

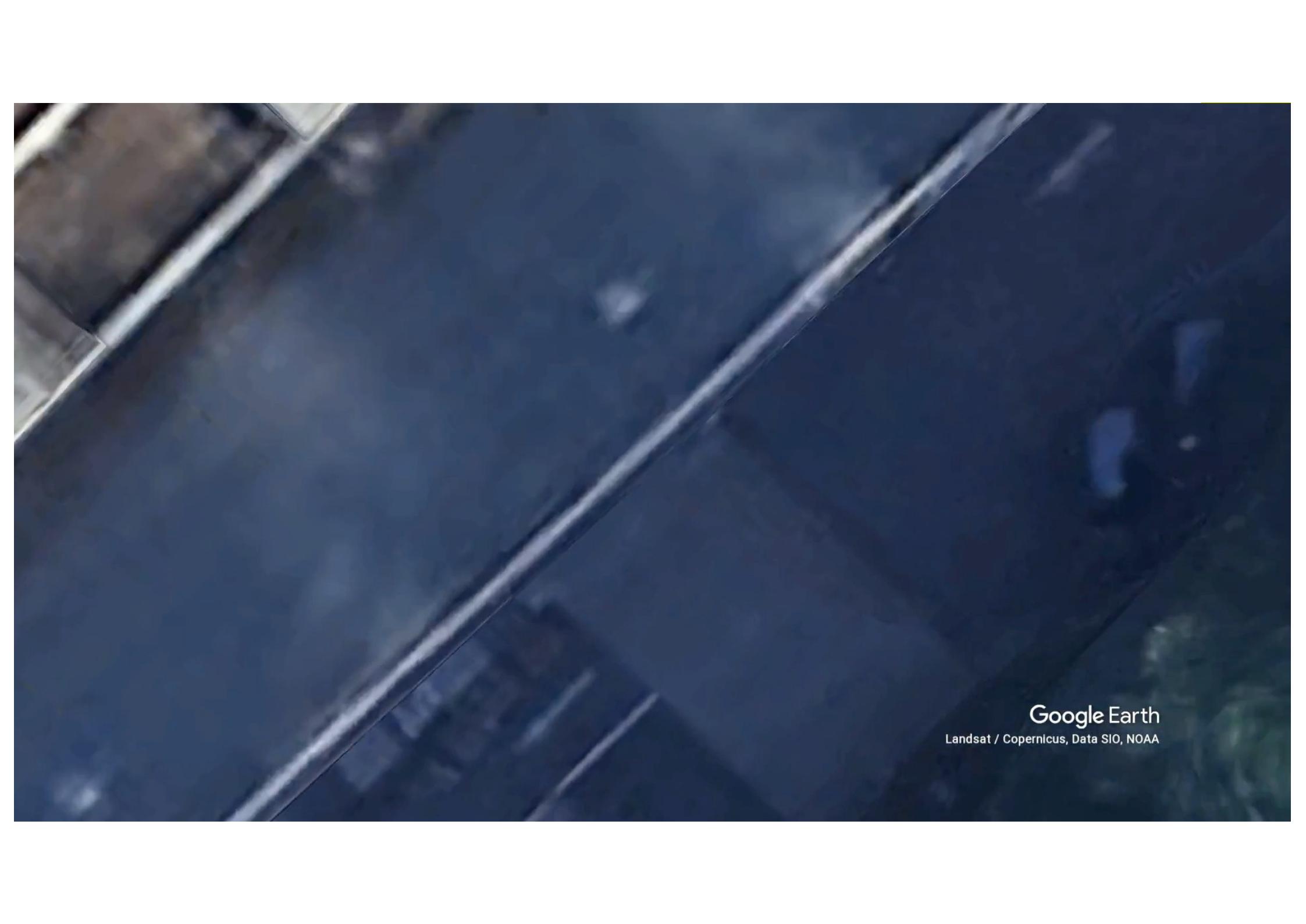


4D Geo Modelling from Different Sources at Large Scale

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Ukolov*



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Google Earth

Landsat / Copernicus, Data SIO, NOAA

Challenge: 4D visualizations

- 3D Modelling via extant photogrammetrical and AI based approaches is limited working with historical images
- Historical sources are incomplete and of very different quality
- 4D modelling adds the challenge to deal with time varying content
- Multimodal content fusion / representation

Münster, S., F. Maiwald, J. Bruschke, C. Kröber, Y. Sun, D. Dworak, D. Komorowicz, I. Munir, C. Beck and D. L. Münster (2024). "A Digital 4D Information System on the World Scale: Research Challenges, Approaches, and Preliminary Results." Applied Sciences 14(5): 1992.



