal view on tablet.

3.2 A COLLECTIVE IMMERSIVE EXPERIENCE

Hyve-3D encourages shared interaction, whereby users are aware of the presence of other co-located or remote users. This possibility allows a wide range of social interactions that are facilitated through the hybrid realm. The overall configuration and set up of Hyve-3D permits verbal and non-verbal communication to be picked up by participants with ease.

3.3 REMOTE DISCUSSIONS VIA REMOTE ANNOTATIONS

Hyve-3D's 3D cursor within the virtual environment is also a reference plane upon which users can sketch and make annotations. These graphical elements support communication and annotations can also be used as virtual landmarks, sign posts, or notice boards to leave interpretations or comments about specific locations or elements of the model. This element is crucial to the research presented here as it allows for generation of unmediated heritage as well as the collecting of individual and collective narratives (Figure 5).

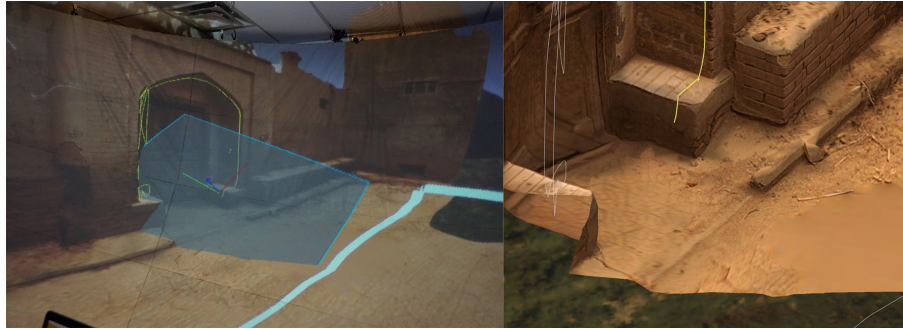


Figure 5. '3D cursor' in Hyve-3D (left) showing a detail with an axonometric view (right).

4. Aesthetics of glitches

In the modelling process there are several determinants of photogrammetric production including transparency, brightness and subtlety between repetitive elements that can be relevant to the object(s) or device-related e.g. camera lens and shutter speed. Frequently data transformation from 2D images to 3D objects may change the message (Manovich, 2001), so that photographs are converted into 3D sculptures with 'errors' that appear like holes on excessively dark or white surfaces. Such internal errors are potentially representative of a gap in knowledge where users must project their own conceptual understanding in order to complete it. This aspect of Hyve-3D's navigation and input technology, paves the way for exemplifying it through the project, which thus becomes a crucial ingredient of the process.

4.1. AN INCENTIVE TO NARRATE

An aestheticisation of the limitations of a technical process such as photogrammetric modelling can be characterized as 'glitch aesthetic', or the 'beauty of error'. Decimation of the original scanned meshes, which causes glitches to magnify, can be celebrated as reinterpretation by the digital realm of the interaction between users and the virtual model.

Another interesting and neoteric aspect of Hyve-3D is that users can interact and draw 3D intuitive sketches directly onto the immersive landscape of virtualised Kashgar, permitting participatory reconstitution of data (Figure 6). The user is no longer passive because the visualised ambiguity enables mutual engagement of the participant and the machine. This sets the context of digital heritage that we are advocating.

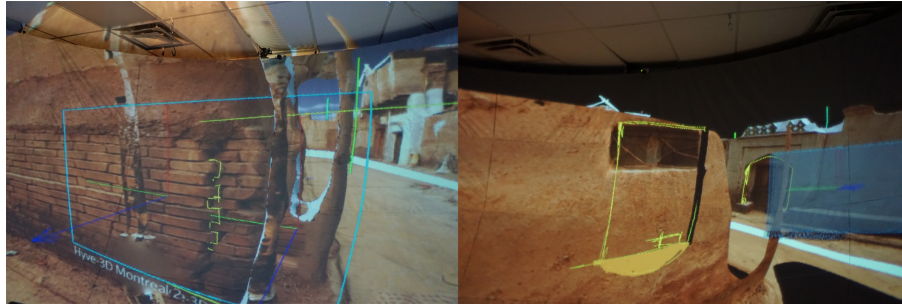


Figure 6. User's 3D sketches over Kashgar model.

