## Credits

**Dylan Eno / Charlotte Simons**
Flowchart creation
*dylaneno.com / blauwfilms.com*

**Debra Knoop / Mila Ernst**
Modemuze and Unlocking Fashion Heritage project
*modemuze.nl / info@modemuze.nl*

**Ape to Zebra**
Flowchart design
*apetozebra.com*

## Consultants for ULFH

**Tijdlab**
photogrammetry, playful integrations VR, AR, fitting mirror quality
*tijdlab.nl*

**The Visual Artbox**
360-degree and panorama photography, photography for 3D models
*visualartbox.com*

**Frans Pegt (Rijksmuseum)**
360-degree photography, photogrammetry and 3D scanning
*franspegt.com*

**Monique Vermeulen (Amsterdam Museum)**
360-degree photography
*amsterdammuseum.nl*

**Dylan Eno / Finn van Tol**
design duo specialised in digital storytelling, photogrammetry, detailed surface registration, expertise in reflective objects, conservator-level precision.
*dylaneno.com / finnmirovantol.com*

**Studio PMS**
digital garment recreation and animation, exhibition design
*studiopms.nl*

**d_archive**
historically accurate research, reverse engineering, creation of 3D replicas, animation, creation of database and educational workshops
*darchive.io*

**Provrex**
VR, AR and MR, photogrammetry, game implementation
*provrex.nl*

**Charlotte Simons**
Blauw Films, digital costume designer
*blauwfilms.com*

## About Modemuze

Modemuze is a growing network and online platform representing 20 Dutch and Flemish museums with unique fashion and jewellery collections. Since 2015, Modemuze.nl has brought together these diverse collections, connecting fashion history and contemporary trends on regional, national, and international levels, across time and cultures. Modemuze serves as a key platform for our community of researchers, makers, wearers, and fashion enthusiasts, who actively contribute and share their passion and knowledge.



MODEMUZE

MODEMUZE.NL

# ULFH

# UNLOCKING FASHION HERITAGE

A MANUAL
FOR DIGITISING
COLLECTIONS

MODEMUZE

# EXPERIENCE FASHION HERITAGE LIKE NEVER BEFORE

Fashion heritage holds stories of craftsmanship, culture, and history, but due to the fragile nature of these collections, most objects remain hidden in storage.

Modemuze's Unlocking Fashion Heritage (ULFH) project explores innovative digital possibilities to present fashion heritage to the public in new ways.

This project is co-funded by: **Gieskes-Strijbis Fonds / Innovatielabs**
More information: **modemuze.nl / Instagram: @modemuze.nl**



**Your Toolbox for Digitising**
This brochure shares the knowledge and lessons learned from the ULFH project. Designed as a practical guide, it offers insights and tools for heritage professionals aiming to digitise their collections. It provides an overview of current digitising techniques, their results, and potential purposes, both within and beyond the heritage institutions. Flowcharts for each technique outline every step of the digitising process, providing clarity on workflows while emphasising the complexity of each stage. For further guidance, consult a professional and refer to the glossary for any unfamiliar terms.

**Unlocking Fashion Heritage**
As interest in craftsmanship grows, fashion collections are becoming key sources for rediscovering lost techniques. Since 2022, ULFH has collaboratively explored the applicability and scalability of digitisation methods, including 360-degree photography and photogrammetry, to make these crafts and historic fashion heritage more visible to a broad public.

**360° Photography**
This technique enables users to explore garments from every angle and in detail like a virtual depot visit from home – anytime, anywhere. Modemuze, in collaboration with Micrio, developed an innovative and immersive storytelling platform, providing an immersive experience of 100 'spinnable' objects, enhanced with diverse expert insights from our community.

**3D Models and AR Fitting Mirror**
High-quality photogrammetry is used to create 3D models for an augmented reality (AR) fitting mirror, developed with Tijdlab, bringing fashion heritage to life and allowing visitors to digitally and interactively experience how it feels to wear historic museum objects.

# PROCESS FOR DIGITISING FASHION HERITAGE

STEP 1

## Define your Goals

Welcome to digitising fashion heritage!

For successful digitisation, having a clear vision of the desired outcome is essential. Start by exploring the various **'Digitising Techniques'** and their **'Price Indications'**, and how they correspond to our **'List of Purposes'** on pages 6-9, to clarify your focus areas and determine the goals for your digitisation project.

STEP 2

## Select Objects

Carefully choose which items to digitise, as your selections can impact the possible digitisation methods and vice versa. Review the **'Object Challenges for Digitisation'** on page 7 to determine which objects are best suited for 3D digitisation and/or 360-degree photography.

Consider the time and expertise needed to display clothing on a mannequin when planning your project timeline. Small objects (accessories) and contemporary silhouettes take up to 1 hour. Large historical silhouettes takes 1/2 - 1 full day or more.