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What if?

Could we better tune the quality of 3D reconstructions to the intended use?

Can 3D reconstructions be created automatically?

Are 3D reconstructions merely a view on multimodal data?

What if 3D reconstructions are co-created by multiple users?



Approach

Building footprint extraction from map data

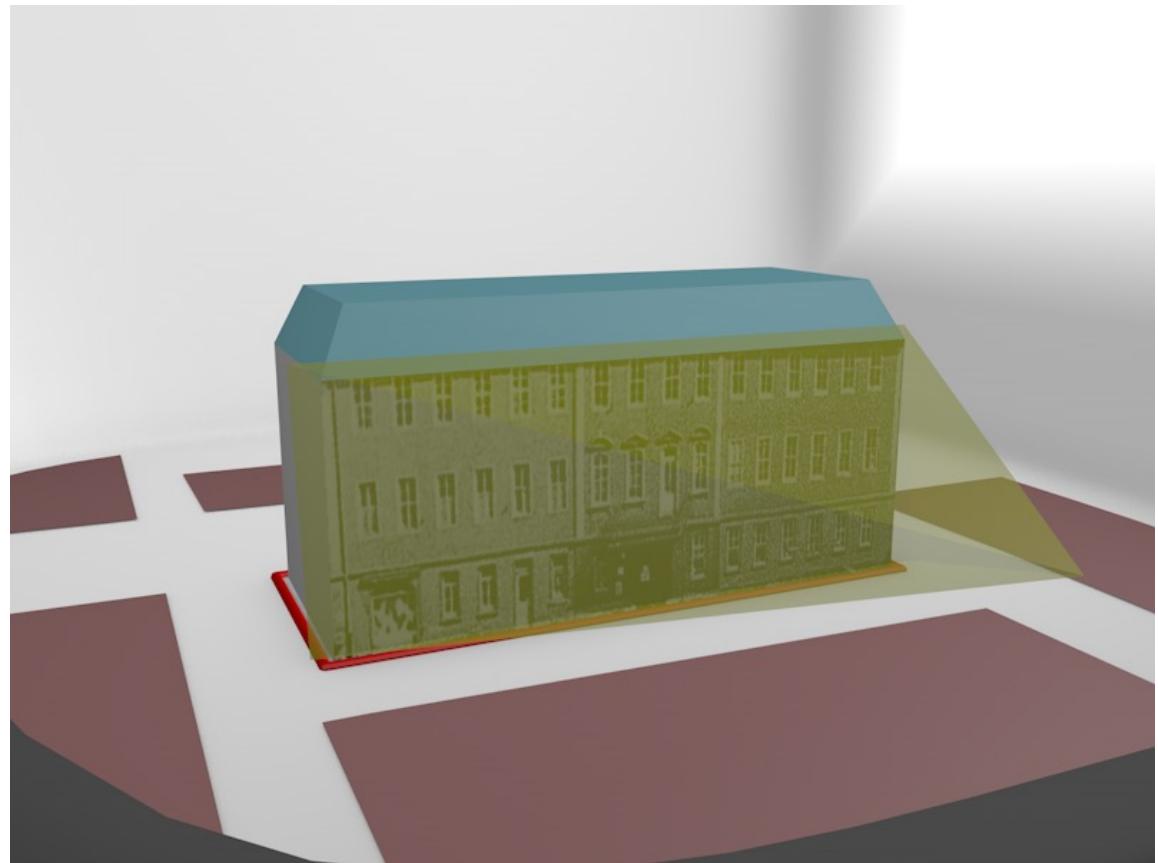
Footprints are extracted from historical maps via line-feature extractor / semantic segmentation.

