Theoretical reconstruction of sacred interiors with 3D modeling and visualizations with augmented reality technology

Sanita Bitko, Bc.sc.comp, Art Academy of Latvia,
sanita.bitko@gmail.com

History of the Biķernieki church

When I started the project, I contacted the Rundāle Palace Museum about the possibility of 3D scanning. **The museum gave permission to scan the sculptures of the Biķernieki Church from all the sculptures in the collection.**

As part of the project, I have collected the history of the Biķernieki Church from both published sources and the archives of the Rundāle Palace Museum.

The most important historical facts of the Bikernieki Church, which were related to the sacral interior, will be compiled in an article in English, which will be submitted for publication in the Collective Monograph of the AAL Scientific Conference V (2022).

Also I presented this topic at the 2nd International Conference of the Art Academy of Latvia «Synergy Between Humanities and Natural Sciences in Cultural History and Theory» on 16 June, 2022.

Lost heritage

As a result of many wars which cross territory of Latvia and many different robberies we have lost a lot of our heritage.

In total, during World War I and World War II and as a result of the Soviet atheistic ideology, about **60%** of the **interiors** of Latvian Lutheran churches were **damaged** or permanently **lost**

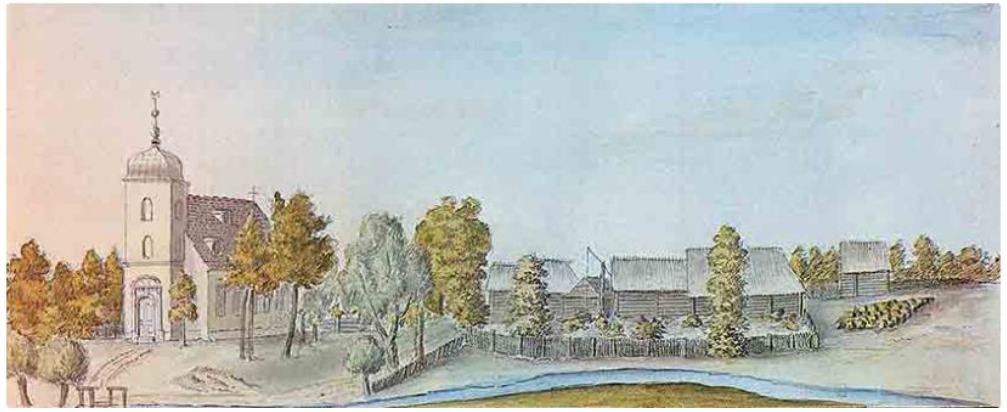
Historians have done a huge amount of work and collected a lot of information till today. But unfortunately, as recent events in Ukraine have shown, peace in the world is very fragile.
So, our aim is protect our heritage for future generation. Just not to lose all the data collected in one day.
Nowadays, to protect does not mean to lock our art object deep in underground, in some bunker and not to show anyone.
Today we have digitalization, and one type of it is 3D modeling which makes it possible not only to save our heritage, but to show it to wider public.

Biķernieku church – lost interior, RPM.

Biķernieku church, RPM.

History of Biķernieki church

A little bit about the history of the Biķernieki Church



Drawing by Johann Christoph Brotze

1765 - 1766

The stone church is built,

Wooden sculptures are made

1875

New organ, rebuilt altar.

1926

Repainting of the church interior

1970

Preserved art objects are donate to Rundāles Palace Museum and Dole history museum

1989

Church reopens

1967

Church is closed, interior has been destroyed

The church is used as a warehouse, stained glass workshop.

Photo from http://bikerudraudze.lv/bikeru-dievnams/

.. before and today ..

From Biķernieku church were preserved several wooden sculptures, which will be reconstructed as part of my research project. About sculptor – in documents we can read master's **Karl Gottlob Appelbaum** (from Radeburg) name, who designed the altar. But in this period Appelbaum was working in several churches in Riga city together with sculptor **Jakob Ernst Meyer** (from Danzig) - so most likely Meyer is the author of the wooden sculptures.

Biķernieku church – lost interior, RPM.

