DFG 3D-Viewer

Development of an infrastructure for digital 3D reconstructions

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Introduction

The process of digital source-based 3D reconstruction includes not only the creation of the virtual model, but also the subsequent visualization of the result, i.e., the transfer of the model into a presentation format (Messemer, 2016). The standardization of the documentation and publication of reconstruction-related 3D data in the field of archeology, art and architecture history is seen as the most important priority across the board (Cieslik and Harris, 2020). Similarly, widely established web-based 3D viewers such as Sketchfab belong to a commercial offer. On the other hand, viewers prepared by scientific institutions like Cologne Repository Kompakkt (Kompakkt, 2022) or the Virtual Research Environment (VRE) made by the Herder Institute (Patrimonium, 2022) have not provided approved and applied standards for the documentation and publication of 3D models. The questions about legal security, verified long-term availability of data, or scientific traceability are still open (Kuroczyński, 2017).

Against this background, the DFG 3D-Viewer project aims to provide first steps towards the implementation an offer of permanent infrastructure, accompanied by low threshold interface usage (DFG 3D-Viewer, 2022). The focus is primarily on historical 3D reconstructions as replicas of works of art and architecture, but it follows a generic approach with adaptability and reusability in other fields of 3D modeling in mind (Münster, 2019). Special attention has been given to aspects relating to FAIR principles (Fair-Principles, 2022), web-based 3D viewer, documentation of 3D data by means of metadata and paradata in an exchange format that follows existing DFG (German Research Foundation) standards and the decentralized display of these web models in the DFG 3D-Viewer and in suitable VRE.

Minimal data standard for publication

The starting point for the project was the WissKI-based (WissKI, 2022) VRE at the Hochschule Mainz – University of Applied Sciences, which has already been successfully used in several projects of digital 3D reconstruction (Kuroczyński et al., 2021). A prototypical 3D repository has been built within the WissKI to upload and semantically index 3D datasets. The crucial point was to propose a minimal metadata set for publication of digital assets, which was based on the analysis of the chosen commercial and institutional 3D repositories. The resulting dataset was transformed into the survey, which will be conducted with the community to establish the publication data set standard.

The other part is fundamental research on data modeling with CIDOC Conceptual Reference Model (CIDOC-CRM, 2022) ontology, which was used for creating mandatory fields for 3D assets publication in the WissKI repository (Kuroczyński, Große, 2020). The concern is about using different combinations of classes and properties to describe the same aspects of the community. The workshop with the SIG CIDOC CRM community members will be organized to clarify the discrepancies and provide the quality of the data model.

The architecture of the DFG 3D-viewer is developed considering existing web-based 3D viewers (Champion and Rahaman, 2020). The research compares existing infrastructures and existing viewers, as well as the concept of a modular architecture for the DFG 3D-viewer. The framework for the scientific 3D infrastructure (considering documentation and publication) is cross-browser, platform independent and based on modern promising and long-term supported technology. It suoports viewing of 3D models with textures, stored in the most common formats used nowadays (i.e. OBJ, DAE, FBX, JSON) (Cieslik and Harris, 2020). It should be also capable of loading 2D images (JPG, PNG, TIFF) (Cieslik and Harris, 2020), 3D metadata and provide 3D world operations on models (Fernie et al., 2020). Solution should be integrable out of the box, open source and client-only in order to distribute workload away from the server and minimize the requirements for repository providers to support the DFG-3D-Viewer.

The framework is based on the existing 3D library - three.js. Architecture is optimized to be technology-independent and can be easily exchanged for any other client-side viewer. The viewer is extended to meet the requirements of the specialist community, including the possibility of displaying highly complex geometries and other data formats (inter alia IFC and FBX) (Fernie et al., 2020). Moreover, uploading 3D data triggers automatic unattended compression (based on Draco algorithm) and encoding into the glTF format which is optimized for web-based visualization.