STEP 3

## Consult a Professional

Consult with a professional to guide you through the flowchart and determine the best solution for your desired outcome. Consider your goals beforehand and contact the appropriate consultant.

We provide an overview of consultants used for the Modemuze project "Unlocking Fashion Heritage", each has their own specialised expertise.

STEP 4

## Prepare for the Consultation

It's always advised to consult a professional before finalising your plans. To ensure a productive meeting, prepare the following:

- **End Result of the Digitised Model:** Look at Step 1. How do you intend to use the digitised object?
- **Photos of the Objects:** Provide images that show the reflectiveness, transparency, size, and possible poses of the garments.
- **Location of Digitisation:** Ensure you have a suitable space for the digitisation process. The space should be large enough to accommodate a lighting setup and turning table, with enough room to move around the object. Generally, a larger and darker space is preferable.
  *Minimum space for 360-degree photography:*
  7 x 7 meters.
  *Minimum space for 3D photogrammetry:*
  4 x 4 meters for medium-sized objects (corsets, jackets, dresses without trains, etc.)
- **Contract:** document all discussed agreements in a formal document, such as ownership.

STEP 5

## Prepare for Digitisation

After the consultation, it's time to prepare for digitisation. The quantity, size, and complexity of the objects will determine the required preparation hours.

Create a plan with all parties involved, scheduling the estimated preparation hours and take into account the following factors:

- Possible transportation
- Mannequin setup and art handling by a textile expert
- Photo studio setup
- Photography workflow
- On-site garment research for 3D replica

STEP 6

## Develop en Deliver

After photographing, the editing and development of the 3D models or 360-images begins. This process can range from minutes using an iPhone 3D scan to several weeks or months for fully recreated garments. Once finished, the company will deliver the agreed files.

Here is a list of what each deliverable includes:

- **Film/Movie:** MOV or MP4 video file
- **3D Model & VR Model:** FBX or OBJ file, viewable and renderable in any modern 3D application
- **AR Integration:** Weblink to an online hosted 3D model
- **360-degree Photo:** 64-72 JPG/TIFF photos; Weblink to an online hosted photo-carousel for website implementation (e.g., Micrio)
- **Still Render/Photo:** JPG or PNG file

Keep in mind that storing and managing large 3D or 360-degree files require significant data storage capacity.

STEP 7

## Display the Results

Now is the time to showcase the results and share the digitised fashion heritage with your audience! Create engaging displays, integrate them into your digital platforms or prepare them for physical exhibitions.

# TECHNIQUES

This brochure presents four current key methods for digitising fashion heritage objects, each with its own process, results, and uses. From 360-degree photography for interactive viewing, to photogrammetry (software that builds a 3D model based on photos of the object) and advanced 3D modeling (the process of creating digital 3D representations of objects from scratch) for detailed digital replicas, it helps you choose the best approach based on your needs and resources.

| Technique | | Cost |
|---|---|---|
| 1 | **360° Photography** / 2.5D viewer<br>*High-resolution 360-degree photos with rotate and zoom features, providing an immersive viewing experience. Created by combining 360-degree images in a 2.5D viewer. Ideal for creating engaging digital storytelling and visual exploration of objects.* | €€ |
| 2A | **Photogrammetry Phone quality** / 3D model<br>*A simple 3D reproduction of an object, suitable for interactive experiences on mobile phone, including AR and 3D viewers. Created by taking multiple images of an object with a phone and a 3D app.* | € |
| 2B | **Photogrammetry Basic quality** / 3D model<br>*A basic 3D model, reproduction of an object, suitable for an interactive experience in VR, AR or 3D viewer. Created using specific 360-degree images from various angles in photogrammetry software. Less suitable for animations or textile simulations (see technique 3).* | €€ |
| 2C | **Photogrammetry High quality** / 3D model<br>*A high-quality 3D model, a digital twin of the physical object, best for large-screen displays, digital storytelling, and academic research. Requires more specific 360-degree images from many angles than the basic-quality version for photogrammetry software. Less suitable for animations or textile simulations (see technique 3).* | €€€ |
| 3 | **Retopology Optimised** / 3D model<br>*An optimised 3D model, reproduction of an object, created through photogrammetry and retopology process, making it versatile for large-scale displays, VR and AR implementable, with the added benefit of supporting animation. While time-consuming, retopology significantly enhances the model's usability for various digital implementations.* | €€€€ |
| 4 | **3D modeling High Quality Replica** / 3D model<br>*A high-quality 3D reconstruction of a garment, ideal for large-scale displays and (realistic) animations, to bring the garment to life in digital environments. Created by extensive and time-consuming research into the garment's original patterns and materials, which ensures historical accuracy while creating the 3D model in software.* | €€€€€ |