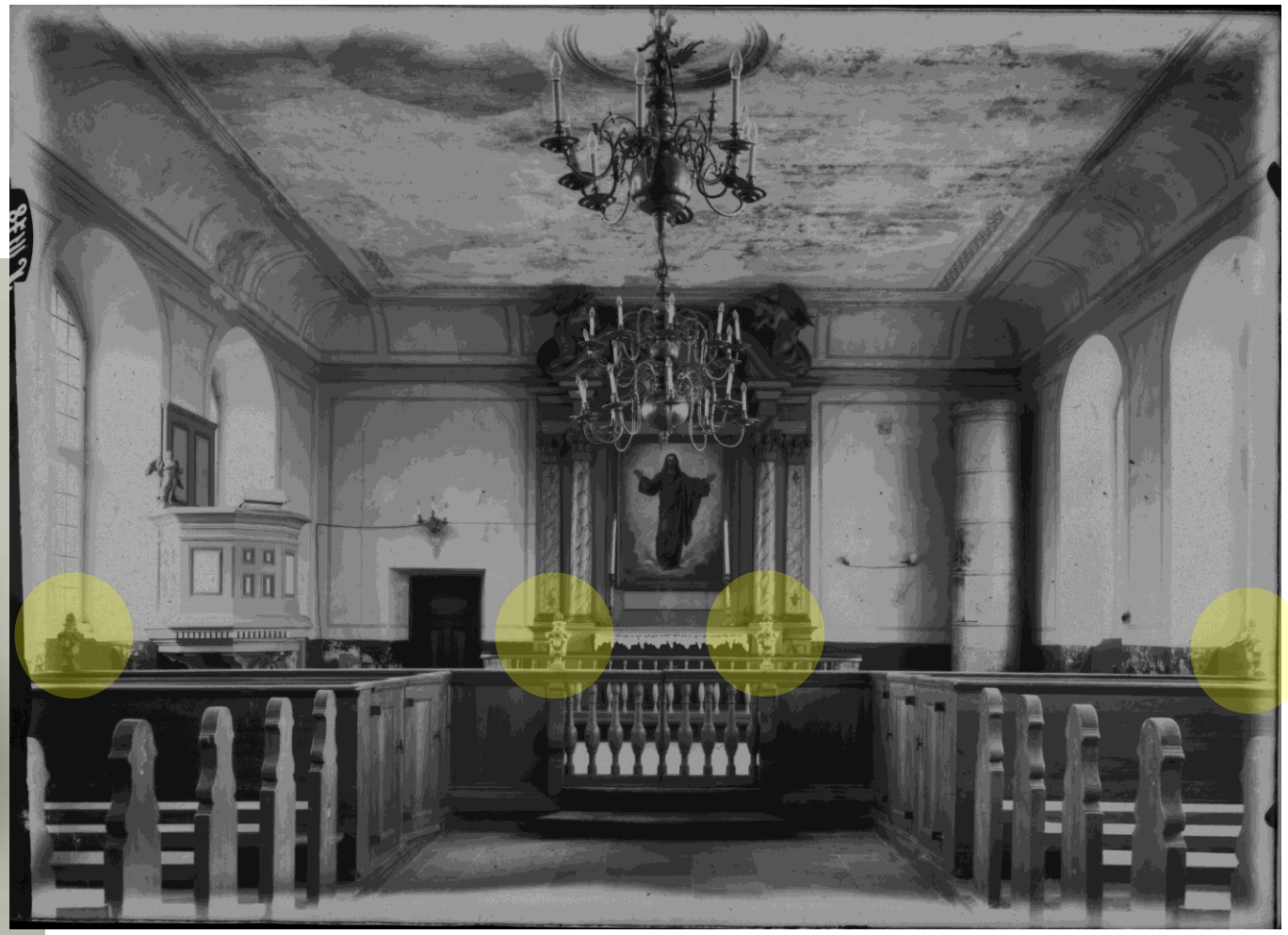
Biķernieku church – interior today.