4.2. TOUCHSTONES TO COMMUNICATE

Photogrammetry, Hyve-3D's representational ecosystem and Kashgar's heritage become a reflection on unmediated authenticity. Conventionally, authenticity consists of systems of values and knowledge. We refer to the concept of 'authenticators as authors of shared knowledge' in contrast to 'authenticators as guardians of knowledge' (Howell and Chilcott, 2013).

In Hyve-3D tagging is a self-referential example of authenticating shared knowledge, e.g. QR codes placed in the model, while editing textures or specific sketches or markers, provide an opportunity for users to leave their traces for others to follow. Tags may lead to photos, media or completely different kinds of representation such as a computer games.

We propose that the errant functionality of photogrammetry can offer a meaningful aesthetic experience to users. Unforeseen aesthetics of holes and glitches, which are both user driven and owned, become touchstones in the communication between all users thus generating authenticity in shared knowledge.

Like layers of history, a cyber-layer transmutes past into present or vice versa at different time-horizons. When the participant is in contact with the Kashgar model through a machine, the system draws upon voluntary memory, whereas interaction with other users activates the participant's memory involuntarily. When reflected as parts of Kashgar, such individual sketches become objects of a virtual museum, linking time and space in different horizons.

4.3. AFFORDANCES TO PARTICIPATE

The appropriated support of Hyve-3D representations provokes active collocated or remote collaboration between participants. Immersion and detailed orthogonal complementary views on tablets facilitate diverse scales and views of the heritage artefact. Furthermore, immersion dismantles the pic-

ture-frame of traditional representations. All these elements comprise essential aspects of the new representational ecosystem as presented by Dorta and Kinayoglu (2014). Subsequently, this affords users the opportunity to interact and participate authentically in an innovative way of reconstructing and accessing cultural heritage (Gero and Kannengiesser, 2012).

5. Conclusion

Unmediated cultural heritage is usually insurmountable within the politics, values and material circumstances of a digital reality. From the perspective of the Augmenting Kashgar Project, the primary focus of this paper is to contribute to the development of a concept of digital heritage theory by resolving the real problems of engagement in the broad context stimulated by the definitional ambiguity of an unmediated cultural heritage. By designing and testing interactive applications in this project, it becomes possible to read unmediated cultural heritage and then to deploy Hyve-3D for the first time in the context of cultural heritage.

Decentralisation of the artefact from its materiality, by tolerating glitches of the digital transcoding processes, leads us to evolution of means for stimulating the subjective performance of users whereby emotions and inter-textual narratives can be represented. In this respect, Hyve-3D and its 3D cursor technology help the visitor map new narratives and emotions on the represented.

In the realms of virtual reality, it becomes possible to connect aspects of authenticity and interpretation of architectural and digital heritage. Within the hybrid environment, the virtual model of Kashgar becomes a medium to compile individual and collective narratives. The interactive experience and multi-locational participation via Hyve-3D turns into collaborative digital reconstitution of the virtual materiality in cultural heritage.

Digital heritage is thus instrumental in visualization of heritage but also provides a medium for its generation, communication and discussion. The methods presented can be developed into a robust and reliable methodology for modelling architectural heritage.