# CHALLENGES

## 360° Photography

| Possibilities | Challenges |
|---|---|
| This technique offers almost no limits to what material can be captured.<br><br>360° Photography offers good results for:<br>• fur<br>• metal<br>• glitter / sequin<br>• lace<br>• feathers<br>• mesh / transparent materials | ***Mannequinage tricks***<br>*When staging garments for 360° photography, it's not possible to use visible mannequinage tricks, as the object will be captured from all angles.*<br><br>***Large trains***<br>*Gowns with large trains do not fit easily on a turntable, making them less suitable for 360°.*<br><br>***Reflective objects***<br>*Extremely reflective objects remain challenging due to their tendency to mirror their surroundings. To capture highly reflective materials, it's advised to completely shield the object with reflectors in the photo studio.* |

## Photogrammetry

| Possibilities | Challenges |
|---|---|
| Every object requires a slightly custom approach to the photogrammetry workflow.<br>For thorough insights, consult with a professional.<br><br>Ideally the garment is positioned in an A-pose or T-pose (the arms slightly apart). Ideally the sleeves are not supposed to touch the bodice.<br><br>New techniques for digitising objects are advancing rapidly, and continuous experiments are being done to capture complicated materials.<br><br>In contrast to photogrammetry, there are no material challenges with 3D modeling. | ***Material wih lot of reflection***<br>*(glitter, sequin, metal, glossy synthetics, etc.) Finn van Tol and Dylan Eno have developed a specialised approach for metal objects.*<br><br>***Material wih long fibers***<br>*(fur, fluffy knits)*<br><br>***Material wih lot of transparency***<br>*(lace, gems, feathers, mesh, tule, etc.)*<br><br>***Objects with a lot of layered materials***<br><br>***Objects with loose hanging elements***<br>*(anklets, cords, strings)*<br><br>***Lightweight garments with a lot of movement***<br><br>***Large garments that take up a lot of space***<br><br>***Many or complicated pleats*** |

# PURPOSE

## The Digital Archive

| | 360° PHOTOGRAPHY | PHOTOGRAMMETRY - PHONE QUALITY | PHOTOGRAMMETRY - BASIC QUALITY | PHOTOGRAMMETRY - HIGH QUALITY | RETOPOLOGY - OPTIMISED 3D MODEL | 3D MODELING - REPLICA |
|---|---|---|---|---|---|---|
| Online access to the digitised collection | 1 | 2A | 2B | 2C | 3 | 4 |
| Accessible files that are easy to share | 1 | 2A | 2B | 2C | 3 | |
| Digitally archive historic silhouettes (on a mannequin) for the last time due to garment fragility | 1 | | 2B | 2C | 3 | 4 |
| Transferring historic and artisanal knowledge | 1 | | 2B | 2C | 3 | 4 |
| Share source-material for conservation and research | 1 | | 2B | 2C | 3 | 4 |
| Digital loan | 1 | | 2B | 2C | 3 | 4 |
| Digital restoration (for costumes no longer suitable for mannequins) | | | | | | 4 |

## Display in the Museum

| | | | | | | |
|---|---|---|---|---|---|---|
| QR code linked to a 3D viewer | 1 | 2A | 2B | 2C | 3 | 4 |
| Displaying digital objects and loan(s) | 1 | | 2B | 2C | 3 | 4 |
| Exhibit digital object next to real object | 1 | | 2B | 2C | 3 | 4 |
| AR experience, such as social media filters | | 2A | 2B | 2C | 3 | 4 |
| 3D printing to create a perfect mannequin | | | | 2C | 3 | |
| Interactively moving with historic garments (digital mirror) | | | 2B | 2C | 3 | |
| Animation and textile simulation of 3D models, *e.g. digital catwalk or virutal gala* | | 2A | 2B | 2C | 3 | 4 |

## Digital Immersion (within Historic Context)

| | | | | | | |
|---|---|---|---|---|---|---|
| Placing the object into a (historically accurate) background *e.g. an image, video or animation* | 1 | 2A | 2B | 2C | 3 | 4 |
| Creating a historically accurate environment * *e.g. with period-appropriate lighting* | | | | | 3 | 4 |
| 3D object for a VR experience | | 2A | 2B | 2C | 3 | 4 |
| Archive and display historic accurate movement of the garment | | | | | | 4 |
| Design sketches turn into 3D objects | | | | | | 4 |

** An environment (not an image) in which a 3D model can be placed. Environment lighting will be cast onto the 3D model.*

*Light dot technique is possible but not optimal.*



## (Re) contextualising

| | 360° PHOTOGRAPHY | PHOTOGRAMMETRY - PHONE QUALITY | PHOTOGRAMMETRY - BASIC QUALITY | PHOTOGRAMMETRY - HIGH QUALITY | RETOPOLOGY - OPTIMISED 3D MODEL | 3D MODELING - REPLICA |
|---|---|---|---|---|---|---|
| Adding new perspectives, information and contexts to digitised objects | 1 | | 2B | 2C | 3 | 4 |
| Museum collection in games | | | 2B | 2C | 3 | 4 |
| 3D library for (digital) creators | 1 | | | 2C | 3 | 4 |
| Styling mix and match garments to create digital outfits | | 2A | 2B | 2C | 3 | 4 |
| Digital catwalk (rendered video) | | | | | 3 | 4 |