Wooden sculptures reconstructed as 3D models

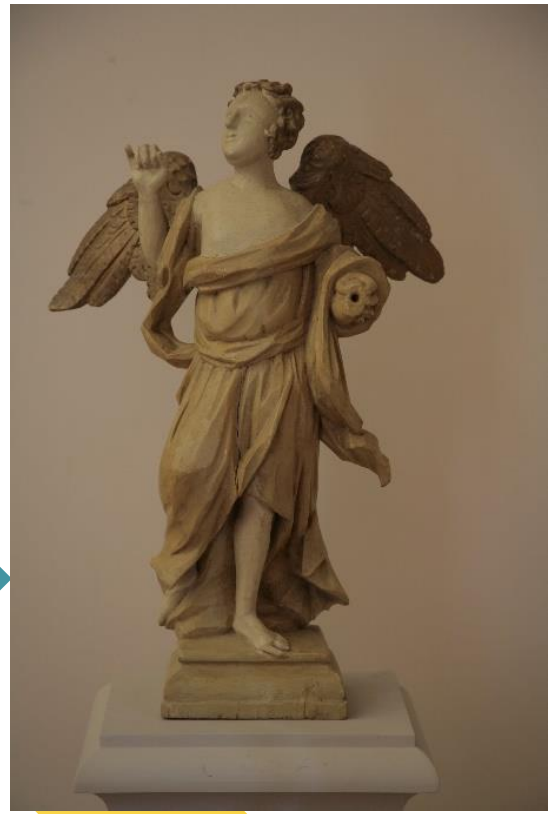
Vases (1765)

RPM, photo Marcis Leopolds Klavins, 1968

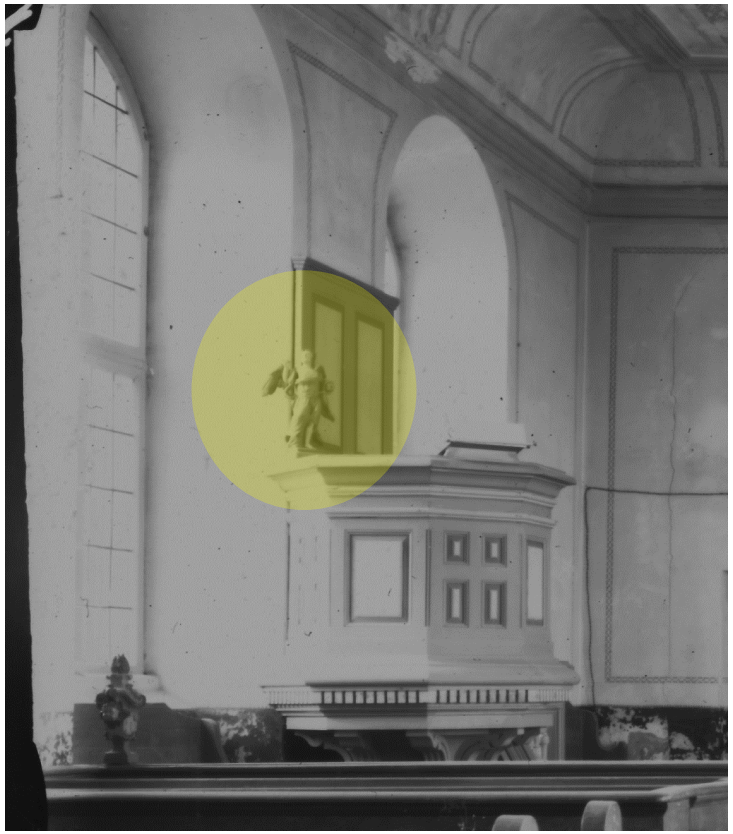
RPM 1331/1-4, h 47 cm, w 20 cm



Angel from pulpit (1765)