Spatialization of photographs

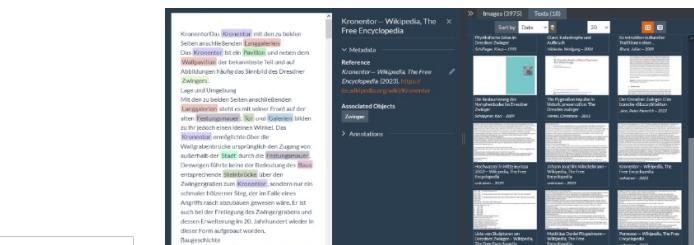
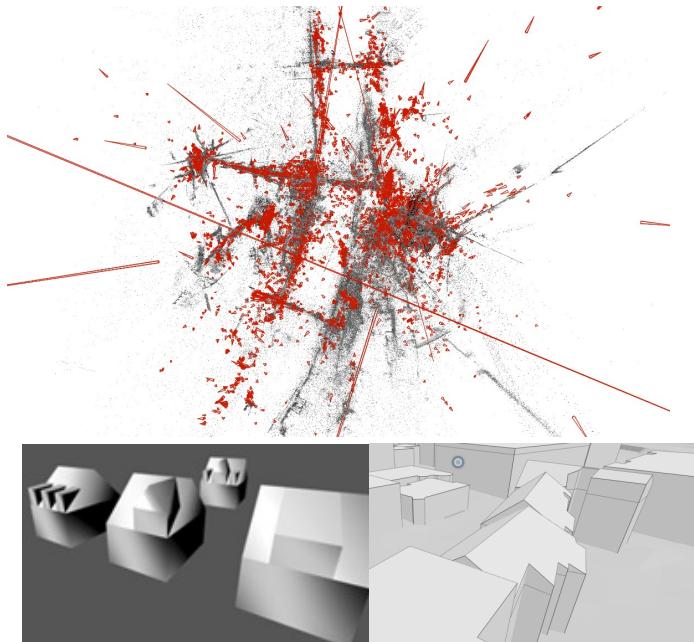
SfM reconstructions calculated using SuperPoint + SuperGlue with bundle adjustment in COLMAP; Dust3r; NERF

Building geometry generator

Example roof shapes from the parametric generator for buildings with four faces implementation in the 4D City application for larger numbers of faces.



4D Data



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Images:

Image retrieval pipeline for contemporary / historic photographs based on requested locations:

Currently: 220.000 images

→ *Main datasets: FORTEPAN, Hungarian National Theater dataset, MegaScenes*

Modelling:

World scale elevation model, building footprints + landmarks as 3D buildings

Currently: 400.000 building geometries; 63.000 3D models of cultural heritage; world-scale DEM (~50m grid)

→ *Main datasets: Objaverse 1.0 and XL*

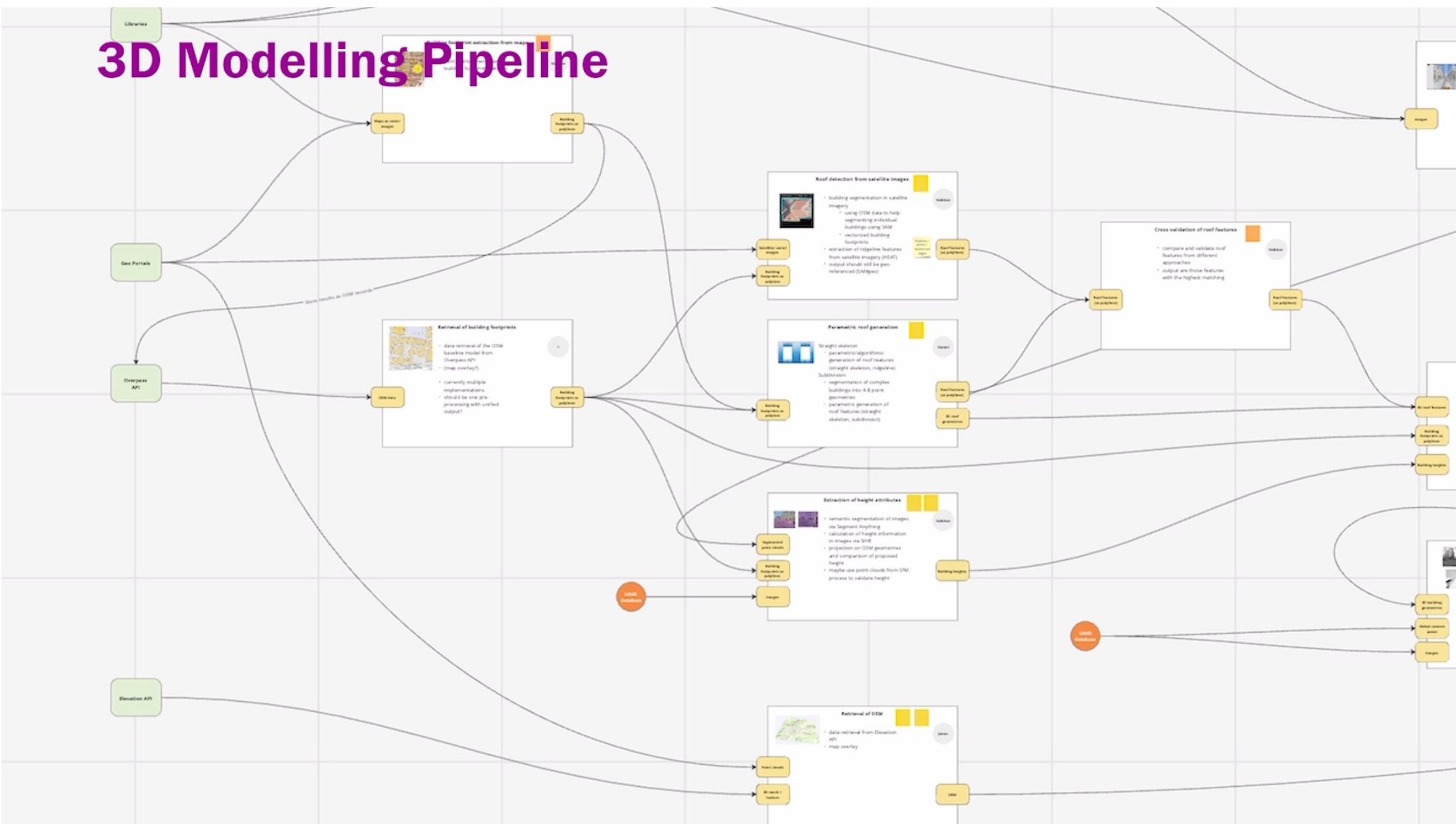
Texts:

World-scale information as POIs; annotated texts

Currently: world-scale Wikipedia, Google Places; ~10 annotated texts

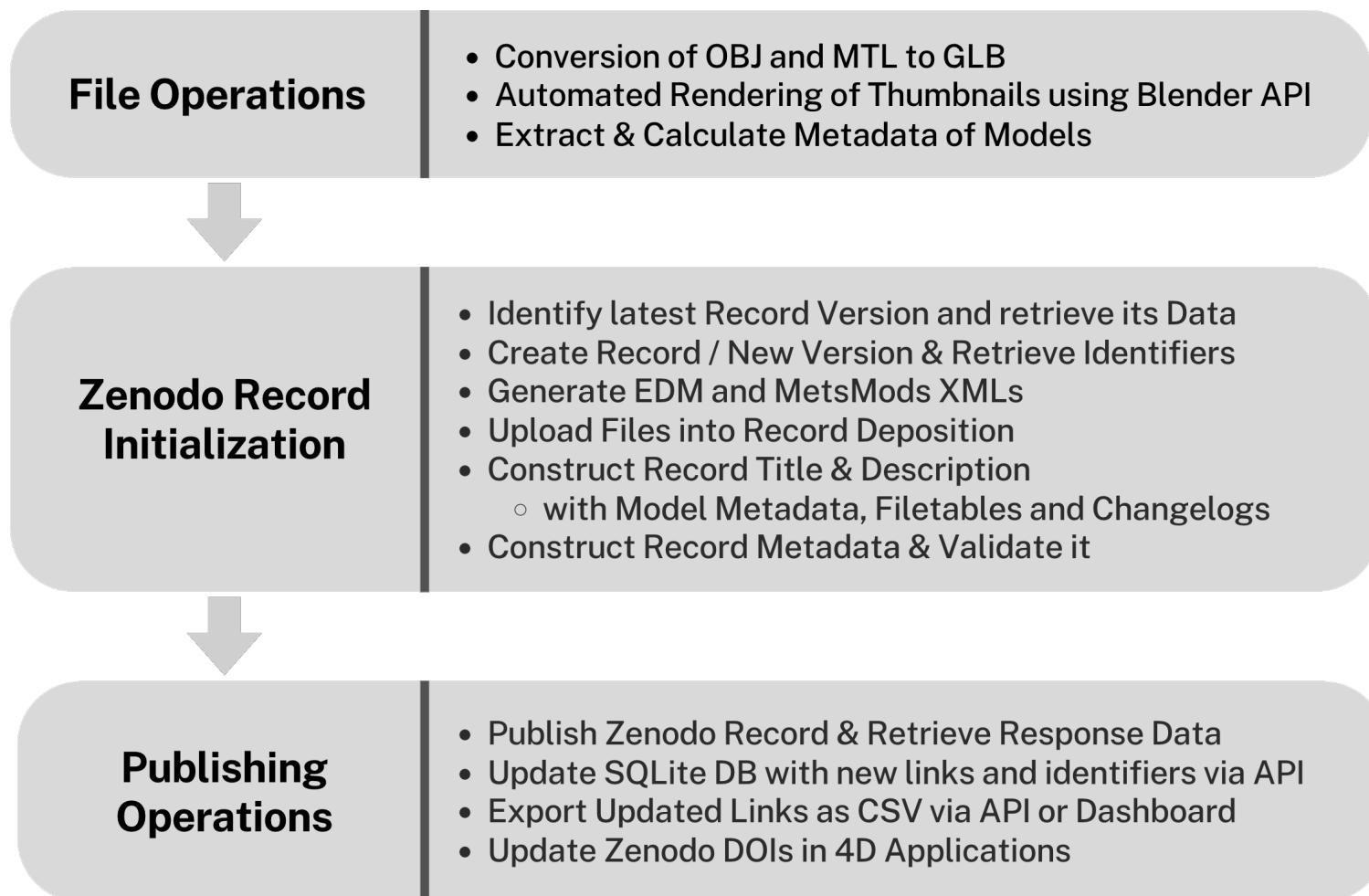
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3D Modelling Pipeline