At an early stage, DFG 3D-Viewer supports all formats mentioned above. The base of three.js technology made it suitable for complex, hand-modeled and laser-scanned objects. The viewer operates on 3D models and views 3D metadata. Finally, it allows to compress the 3D models on-the-fly and encode into glTF format.

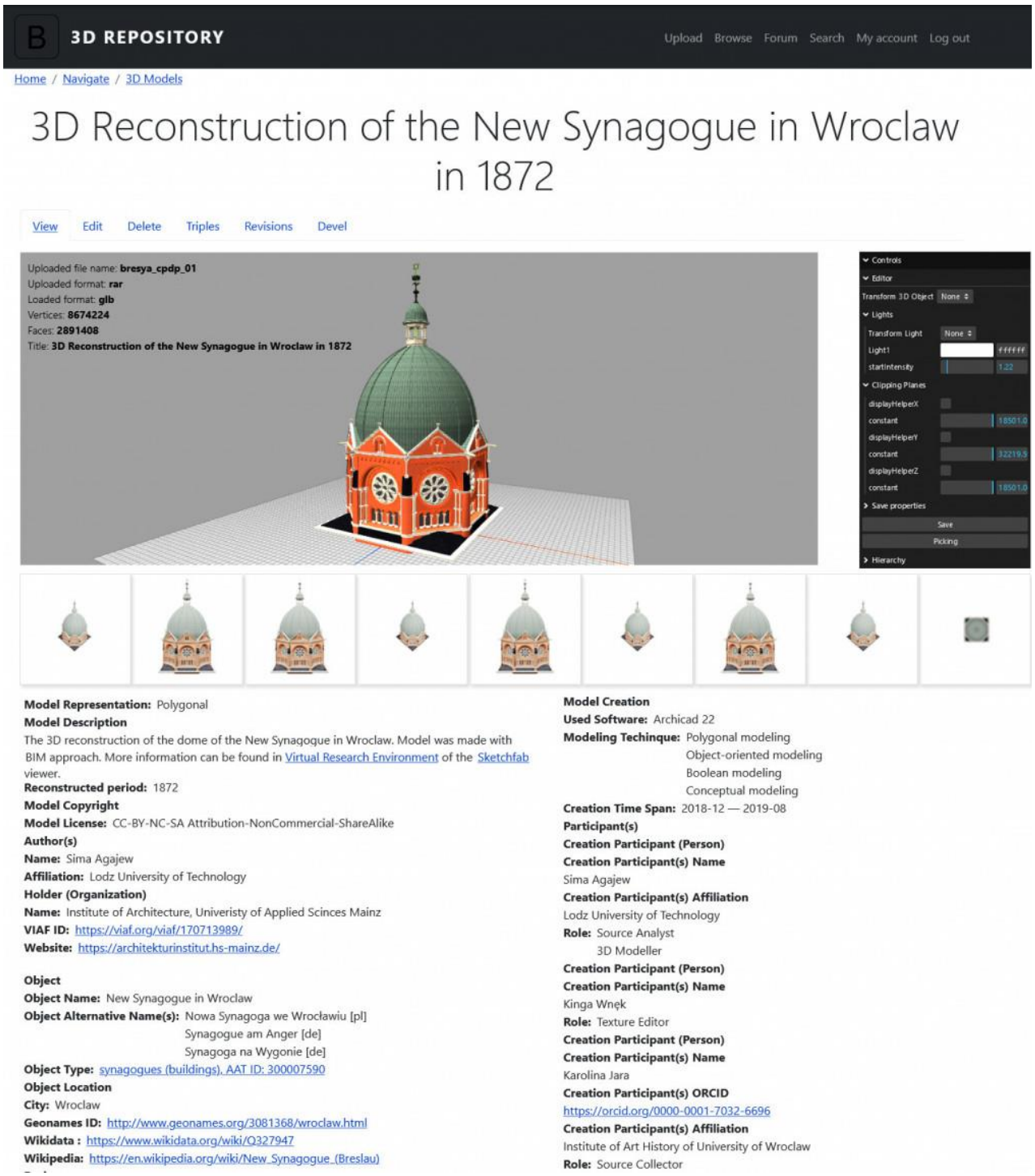

Fig.1 WissKI-based 3D repository with implemented DFG 3D-Viewer module (©2022, AI MAINZ)