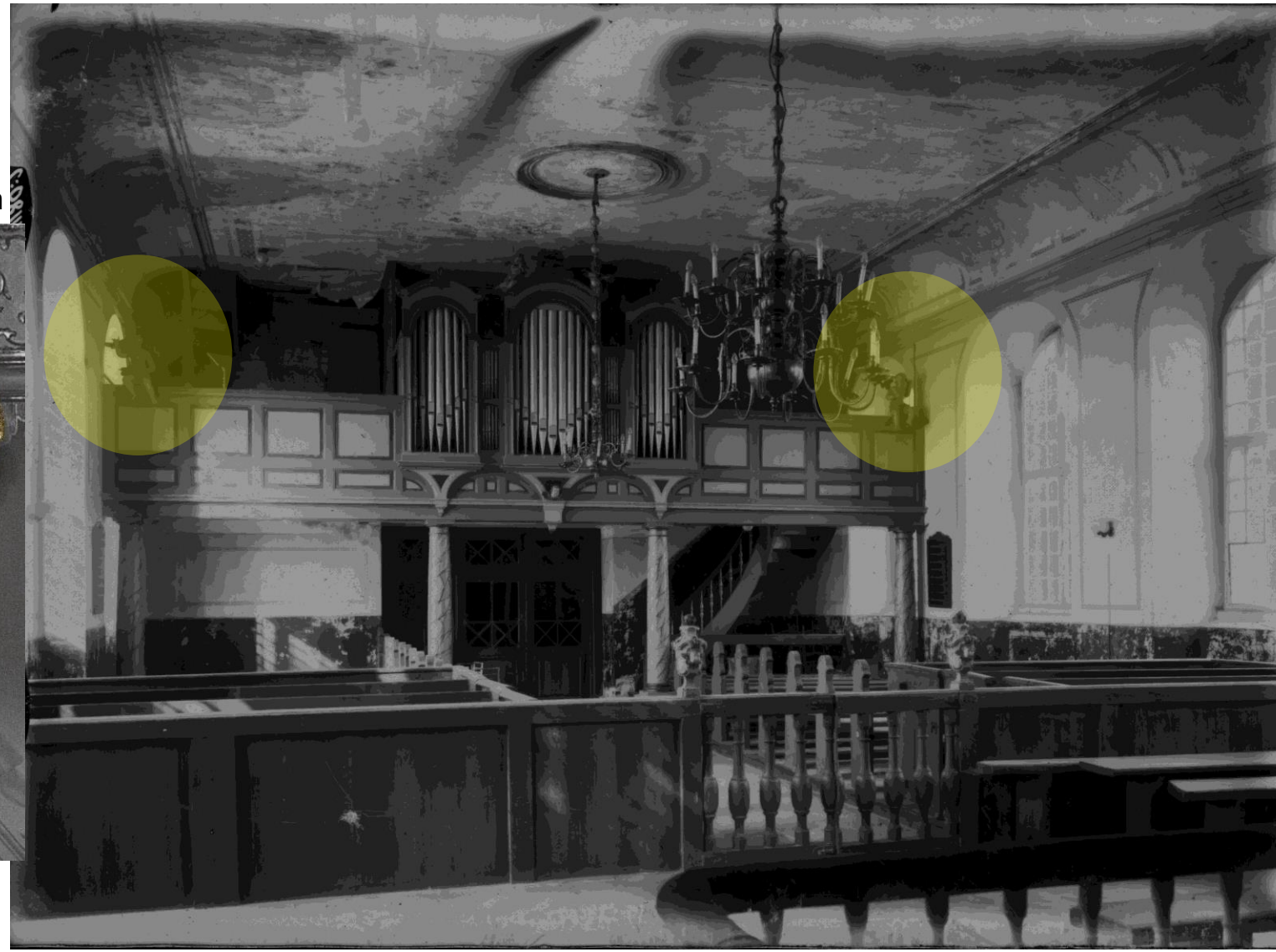
RPM 1329, h 58 cm, w 23 cm.



RMP, nr. 11178

Angel from old organ facade (1765)