## Education and Study Material

| | | | | | | |
|---|---|---|---|---|---|---|
| 3D viewer for educational purpose in the classroom | 1 | | 2B | 2C | 3 | 4 |
| Use digital file to reverse engineer the patterns | 1 | | | 2C | 3 | 4 |
| Research material for a community or to build a community with. Think of game developer communities. | 1 | | 2B | 2C | 3 | |
| Study the garment's construction and patterns | 1 | | | 2C | 3 | 4 |
| Digitally study the inside of a garment | | | | | | 4 |
| Turning garments into its patterns/taking garments appart and turning them inside out | | | | | 3 | 4 |
| Disassemble en reassemble clothing down to its fibers | | | | | | 4 |

## Commercial purposes

| | | | | | | |
|---|---|---|---|---|---|---|
| The creation of artworks such as digital photo frames, prints and NFTs | 1 | 2A | 2B | 2C | 3 | 4 |
| Rendering simple videos of the garments for social media posts to create public engagement. | | 2A | 2B | 2C | 3 | 4 |
| 3D printing to create merchandise | | | | 2C | 3 | |
| Digital files as downloadables for 3D artists | | | | 2C | 3 | 4 |

The suggested purposes and digitisation methods are offered as general guidelines and may vary depending on individual creators and evolving technologies. We recommend consulting an expert to ensure the most suitable technique is selected for your specific needs.

*Light dot technique is possible but not optimal.*

1

# 360° PHOTOGRAPHY
## 2.5D VIEWER

*High-resolution 360-degree photos with rotate and zoom features, providing an immersive viewing experience. Created by combining 360-degree images in a 2.5D viewer. Ideal for creating engaging digital storytelling and visual exploration of objects.*

## 1. Prep

**Crew**
- Photographer
- Art Handler
- Assistant

**Location**
- Photostudio
  *Minimum space: 7 x 7 meter*

**Gear**
- High Res camera
- Lights
- Turning table
- Dressed mannequin(s)
- Color grading chart
- Reflective screens
  *To cancel out shadows*

## 2. Photography

**Object is displayed on a mannequin**
Depending on the size of the object, a suitable turntable is chosen.

*There are several different turntable formats: 80, 130, 180 cm. Use the right size turntable to make sure the garments doesn't drag on the floor. And make final fitting adjustments on the turntable.*

**Light set-up that suits the object**
up to 1 hour

**360° photographs**
64 - 72 photos / 30 min

*Estimated turnover: 5 items can be photographed in 360° in 8 hour workday*

*To create an even more smooth transition while turning 360-degrees, it's advised to take even more picures.*

**Take one extra picture with colorgrading chart**

## 3. Processing

**Photo editing**
1-2 hour

**Upload images to 360° viewer**
Modemuze uses Micrio
1/2 hour

## Results

- High-resolution 360° photographs with rotation and zoom capabilities in viewer
- File size (+.Tiff and .JPG): ± 40 GB.
- Digital reproduction of the object as photographed in 360°.
- Files can be easily shared and viewed anywhere.
- Online access to the collection via a 360° viewer (2.5D).

## Purposes

**Archiving and Display**
- Digitally archive historic silhouettes to preserve fragile garments and reduce physical handling.
- Suitable for conservatory purposes, research, and digital loans.
- Enables layered, contextual storytelling about the objects to transfer historic and artisanal knowledge (Micrio viewer).
- Can be integrated into (museum) displays via screens, QR codes, or alongside physical objects.

**Education and Research**
- Easy to use for educational purposes, in classrooms and beyond.
- Can be used as research material for reverse engineering historic patterns.

**Immersion and Creation**
- Can be photoshopped and contextualised in a historically accurate background for displays (image or video).
- Source of inspiration for (digital) creators.

2A

# PHOTOGRAMMETRY
## PHONE QUALITY 3D MODEL

*A simple 3D reproduction of an object, suitable for interactive experiences on mobile phone, including AR and 3D viewers. Created by taking multiple images of an object with a phone and a 3D app.*

## 1. Prep

**Crew**
- One-person job

**Location**
- Any location

*A diffused lighting setup is ideal, but good results can still be achieved with sufficient lighting (minimising shadows is preferred).*

**Gear**
- Smartphone
- 3D scanning app
  *e.g. Polycam, Metascan, PhotoCatch*
- Object or person to scan

*Phone scans can also be peformed on displayed objects in a museum.*

## 2. Photography

**Move systematically with your phone's camera around the object**
10 min

**Take at least 150 photos for a good scan, divided into 5 rounds at different angles (top to bottom)**
about 20-30 photos per round

