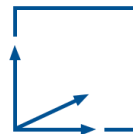# Analysis of Antique Statues using 3D Scans

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Final: Bachelor in Informatics

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Introduction / Motivation

Public image in Ancient Rome

Many portrait sculptures of emperors, often copies	Disgraced emperors (usurpers, tyrants) had their portraits destroyed or reworked

Identify a pair of reworked and original statue and try to determine how closely they fit together

Obtain information about the reworking process	Show before/after comparison in educational context

Subjects: Caligula and Claudius

Goals of this Thesis

1

Visit the Museum of Casts in Munich

- Collect expert information about the portraits
- Perform scans of both statues

2

Compare statues via the acquired scans

- 3D viewers/tools for aligning and measuring
- Algorithmic approach for specific areas

3

Create an educational AR application

- Showcase information indicating Claudius' rework
- Overlay Caligula on top of Claudius to show differences

Problem Description: Issues

Create accurate 3D scans	• Capture textures for the application • Use cheap/available hardware
Find a possible superimposition of the statues	• Pick suitable reference points and appropriate scale for alignment • Choose a proper similarity measure for the statues
Tracking statues for use in AR	• 3D tracking not as widely available as conventional 2D markers

Existing Solutions / Related Work

Scanning method

- Photogrammetry
- Laserscanning
- LiDAR technology

Digital analysis

- Augustus Once And For All by William Storage
- Statue Categorization Algorithms for Augustus by Lu et al.

AR in Cultural Heritage

- Proxy Painting by Lange et al.
- CHESS project

Critical Research Issues

Comparison of ancient statues

- Handling limited data
- Similarity measures for 3D objects
- Classification of similarities

Proposed Work / Approach

Create Scans via Photogrammetry	Analyze Statues	AR Application using Unity Game Engine
• Keep textures • Editing with 3D viewers/tools	• Scale and align via measuring and point-picking • Algorithmic comparison with custom C++ code	• Track statues via Vuforia Engine Model Targets

Implementation

Photogrammetry via the software 'Meshroom'

- Take ~100 overlapping images from all around each statue
- Run the photogrammetry pipeline
- Clean the output in postprocessing with Blender/Cloudcompare