RPM 1327, h 52 cm, w 46 cm

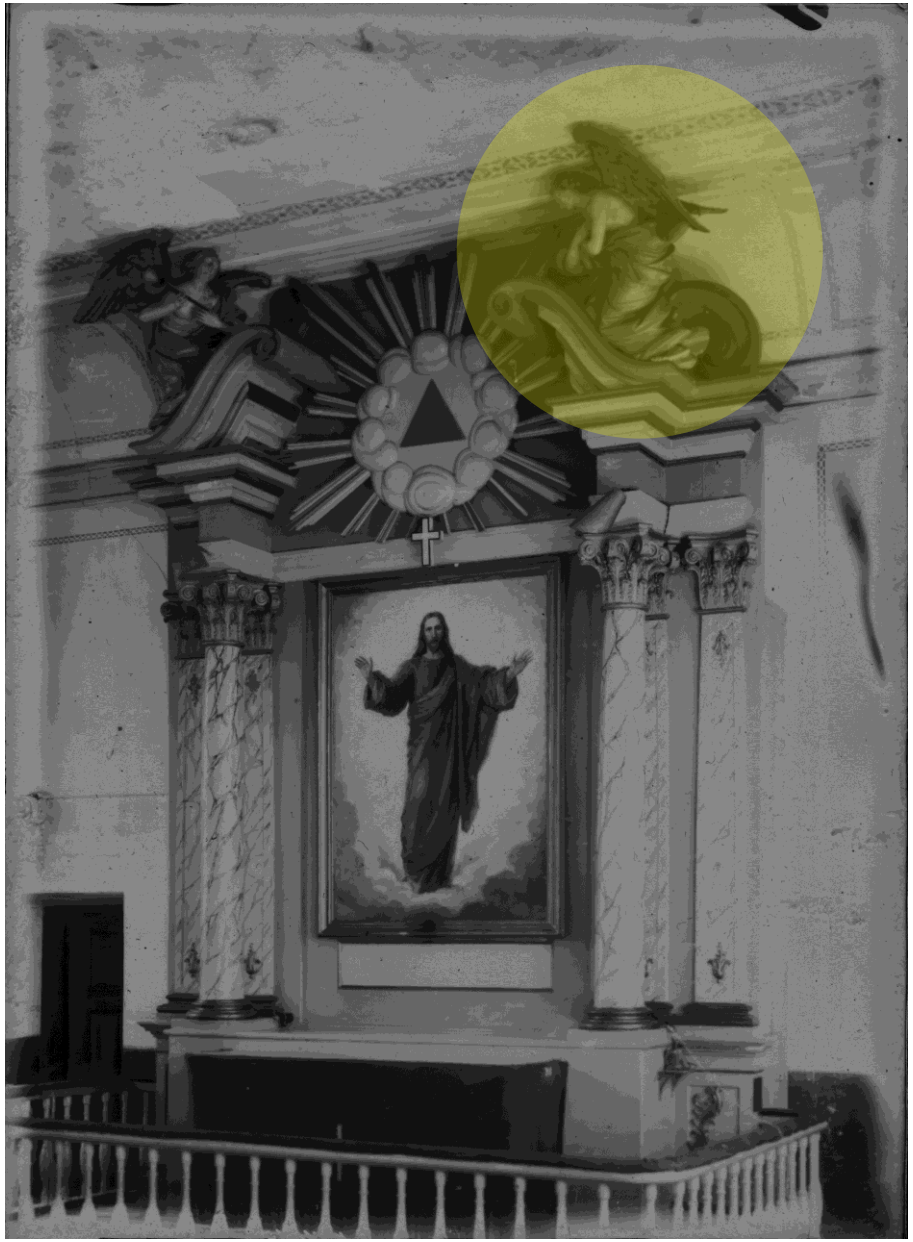


RMP, nr. 2823, photo: Marcis Leopolds Kalvins, 1968

Angel from altar (1765)

RMP, nr. 2819, photo: Marcis Leopolds Kalvins

RPM 1325, h 120 cm



About 3D models. How to build them?

It would be too difficult (even impossible) to draw such a sculpture in a 3D modelling program to end up with a real 1:1 model. So it is convenient to use 3D scanning.