*The object or person must not move during the scan.*

*Scan de QR code (https://youtu.be/XoJRlK-tgUc) for a tutorial video made by Modemuze in collaboration with the Kunstmuseum The Hague and learn how to digitise a person in their fabulous outfit by using your phone.*

## 3. Processing

**Process images in app and set amount of polygons (resolution)**
Polycam, Metascan, PhotoCatch

**Export 3D model as .FBX or .OBJ to software of choice or view the generated 3D object directly in the app**

## Results

- Simple 3D reproduction of an object, for viewing on a phone screen due to lower quality.
- Small file size (.FBX or .OBJ): ± 5 - 20 MB.
- Easily shareable and viewable through a shared link.

## Purposes

**Archiving and Display**
- Interactive and playful addition to a museum visit and beyond (on your phone).
- AR implementable on a phone for enhanced public engagement, such as social media filters.
- Can be used as an interactive tool during visits, allowing visitors to learn how to digitise objects themselves.

**Immersion and Creation**
- Can be contextualised into historically accurate background for displays (image or video).
- Can be rendered into simple videos of the garments for public engagement.
- Source of inspiration for (digital) creators, creating new digital designs or artworks.

2B

# PHOTOGRAMMETRY
## BASIC QUALITY 3D MODEL

*A basic 3D model, reproduction of an object, suitable for an interactive experience in VR, AR or 3D viewer. Created using specific 360-degree images from various angles in photogrammetry software. Less suitable for animations or textile simulations (see technique 3).*

## 1. Prep

**Crew**
- Photographer
- Art Handler
- Assistant

**Location**
- Photostudio
  *Minimum space for 3D photogrammetry: 4 x 4 meters for medium-sized objects*

**Gear**
- High Res camera
- Lights
- Adjustable tripod or ladder
  *To photograph from above, the tripod needs to be taller than the object..*
- Turning table
- Dressed mannequin(s)
- Colorgrading chart

## 2. Photography

**Object is displayed on a mannequin**

*It is important that the garment is set up in A-pose or T-pose (arms should be loose from the body and trouser legs apart)*

**Diffuse light set-up**
30-60 min

*Lighting object from all sides to minimise shadow.*

*Avoid heating up of lamps by using LED or removing glass panels or shades.*

**Ways to photograph around an object**
- The object is positioned on a turntable.
- Chose a suitable turntable depending on the object size, Available sizes: 80, 130, 180 cm.
- Or the photographer walks around the object.

**360˚ photographs from 2-3 angles**
50-100 photos per angle / 30-60 min

*Frontal and high angles are necessary.*

*A low angle is optional.*

**Take one extra picture with colorgrading chart**

## 3. Processing

**Process images through photogrammetry software like Photocatch or Agisoft.**

**Use low quality export setting inside photogrammetry program.**

*VR and AR are not compatible with large files. 3D meshes need to be of low polycount.*

*Meshes need to be optimised for smooth performance in the 3D viewer.*

*Optimised meshes can be created through low-resolution exports in Photocatch or Agisoft, or need to be retopologised in another 3D software (continue with technique 3).*

**3D object can be viewed in any 3D viewer. Use Vectary for example to view AR models.**

## Results
- Basic 3D reproduction of an object, viewable and rotatable on any screen in 3D viewer.
- Small file size (.FBX or .OBJ): ± 0.1 - 3 GB.
- Easily shareable and viewable.
- Detailed photos of the dressed garment.

## Purposes

**Archiving and Display**
- Can be integrated into museum displays via a QR code linked to a 3D viewer or displayed on a screen.
- Suitable for VR implementations, such as virtual exhibitions or games.
- Suitable for AR implementations, such as social media filters.

**Immersion and Creation**
- Can be contextualised into historically accurate background for displays (image or video).
- Can be rendered into simple videos of the garments for public engagement.
- Source of inspiration for (digital) creators, creating new digital designs, artworks or for game developers.

2C

# PHOTOGRAMMETRY
## HIGH QUALITY 3D MODEL

*A high-quality 3D model, a digital twin of the physical object, best for large-screen displays, digital storytelling, and academic research. Requires more specific 360-degree images from many angles than the basic-quality version for photogrammetry software. Less suitable for animations or textile simulations (see technique 3).*

## 1. Prep

**Crew**
- Photographer
- Art Handler
- Assistant

**Location**
- Photostudio
  *Minimum space for 3D photogrammetry: 4 x 4 meters for medium-sized objects*

**Gear**
- High Res camera
- Lights
  *The best practice is to work with a cross-polarised set-up. This means that both the camera and the lights are polarised.*
- Adjustable tripod or ladder
  *To photograph from above, the tripod needs to be taller than the object..*
- Turning table
- Dressed mannequin(s)
- Colorgrading chart
- Optional Chrome and Matt ball