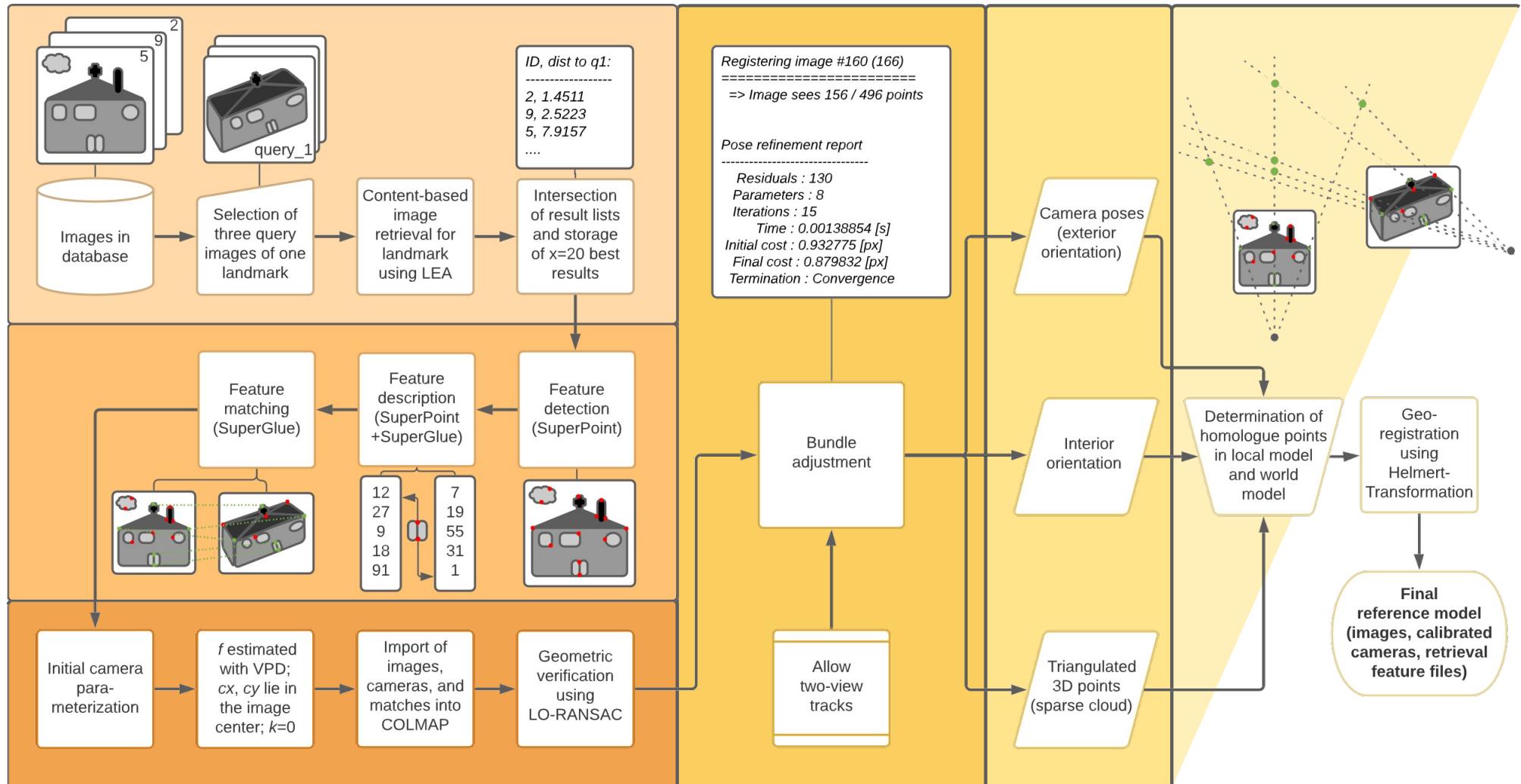


Spatial Data: Example: Zenodo Storage

<https://github.com/Digital-Humanities-Jena/zenodo-toolbox>



Spatial Data: Example: Photogrammetric Pipeline



Achievements

**4D Application usage:
40.571 user sessions**

- From 3/2024 to 10/2024

**3D Data Ingestion in Europeana:
63.489 3D datasets**

- Amsterdam: 200
- Sion: 1.359
- Trento: 6.430

Usage:

In 8 countries

- Germany, Austria, Netherlands, Italy, Switzerland, Belgium, Hungary, Czech Republic

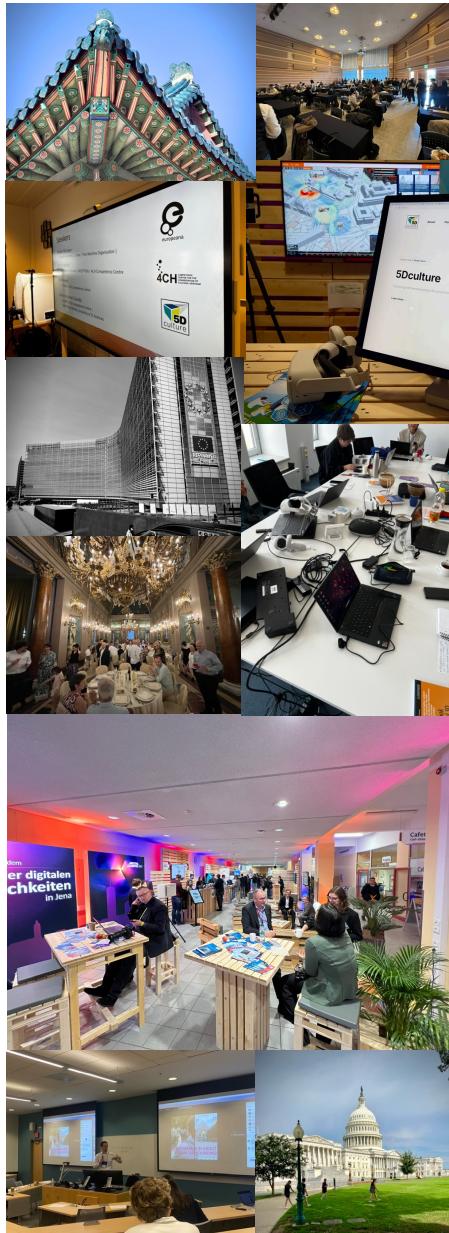
Outreach:

23 presentations

- Presentations of the 4D apps in 15 countries/ 4 continents



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Mainz, DE – EU CoVHer Project Meeting – 3/2023