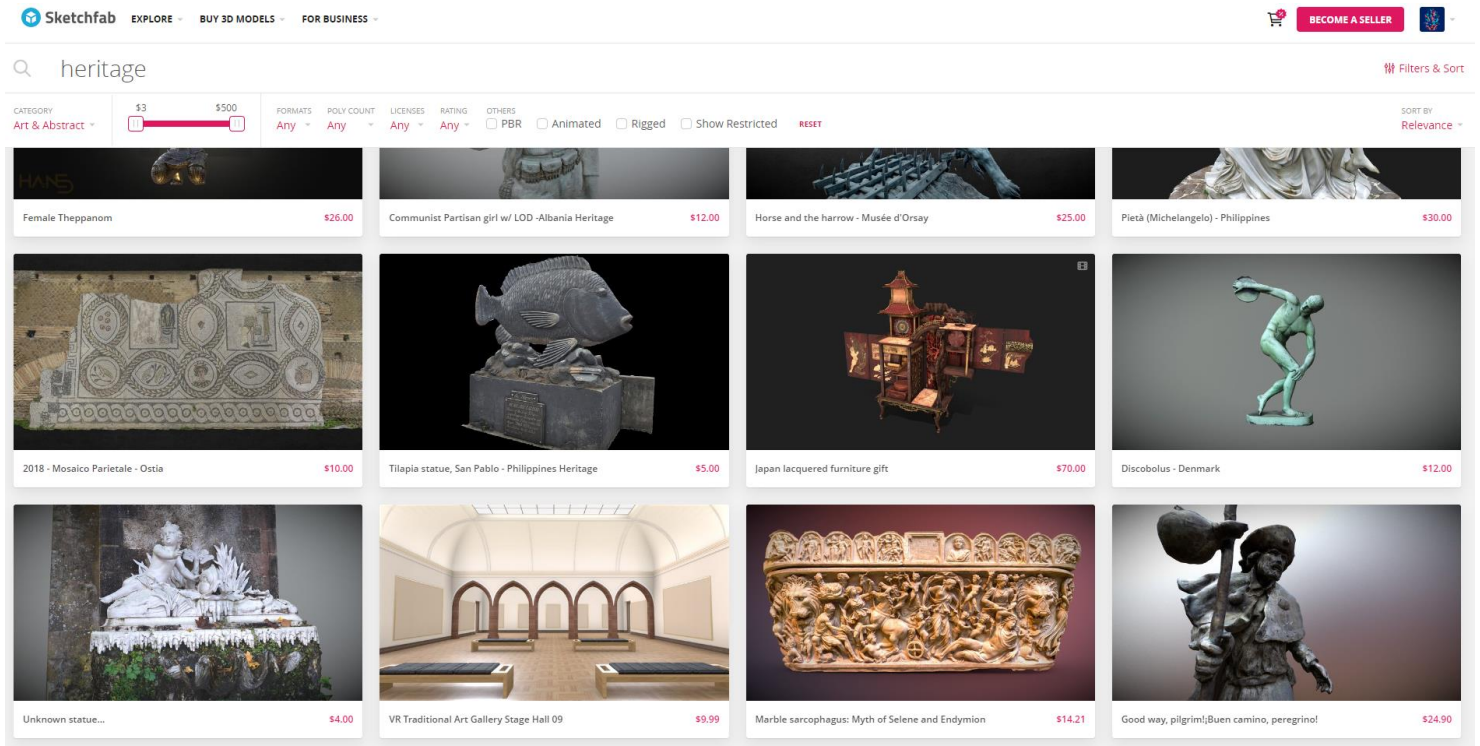
In 2022 I found out, that in market appears brand new product – a budget class 3D scanner from Revopoint company and decided to try it. I should add that until today I had no experience with any 3D modelling software.

But as you now – if you buy a photo camera it does not make you a professional photographer. And the same I can say about 3D scanning.

To create a 3D model it was a challenge. First of all, the scanning process itself is not simple, and after scanning I use at least 3 different 3D modelling programs to process and finish this model. (CloudCompare, Meshlab, RevoStudio).