## 2. Photography

**Object is displayed on a mannequin**

*It is important that the garment is set up in A-pose or T-pose (arms should be loose from the body and trouser legs apart)*

**Color chart placed in frame, next to the object**
Optional: Chrome and Matt ball

**Diffuse light set-up**
Time est: 1-3 hour (once)

*Lighting object form all sides to minimise shadows.*

**Ways to photograph around an object**
- The object is positioned on a turntable.
- Chose a suitable turntable depending on the object size, Available sizes: 80, 130, 180 cm
- The photographer walks around the object

**360° photographs from 3-5 angles**
± 100 pictures per angle. Time est: 1-2 hour

*Details of the garment can be photographed separately to improve its quality within the 3D model, use professional quality photogrammetry programs like Agisoft for this feature.*

*Total amount of pictures highly depends on the object. Objects with a lot of intricate details need more photos. Range: 600 - 3000 pictures.*

## 3. Processing

**Process images through software like Agisoft or MetaShape**

**Visualise the 3D model through rendering.**
- Design the background or landscape of your render. These can be created using a 3D-designed environment or a 360° scan of a real location.
- Create a (historical accurate) lighting set-up around the 3D object
- Render the final scene, producing either an image or video

*The costs of rendering vary on the length and complexity of the scene.*

*For (historically unaccurate) 3D clothing simulation. Provrex can be consulted.*

## Results
- High-quality 3D model, a digital twin of the real object, viewable and rotatable on large screens in 3D viewer.
- Large file size (.FBX or .OBJ): ± 0.1 - 7 GB.
- Highest resolution 3D mesh, consisting of millions of triangle polygons.
- Online access to the digitised collection through a 3D viewer.
- Many detailed high-resolution photos of the garment, essential for validating degradation of real object and useful for possible future regeneration as the digitising software develops.

## Purposes

**Archiving and Display**
- Digitally archive historic silhouettes to preserve fragile garments and reduce physical handling.
- Transfer historic and artisanal knowledge through the detailed 3D model.
- Suitable for academic research and to extract details for conservatory purposes.
- Can be 3D printed to create a perfect mannequin for display.
- Can be integrated into museum displays via QR codes linked to a 3D viewer or displayed on large screens.
- Can be used for digital loans

**Education and Research**
- The 3D viewer is useful for educational purposes, in classrooms and beyond.
- Can be used as research material to reverse-engineer historical garment patterns and study fashion history.

**Immersion and Creation**
- Can be contextualised into historically accurate background for displays (image or video).
- Can be rendered into simple videos of the garments for public engagement.
- Source of inspiration for digital creators, creating new digital designs, artworks or for game developers.

3

# RETOPOLOGY

## OPTIMISED 3D MODEL

*An optimised 3D model, reproduction of an object, created through photogrammetry and retopology process, making it versatile for large-scale displays, VR and AR implementable, with the added benefit of supporting animation. While time-consuming, retopology significantly enhances the model's usability for various digital implementations.*

### 1. Prep

**Follow the steps of the Photogrammetry technique of 2B or 2C to create a 3D model**

*Not all 3D models created through photogrammetry are suitable for all purposes, but retopology expands their versatility by optimising them for various uses.*

*Since there's no universal solution for conversing 3D models across different mediums, always consult a professional.*

**Crew**

- 3D and retopology experts (e.g. Tijdlab and Dylan Eno)

*Ideally work with an digital expert who is able to digitise and execute the post-process of retopology, depending on your project needs.*

**Gear**

- Various 3D software

### 2. Photography

**Create a 3D model using photogrammetry of technique 2B or 2C, resulting in a standard triangle polygon mesh.**

### 3. Processing

**Use software like Marmoset, Blender or Maya to perform retopology on the 3D model.**

- Reduce the number of polygons in 3D model (e.g.,from 4,000,000 triangles to 50,000 quads).

*This process smooths the distribution of polygons to better follow the garment's shape and makes the model more suitable for animation, VR, and AR applications.*

*When optimising, you lose a little bit quality of definition of the 3D garment.*

**Apply additional retopology steps**

- Clean mesh and UV mapping, time-consuming process but essential for fully optimised models.
- Extraction of Roughness, Normal and Height maps, optionally add Specularity, to add layers of detail for AR/VR models, maintining high quality while easily implementable.
- If necessary, details of 3D model can be corrected through photoshop after retopology process

**Place the optimised model in a 3D environment (rendering) or develop further for interactive AR/VR experiences.**

*Consult Tijdlab or another 3D expert for a digital AR fitting mirror*

### Results

- Optimised 3D model, a digital reproduction of an object, viewable and rotatable on large screens in 3D viewer.
- Reduced 3D mesh, consisting of thousands of quad polygons that follow the shape of the garment, enabling animation of 3D model.
- After the retopology process (reducing the polygon count to clean a mesh and UV map), the 3D model loses some definition of details of the garment.
- File size (.FBX or .OBJ): ± 0.1 -1 GB.
- Online access to the digitised collection through a 3D viewer.