Jena, DE – EC2U European University Alliance – 5/2023

Florence, IT – CIPA Symposium – 6/2023

Trento, IT – OECD Summer Academy – 9/2023

The Hague, NL – Europeanatech – 10/2023

Daijeon, Korea – ISDH Conference - 11/2023

Amman, Jordan - AARMENA Doctoral School – 12/2024

Thessaloniki, GR – EU INDUX-R Kickoff - 1/2024

Siena, IT – 3DArch Workshop – 2/2024

Passau, DE – DHd Conference – 2/2024

Rovaniemi, FI – EU Digicher Kickoff - 3/2024

Ferrara, IT – 4CH Conference – 4/2024

Mainz, DE – NFDI4Culture Community Forum

Rotterdam, NL – Urban Future Festival – 6/2024

Lille, FR – Holusion – 6/2024

Vilnius, LT – EU DigiCher Virtual Exhibition – 9/2024

Brussels, BE – European Commission, ERRIN, S3 – 6, 10/2023, 6/2024

Washington, US – ADHO 2024 – 8/2024

Turin, IT – EU Meta-Museum KickOff – 10/2024

Melbourne, AU – SUMAC / ACM Multimedia - 10/2024

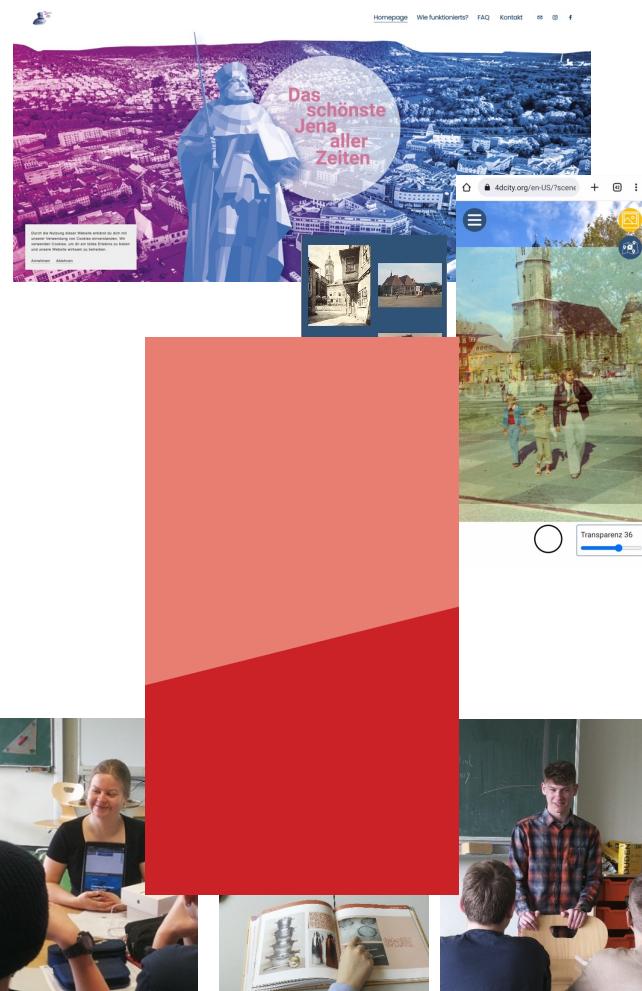
Vienna, AT - CHNT 2024 – 11/2024

Limassol, CY – Euromed – 12/2024

Rimini, IT – S3CoP Forum – 12/2024

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What else?

Crowdsourced Image Collection

Participatory virtual history knowledge bases, co-designed by citizens

- Jena 4D Contest 2022: 4000+ images collected
- Schleiz 4D 2024: in progress

Crowdsourced 3D Digitization

3D heritage as combined low-end guided workflow to capture photographs of endangered heritage via smartphone and server-based 3D modelling

Hackathons

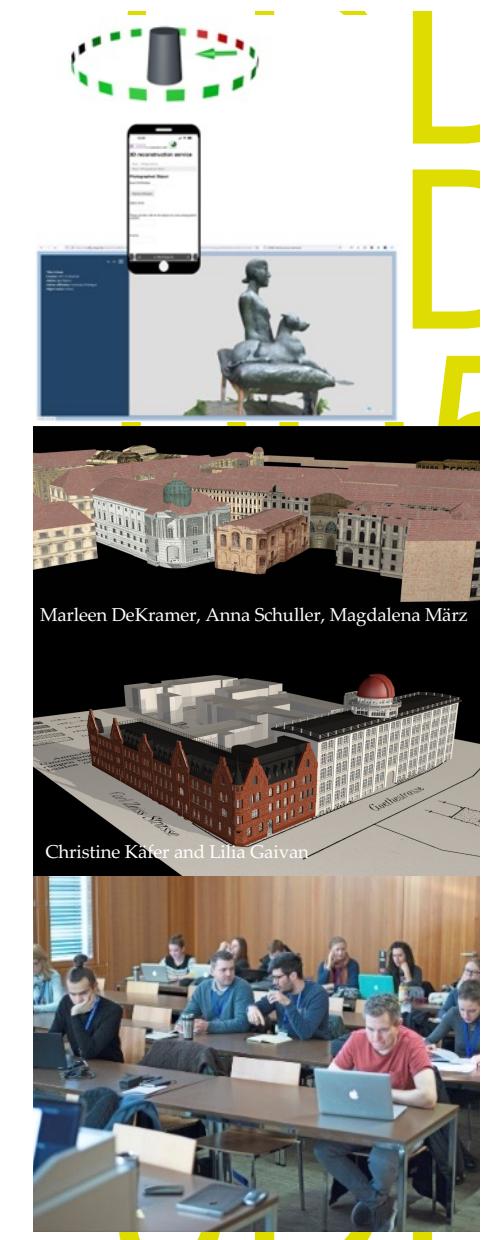
“Modellathon” as an international student 3D reconstruction competition in 2018 and 2020

