CultLab3D – On the verge of 3D mass digitization

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Why Digitization?

2003 Earthquake – Bam, Iran, renown mud brick architecture

2004 Fire - Herzogin Anna Amalia Library Weimar

2009 Collapse – Cologne city archive 30 shelf-Km destroyed

2012 War - UNESCO World Heritage Timbuktu, Mali

What happened so far ..

- **Digitization**: Transfer of real documents or artifacts into a digital representation

- **Two-dimensional cultural heritage objects**:
  - Huge campaigns on national, European and international Level to digitize antique scriptures, writings and paintings, e.g. German Digital Library, Europeana and Google Library Project, Microsoft Book Digitization Project.
  - Emerging world-wide multi-million Euro market of device manufacturers and service providers within the last 10 years.
.. and in 3D ?!

Three-dimensional cultural heritage:


To date: Manual 3D Digitization of Artifacts

- Example: Digitization of a Rongorongo Tablet, Easter Islands
  - Polymetric 3D Scanner PT-M (4 Mpixel Cameras, 35mm Lenses) – High-Resolution of 15μm
  - 300 Scans, 36 hours for global registration alone on a 32 core machine with 256GB RAM
  - 18h total scan time - manual re-positioning of scanner = 85% time expenditure
Light-surface interaction: High-res. scans and filters allow char recognition
First attempts at speeding up the process

- **DOME:**
  - University of Bonn, Prof. R. Klein
  - 176 Cameras and light sources
  - Geometry, texture and material property acquisition

- **ORCAM:**
  - DFKI, Prof. D. Stricker
  - Geometry, texture and material property acquisition

- **Drawback:**
  - Occlusions cannot be scanned
  - Processing time per artefact takes hours
  - Post-processing takes hours
  - Manual artefact placement and removal
What’s missing? (e.g. Berlin Museums)

- ~ 6 million artifacts
- 120,000 New entries per year

- Effort appraisal …
  - 3D digitization of only the new entries …
    - 120,000 / 365 days / 24 h / 60 minutes =
    - 0.22 objects/min = 4.38 min/object !!!

- Not feasible! Missing automated, scalable and economic digitization procedures!

Challenges for 3D mass digitization in Cultural Heritage

- Improved / Simplified methods for:
  - Geometry, texture, material property acquisition

- Reduction of cost / high throughput:
  - Automation and Industrialization

- Improved workflows:
  - Single-pass, multi-stage, parallel lines

- Fast post-processes:
  - Parallel computation
  - Multi-core, multi-GPU computation
  - out-of-core computation

www.cultlab3d.de
Challenges for 3D mass digitization in Cultural Heritage

• Comprehensive:
  • All sizes
  • All materials
• Comparable quality standards for 3D digitization:
  • Environmental parameter control:
    • Lighting
    • Temperature
    • Humidity
• Definition of minimum equipment capabilities

www.cultlab3d.de
CultLab3D: First Evaluation at Liebieghaus, Frankfurt - Jul/Aug 2014

(Photo: Norbert Miguletz, ©Liebieghaus Skulpturensammlung)
The "Apoll of Belvedere" (1497/98) of Renaissance-Sculptor Pier Jacobo Alari Bonacolsi (around 1460–1528), named Antico was the first real artifact ever to be digitized by CultLab3D at the medieval hall of Liebieghaus Skulpturensammlung.

(Photograph: Norbert Miguletz; ©Liebieghaus Skulpturensammlung)
Apollo – Sample input

Apollo – Textured

In cooperation with Autodesk
Madonna from Thüringen (CultArc3D) – Sample input
Madonna from Thüringen – Textured

In cooperation with AUTOESK

Madonna from Thüringen – Diffuse

In cooperation with AUTOESK
Madonna from Thüringen – DOF

Enthroned Mother of God (CultArc3D) – Sample input (bottom imgs)
Enthroned Mother of God (CultArc3D) – Sample input

Enthroned Mother of God – Textured

In cooperation with

AUTODESK

Fraunhofer IGD
Enthroned Mother of God – Diffuse

In cooperation with AUTODESK

Enthroned Mother of God – DOF
Girl with Column (CultArm) – Sample input

Girl with Column – Textured

In cooperation with Autodesk
Girl with Column – Diffuse

In cooperation with

Girl with Column – DOF
Old woman (CultArm) – Sample input

Old woman – Textured

In cooperation with AUTODESK
Challenges for 3D mass digitization in Cultural Heritage

• Artefact Classification:
  • Using prior knowledge of already digitized (similar or related) content

• Artefact Annotation:
  • Visual, 3D centered, linking with media-, meta- and provenance data
  • Fostering adoption of standards concerning the description of cultural heritage concepts and relationships (e.g. CIDOC-CRM)

Interactive Semantic Enrichment of 3D CH Collections
Challenges for 3D mass digitization in Cultural Heritage

• Digital rights:
  • Prompt legislators to act and define laws to govern ownership of 3D virtual models
  • Similar (very extensive) laws govern ownerships of photos

• Signatures:
  • Define procedures for 3D virtual models to be signed and easy to authenticate as to their source and the technology used to create them

Challenges for 3D mass digitization in Cultural Heritage

• Certification:
  • We need suitable governmental or government-accredited entities to issue certificates for virtual 3D reproductions

• Formats:
  • Need to be easy to read-/write 100+ years from now

• Longterm storage:
  • storage hardware or approach needs to ensure safe and secure longterm preservation of data:
    • e.g. Fraunhofer Cloud Services
Challenges for 3D mass digitization in Cultural Heritage

- 3D Internet:
  - from websites to web applications
- Increased interest:
  - Product presentations
  - Visualization of abstract information
  - Immersive applications for tourism or cultural heritage
- Improved user experience:
  - Today: Adobe Flash-based web sites
  - Tomorrow: Immersive and embedded 3D

Example: 3D Artifacts in Europeana

Europeana 3D Web presentation
Article Three of the Lisbon Treaty states:

The European Union “... shall respect its rich cultural and linguistic diversity, and shall ensure that Europe's cultural heritage is safeguarded and enhanced.”
Upcoming:

ACM EUROGRAPHICS GCH2014
October 6 – 8, 2014
Darmstadt, Germany
http://diglib.eg.org/GCH2014/

EVA Berlin 2014
November 5 – 7, 2014
Berlin, Germany
http://www.eva-berlin.de

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