### Purposes

*An optimised 3D model includes most of the same possible purposes of a High Quality 3D Model (see p.16). The main difference is the more suitable possibility of animation.*

**Display, Immersion and Creation**

- Interactively moving with historic garments (AR fitting mirror).
- 3D object for a VR experience.
- Social media filters.
- Heritage collection in games.
- Creating garment movement (textile simulation), such as walking, virtual gala or digital catwalk.
- 3D printing to create merchandise.

4

# 3D MODELING

## HIGH QUALITY REPLICA

*A high-quality 3D reconstruction of a garment, ideal for large-scale displays and (realistic) animations, to bring the garment to life in digital environments. Created by extensive and time-consuming research into the garment's original patterns and materials, which ensures historical accuracy while creating the 3D model in software.*

### 1. Prep

**Crew**
- 3D modeling experts (e.g. d_archive or Studio PMS)
- Museum staff and art handlers
- Various heritage experts

**Location**
- Access to the archives

**Gear**
- Research gear for garment inspection
- Various 3D software programs
- Scanners and/or high res camera

### 2. Research

**Consult with conservators to gain insight into garment's history and handling requirements.**

**On-site research of the garment**
- Conduct in-depth pattern and material research in the archive.
- Take exact measurements for precise digital replication.

*2-50 hours / garment*

2. Research

**Collect reference videos and images to study details and movement of the garment.**

### 3. Construction

**Create a digital version of the pattern using 3D software.**
- Pay attention to the accuracy of the pattern to ensure historical accuracy.

*The time required for 3D modeling depends on garment complexity, ranging from a few hours to several weeks.*

**Prototyping and fitting**
- Use CLO3D or Marvelous Designer for prototyping the 3D garment.
- Focus on key aspects: volume, shape, and movement.

**Consult with experts**
- Throughout the process, consult with experts (historical, textile, or technical) to refine the garment's accuracy and design.

### 4. Texturing

**Once the 3D model is completed, you can start texturing to add original textile textures. Digital textures can be created in a variety of ways.**

**Texture creation tools**
- Flatbed scanner
- Vizoo or Bandicoot scans
- Photographs

**Software for texturing**
- Substance Designer
- Substance Painter
- Photoshop
- 3D rendering software

### 5. Animation

**Animate the 3D garment to simulate (historical) movement.**

*Consider both the complexity of the garment and the animation, as these factors significantly impact the time required for this phase.*

### 6. Rendering

**Visualise the 3D model through rendering.**
- Design the background or landscape of your render. These can be created using a 3D-designed environment or a 360° scan of a real location.
- Create a (historical accurate) lighting set-up around the 3D object
- Render the final scene, producing either an image or video

*The costs of rendering vary on the length and complexity of the scene.*

### Results

- A 3D reconstruction of a garment with high-quality textures for display on large screens.
- Large file size depending on deliverable (3D Model / Movie / Render / Photo).
- Digital reproduction of historical patterns.
- Online access to the digitised collection.

### Purposes

**Archiving and Display**
- Digitally archive fragile historic silhouettes for preservation and future reference.
- Suitable for academic research and to extract details for conservatory purposes.
- Archive and digitally display the (historical accurate) movement of garments.
- Can be integrated into museum displays or used for digital loans.
- Complete digitalised research of a historical object, transferring artisanal and historical knowledge or providing new perspectives.

**Education and Research**
- Useful for educational purposes, in classrooms and beyond.
- Allows for in-depth digital study of the garment: viewing inside, disassembling to study patterns, and reassembling down to the fibres.
- Design sketches can transform into 3D
- Historical patterns can be reverse-engineered and re-created for further study or use in real-life garment production.

**Immersion and Creation**
- Can be contextualised and placed into a (historically accurate) background (image, video or animation) or environment (with period-appropriate lighting).
- Can be rendered into videos.
- 3D designs can be styled, mixed, and matched to create digital outfits or fashion collections.
- 3D files can be fitted onto a variety of digital avatars.
- 3D files can be downloadable and serve as inspiration for digital creators.

# GLOSSARY

**CGI**
Computer-generated imagery (CGI) refers to all 2D or 3D visuals generated by a computer.

**3D Object**
A digital object. A 3D object consist of vertices connected to each other, creating polygons. A group of polygons creates a 3D mesh, or 3D surface, which defines the shape and structure of the object.

**Vertices**
Vertices are point coordinates in 3D space. A Vertice is a vector point on an X, Y, and Z coordinate.

**Polygon**
In 3D modeling, polygons are flat shapes formed by connecting three or more vertices in a specific order. They are used to construct the surfaces of 3D objects.

**Mesh**
A 3D mesh is a surface composed of polygons and planes. Quad meshes and triangle meshes are two common types of meshes.