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Conflict of Interests Disclosure

None

Author Contributions

Please list the contributions of the project participants here, according to the CRediT system. See specific descriptions of the role here: (http://credit.niso.org/). **Please omit non-applicable roles**.

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References

Champion, E. and Rahaman, H. (2020). 'Survey of 3D digital heritage repositories and platforms', Virtual Archaeology Review, 11(23), pp. 1–15. DOI: https://doi.org/10.4995/var.2020.13226

Cieslik, E. and and Harris, S. (2020). *3D Digitization in Cultural Heritage Institutions Guidebook*. Dr. Samuel D. Harris National Museum of Dentistry. Available at https://www.dental.umaryland.edu/media/sod/national-museum-of-dentistry/pdfs/3D-Digitization-Guidebook.pdf (Acessed: 24 June 2022).

Fernie, K.; Blümel, I.; Corns, A.; Giulio, R.d.; Ioannides, M.; Niccolucci, F.; Beck, J.; Mathys, A.; Rossi, V.; Vastenhoud, C.; et al. (2020). *3D Content in Europeana Task Force*. The Hague: Europeana.

Kuroczyński, P. (2017). 'Virtual Research Environment for Digital 3D Reconstructions: Standards, Thresholds and Prospects', Cultural Heritage and New Technologies 2016 Proceedings, Studies in Digital Heritage, Open Access Journal, 1(2), pp. 456–476. DOI: https://10.14434/sdh.v1i2.23330

Kuroczyński P., Große P. (2020). OntSciDoc3D – Ontology for Scientific Documentation of source-based 3D re-construction of architecture. In: CHNT 25, 2020-Abstracts. Available at https://www.chnt.at/wp-content/uploads/OntSciDoc3D-%E2%80%93-Ontology-for-Scientific-Documentation-of-source-based-3D-reconstruction-of-architecture.pdf (Accessed 26 January 2022).

Kuroczyński, P., Bajena, I., Große, P., Jara, K., Wnęk,, K. (2021). 'Digital Reconstruction of the New Synagogue in Breslau: New Approaches to Object-Oriented Researc', in: Niebling, F., Münster, S. (eds.). *Proceedings of the Conference on Research and Education in Urban History in the Age of Digital Libraries & Digital Encounters with Cultural Heritage*. Berlin: Springer (in Edition).

Messemer, H. (2016). 'The Beginnings of Digital Visualisation of Historical Architecture in the Academic Field', in Hoppe, S. / Breitling, S. (eds.). *Virtual Palaces, Part II. Lost Palaces and their Afterlife. Virtual Reconstruction between Science and Media*. München: Palatium, pp. 21–54.

Münster, S. (2019). 'Digital Cultural Heritage as Scholarly Field – Topics, Researchers and Perspectives from a bibliometric point of view', Journal of Computing and Cultural Heritage, 12(3), pp. 22–49. DOI: https://10.1145/3310012

Online resources:

https://www.cidoc-crm.org/ (Available on 24.06.2022).

https://dfg-viewer.de/en/dfg-3d-viewer (Available on 24.08.2022).

https://www.go-fair.org/fair-principles/ (Available on 24.06.2022).

https://kompakkt.de/home (Available on 24.06.2022).

https://www.new-synagogue-breslau-3d.hs-mainz.de (Available on 24.06.2022).

www.patrimonium.net (Available on 24.06.2022).

http://wiss-ki.eu/ (Available on 24.06.2022).