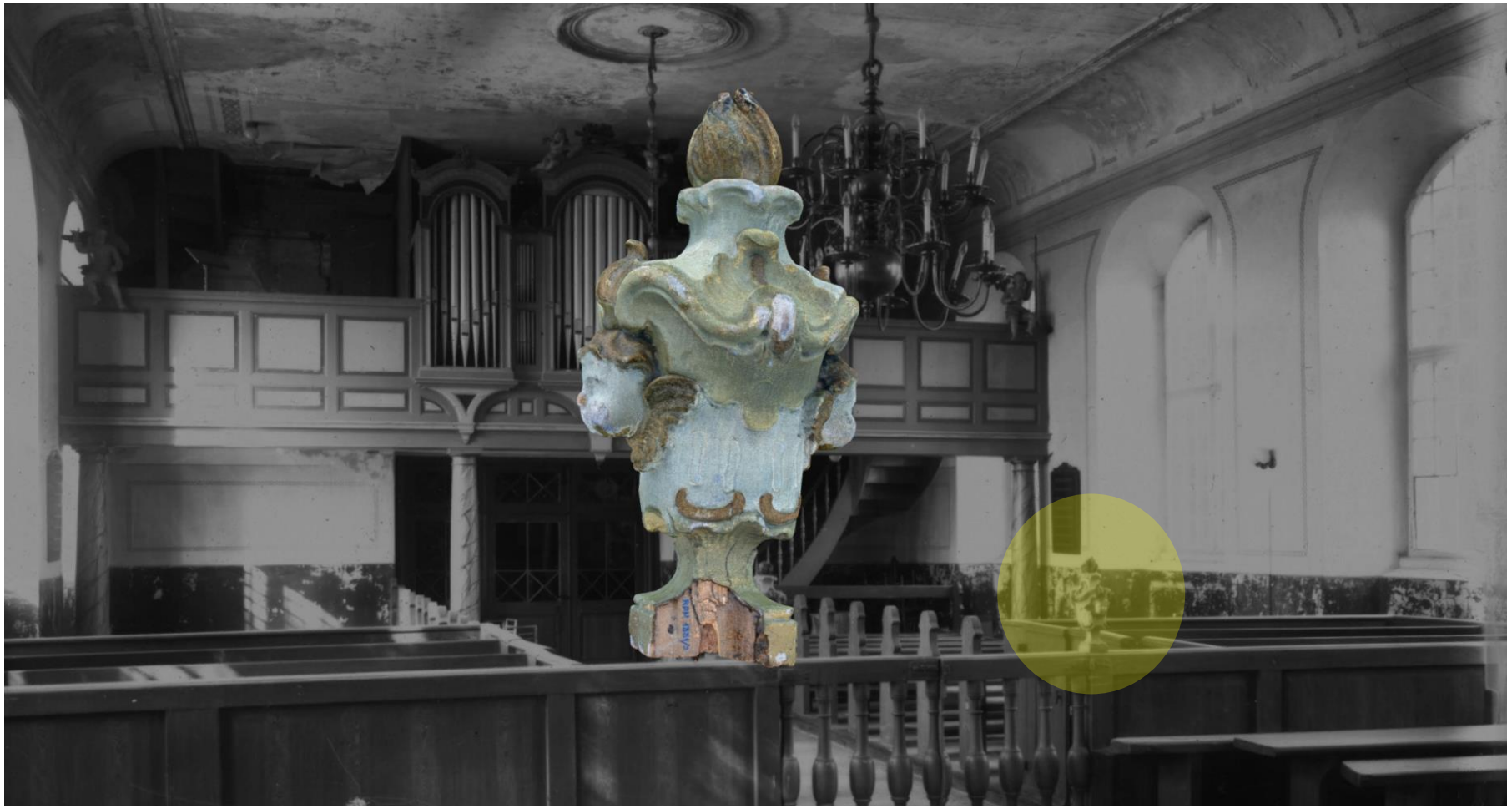
Where to store models?

It is possible to store 3D models in internet platform «Sketchfab» and they offer premium package for free or with good discount for non profit organization or museum, libraries.
In the summer of 2022, I wrote an application and received a premium package with the possibility to insert 3D models.
I created a profile called arthistorylatvia.org to be able to store 3D models in the future. I also created a website to show the different digitisation projects in one place– http://arthistorylatvia.org/



Altar barrier vase (unrestored): height 47 cm

You can open 3D model here https://skfb.ly/oxQpZ



Altar barrier vase (restored): height 47 cm

You can open 3D model here https://skfb.ly/oxQ8O

Angle from pulpit: height 58 cm

You can open 3D model here https://skfb.ly/oxCFG

Angel from old Organ facade

Technically, the scanning is done in parts and then the model is assembled in 3D modelling software (I even had to buy a new, more powerful computer to handle the 3D modelling)

For example, to assemble an Angel of the Organ façade the first attempt to put the angel together took over a week. The process of putting it together is complicated and failed on the first try. The model was of poor quality and had to be rescanned and put back together.

The photograph shows the layers on the right hand, which do not exist in nature.

To create a good quality model, I scanned it again and put it back together

Angel from old Organ façade: **height 52 cm**
You can open 3D model here https://skfb.ly/oCwpw

Angel from altar

This was the biggest challenge in 3D modelling. The sculpture is more than 2 times larger than the previous ones - 120 cm high.

The scanning was not only difficult because of the size of the model, but also because of the deep folds of the drapery and the position of the angel's hands, which cover the body and vice versa - the body covers the inside of the hands.
Like the previous angel, this one had to be scanned twice:
1. As mentioned above, the sculpture is scanned in parts, which must be joined together. It is not always possible to scan everything accurately the first time so that the parts can be joined later.
2. Another problem with a model of this size was the white balance problem when scanning. The first scan was too blue and far from reality. Unfortunately, there are no white balance settings available on the scanner.