Digital analysis on the scans

- Alignment and scaling via Point-picking in Cloudcompare
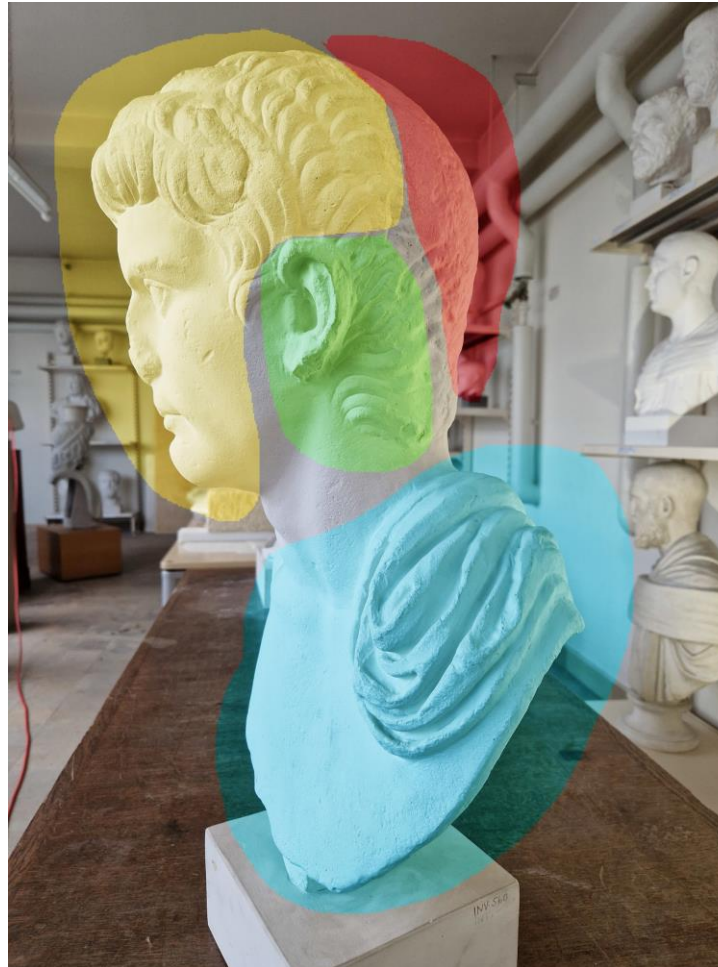- Measuring facial proportions in Meshlab
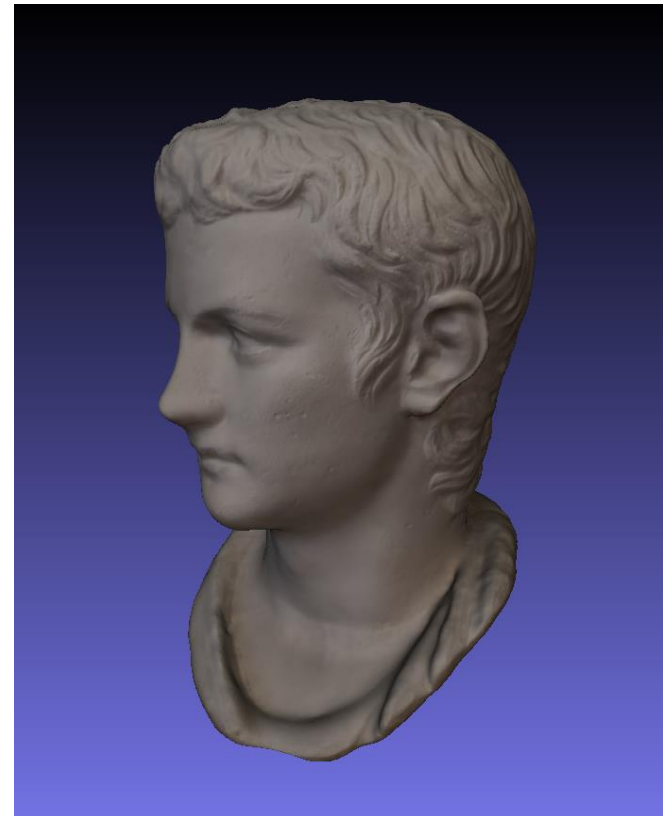
Digital Alignment – Reference Points

Yellow:

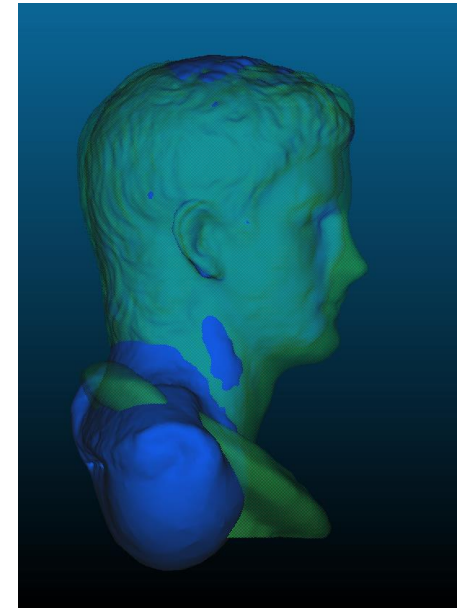- reworked area

Green:

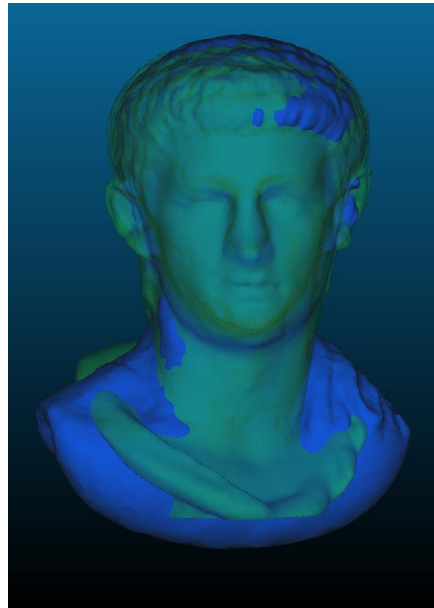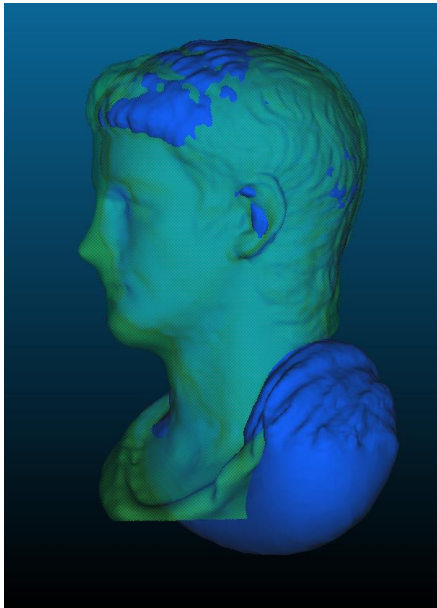- most likely to contain suitable reference points

Red:
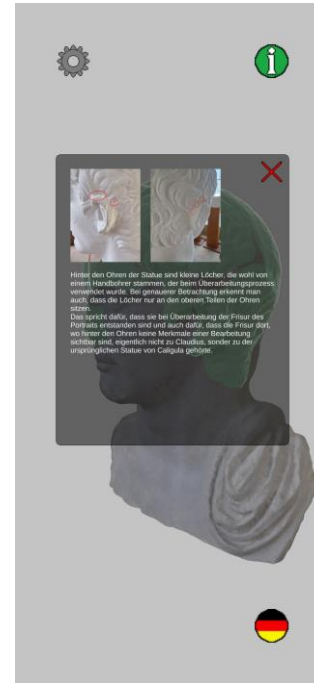
- no details
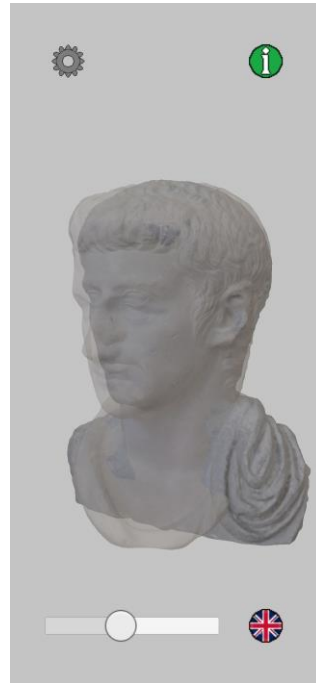
Blue:

- statue base

Final Alignment and Algorithms

- Uncertainty due to different ear shape, asymmetry
- Algorithms detect alignment difference instead of structural differences

Evaluation (User Studies, Test Runs)

- Test runs at the museum
  - Assess the model target quality
  - Show app / features

Discussion / Suggested Future Work

Streamline the scanning process with an appropriate workflow

More sophisticated digital and algorithmic approaches with much more data

- Compare areas of interest based on specific features
- Cross-verify the results with prior knowledge

Revisit the AR application once 3D-object-tracking becomes more mainstream

Conclusion

Scanning
- Decent quality, good textures
- High time investment

Analysis and Algorithms
- Difficult to find reference points
- Satisfactory superimposition of the statues
- Without reference impossible to verify accuracy

AR application
- Easy to track Model Targets
- 3D tracking not yet possible in Browser application

List of References

1. https://viamus.uni-goettingen.de/fr/e/uni/d

2. http://www.rome101.com/Portraiture/Augustus/IsItRecarved/

3. https://www.researchgate.net/publication/271553318_Portrait_sculptures_of_Augustus_Categorization_via_local_shape_comparison

4. https://diglib.eg.org/bitstream/handle/10.2312/gch20181345/097-104.pdf