**Triangle Mesh**
Triangle meshes are commonly produced by photogrammetry software, where three vertices connect to form a tri-polygon. Triangle meshes are not optimised for texturing or animation, and need to be Retopologized.

**Quad Mesh**
A quad mesh is a 3D mesh consisting of polygons with square shapes, where four vertices connect to form a quad polygon. Quad meshes are the most preferable because they are optimal for animation (this is not possible with a triangle mesh).

**Retopology**
Retopology is the process of creating a new surface with a simpler structure over an existing 3D model, often done to optimise the model for animation, rendering, or other purposes.

**UV-Maps**
A UV map is a 2D layout that shows how a 3D model's surface is flattened so textures (like patterns or labels) can be applied correctly. Imagine peeling the paper off a box and laying it flat—this is similar to UV mapping. UV-maps are crucial for ensuring that textures fit correctly and look realistic on 3D models. To create a UV map, it is easier to use a quad mesh.

**Texture**
A texture is an image applied to a 3D object's surface to create materiality. Texture maps include various types such as diffuse maps, roughness maps, height maps, normal maps, and metalness maps.

**Diffuse Map**
A texture map that defines the base color of an object's surface.

**Roughness Map**
A texture map that controls how rough or smooth an object's surface appears.

**Height Map**
A texture map that encodes height information, often used for creating surface details such as bumps or wrinkles. Can also be called a Displacement Map.

**Normal Map**
A texture map that encodes surface normals, affecting how light interacts with the object's surface and creating the illusion of fine details.

**Metalness Map**
A black-and-white texture of the object's surface that shows which parts of a material should look like metal (white) and which should not (black).

**Extended Reality (XR)**
XR is an umbrella term for all immersive technologies, including AR, VR, and MR, aiming to create experiences that bridge the gap between physical and digital realities.

**Augmented Reality (AR)**
AR enhances the real world by overlaying digital information onto it, typically through devices like smartphones or AR glasses.

**Virtual Reality (VR)**
VR immerses users in entirely digital environments, shutting out the real world and replacing it with a simulated one through headsets or goggles.

**Mixed Reality (MR)**
MR seamlessly blends virtual and real-world elements, allowing digital objects to interact with the physical environment and vice versa.



**360° View**
A 360-viewer is a software tool that enables users to view and interact with objects in 360-degrees (2.5D), offering high-definition rotation and zooming.

**DSLR Camera**
A DSLR (Digital Single Lens Reflex) camera produces sharper and higher-quality images than regular digital cameras due to its interchangeable lenses and mirror reflex system.

**Polarization**
A polarization filter is used for cameras or lights to even out highlights. Cross-polarization occurs when both the camera and light have polarization filters.

**Photogrammetry**
Photogrammetry is a technique that creates 3D models from 2D photographs by analyzing multiple images of an object taken from different angles. The software identifies common points across these images to reconstruct the object's shape and appearance in three dimensions.

**3D-Scanning**
3D scanning is the process of capturing the physical shape and appearance of an object using laser, light, or x-rays to create a digital 3D representation. Usually a handheld controller is used while walking around an object.

**3D Modeling**
3D modeling is the process of creating digital 3D representations of objects or characters from scratch. Artists and designers use tools in 3D software to shape virtual objects by manipulating vertices and polygons. This process allows for handmade digital copies, resulting in optimised models that can be animated.

**Rendering**
Rendering is like taking a picture of a 3D scene using a computer. It's the process of turning a 3D model or animation into a 2D image or video. During rendering, the computer simulates how light, shadows, and different materials would look to create a realistic or stylized final image.

**A-Pose**
In 3D modeling, the A-Pose has the character standing upright with arms angled slightly downward, resembling an "A."

**T-Pose**
In 3D modeling, the T-Pose has the character standing upright with arms extended horizontally, forming a "T."

**Color Grading Chart**
A chart or reference tool used in color grading to help adjust and manipulate the colors and tones of an image or video to achieve a realistic or desired aesthetic.

**Matte Ball and Chrome Ball**
These are objects used in photography and computer graphics for lighting and shading reference. A matte ball is typically a diffuse white sphere used to measure overall ambient lighting in a scene, while a chrome ball is a reflective sphere used to capture accurate reflections of the surrounding environment.

**Digital Archiving**
Digital archiving is an addition to physical archiving. Digital archives are digital databases of physical objects consisting of images or 3D objects, which can be accessed by users through websites (open) or private (closed) systems.

**Digital Reproduction**
A Digital Reproduction is a digital copy of a physical item. This includes photography, 360-degree photography and low-resolution 3D scans.

**Digital Twin**
We refer to a Digital Twin when the digital object is an exact standalone copy of its physical counterpart, including high-resolution photogrammetry scans.

**Digital Reconstruction**
A digital reconstruction is a digital interpretation of a physical object. This can include a 3D model.