- 2018: 9 Models of the Vienna Hofburg
- 2020: 7 Reconstructions of the Zeiss Factory

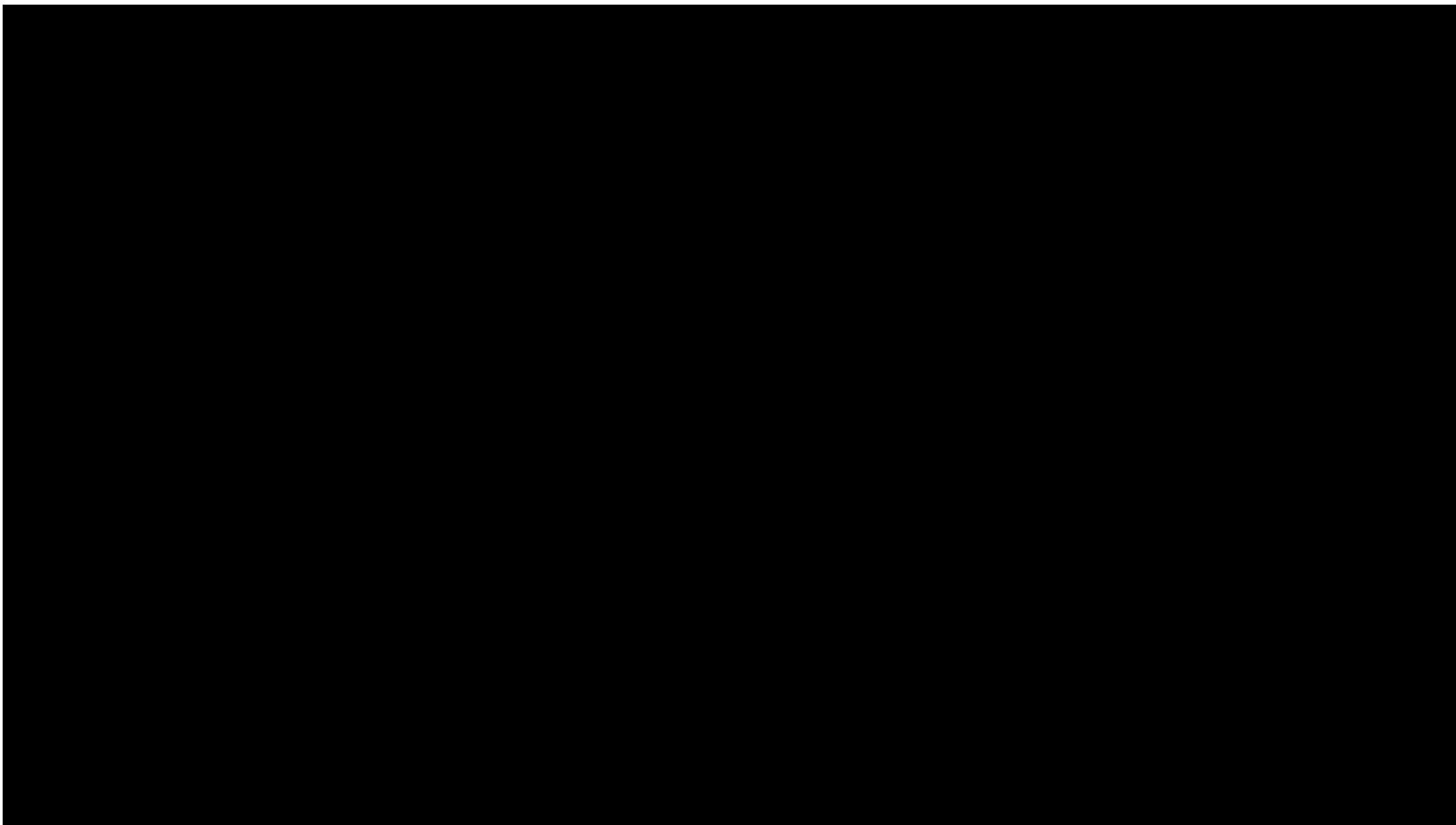
School Projects

Teaching projects by university students to pupils

- Since 2023 110+ pupils participated, teached by 10 students



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Thank you

<https://4dbrowser.eu>

<https://4dcity.org>



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