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References

- Aydin, S., Schnabel, M. A. and Moleta, T.: 2016, Transcoding of Game Design into Museology: An Object-Oriented Perspective, in M. Sahin and S. Uddin (eds.) *DCA European Conference 2016*, Istanbul (in press).
- Aydin, S and Schnabel, M. A.: 2016, The Museum of Gamers: Unmediated Cultural Heritage through Gaming, in K. J. Borowiecki, N. Forbes and A. Fresa (eds.) *Cultural Heritage in a Changing World*, Springer, Basel, 18 (in press).
- Dorta, T, Kinayoglu, G. and Hoffmann, M.: 2014, Hyve-3D A New Embodied Interface for Immersive Collaborative 3D Sketching, *SIGGRAPH '14 Studio: Special Interest Group on Computer Graphics and Interactive Techniques Conference, Studio Proceedings*, Article 37, Vancouver.
- Dorta, T. and Kinayoglu, G.: 2014, Towards A New Representational Ecosystem for The Design Studio, in N. Gu, S. Watanabe, H. Erhan, H. Haeusler, W. Huang, R. Sosa (eds.) *Rethinking Comprehensive Design: Speculative Counterculture, Proceedings of the 19th International Conference of CAADRIA 2014*, Kyoto, Japan, 699–708.
- Dorta, T., Kinayoglu, G. and Hoffmann, M.: 2016, Hyve-3D and the 3D Cursor: Architectural co-design with freedom in VR", *International Journal of Architectural Computing (IJAC)*, MultiScience, Essex, UK, (in press).
- Gero, J. and Kannengiesser, U.: 2012, Representational affordances in design, with examples from analogy making and optimization, *Research in Engineering Design*, **23**(3), 235–249.
- Hall, S. 1999, Un-settling 'the heritage', re-imagining the post-nationWhose heritage? *Third Text*, **13**(49), 3–13.
- Howell, R. and Chilcott, M.: 2013, A sense of place: re-purposing and impacting heritage resource evidence through digital heritage and interpretative practice, *International Journal of Intangible Heritage*, **8**, 165–177.
- Manovich, L.: 2001, *The language of new media*, MIT Press, Cambridge, Mass.
- Message, K.: 2009a, Museums in the Twenty-first Century: Still Looking for Signs of Difference, *Konsthistorisk tidskrift/Journal of Art History*, **78**(4), 204–221.
- Message, K.: 2009b, New directions for civil renewal in Britain: Social capital and culture for all?, *International Journal of Cultural Studies*, **12**(3), 257–278.
- Murray, J. H.: 1998, *Hamlet on the holodeck: the future of narrative in cyberspace*, MIT Press Cambridge, Mass.
- Norman, D. A.: 2002, *The design of everyday things*. 1st Basic paperback. ed., Basic Books, New York.
- Schnabel, M. A. and Aydin S.: 2015, Amphiboly of Digital Heritage: Why to create authenticity through gamification, in G. Guidi, R. Scopigno, J. C. Torres, H. Graf (eds.) *2nd International Congress on Digital Heritage 2015, VSMM, EUROGRAPHICS, CIPA ICOSMOS/ISPRS, IEEE*, **2**, 129–132.
- Schnabel, M. A., Kvan, T., Kuan, S. K. S. and Li, W.: 2004. 3D Crossover: Exploring Objets digitalisé: *International Journal of Architectural Computing (IJAC)*, MultiScience, Essex, UK, **2**(4), 475–490.
- Singer, A.: 1998, Beautiful Errors: Aesthetics and the Art of Contextualization, *boundary 2*, **25**(1), 7–34.
- Smith, L.: 2006, *Uses of heritage*, Routledge, London, New York.
- Tang, H-H., and Gero, J. S. (eds.): 2001, Sketches as Affordances of Meanings in the Design Process, in J. S. Gero, B. Tversky and T. Purcell (eds.), *Visual and Spatial Reasoning in Design II*, Key Centre of Design Computing and Cognition. University of Sydney, Australia, 271–282.
- Waterton, E.: 2010, *Politics, policy and the discourses of heritage in Britain*, Palgrave Macmillan, London, UK.
- Watson, S. and Waterton, E.: 2010, Reading the Visual: Representation and Narrative in the Construction of Heritage, *Material Culture Review*, **71**(Spring 2010).