Angel from altar: **height 120 cm**

You can open 3D model here https://skfb.ly/oCtWM

Due to the large size, you may have to wait longer for the model to load

Summary of 3D scanning

Nuances to consider for 3D scanning:

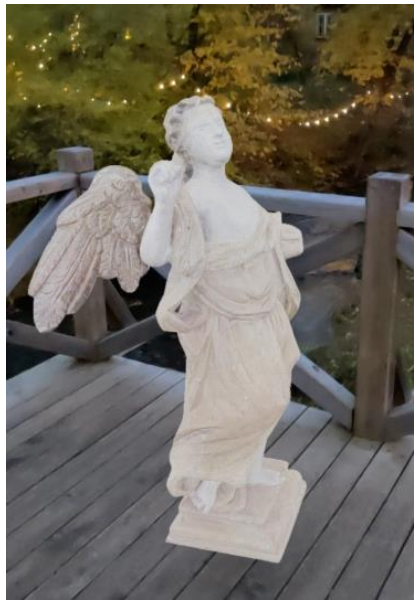
- It is difficult to scan the gilded parts: gold reflects light, so they are only partially scanned.
- Black parts cannot be scanned, leaving holes in the model instead
- If the sculptor has created a very plastic garment for the sculpture, rich in deep folds, the difficulty is to scan the deepest point of the drapery.
- If the sculpture cannot be scanned at an angle of at least 270°, it may be difficult to put it together. Gestures, especially the sculpted figure’s raised or bent arms covering its body and the position of the angels' wings may interfere with a correct digitalisation of the sculpture.
- Each scanner has a minimum scanning distance, so problems are caused by body parts placed too close together, e.g., arm placed too close to body, or close leg placement, making it physically impossible to scan a part of the sculpture.
- For scanning a larger sculpture, the white balance settings are an important option. Unfortunately, rarely does a scanner have this option.

AR – Augmented reality

Using new technologies such as augmented reality (AR), it is possible to visualise 3D models of sculptures in user's environment in real time.

The Sketchfab platform offers not only online viewing of models, but also AR functionality with the following working principle:

- a QR code can be printed for each 3D model;
- the QR code must be scanned with a mobile phone;
- the app offers to scan the surface on which to place the model;
- after loading, the model is virtually placed on the selected location;
- 3D model can be viewed via the mobile phone screen



Video example of what the model looks like on a phone (using AR)
https://www.youtube.com/watch?v=vIq9S4MhDfA

Angel from pulpit. Depicted throught AR, even in the shop

Problems using existing AR solutions

In my research into augmented reality, I found several problems:
1. Too large model size. Augmented reality is used in marketing today, for example it is possible to see how a chair or sofa looks in your home. Such models are constructed in 3D modelling software, and you can control their size. Scanning wooden sculptures, they have complex shapes, lots of plastic details, folds in clothes, detailed facial features. The model comes out very large in size. If you reduce the size of the model, the quality of the model is significantly reduced.

2. Internet limits on the user's phone. To represent an object through augmented reality, e.g. in a church - the viewer must have a very fast internet connection to load the model, and a no-limit internet connection so that viewing the models does not consume all available internet MB.

As a result: the user may not wait for the model to load (slow internet, large model) or may spend the full amount of available internet without knowing it

Possible solutions

In 2022 November, I went to Leipzig, where MUTEC (International Trade Fair for Museum and Exhibition Technology) took place as part of DENKMAL.
Unfortunately, there is currently no publicly available AR application on the market to solve these problems. The only offer is custom programming.

Benefits of 3D modeling

- As we know – not all of art objects are shown in museums exhibition lot of them are stored in collection, but with digital 3D models it could be available to everyone.
- To scan unrestored sculptures, we can attract students to choose restoration profession – just to show how much work still need to be done.
- Not all object can be restored, but in this case here can help digital restauration with 3D modelling programs.
- If we have 3D model – we can print it with 3D printer or cut from wood with CNC. Plus, we can print it in original size, or a smaller size. If you travel abroad – everywhere you can by a small size sculpture of popular artworks. In Latvia we can do the same just need to choose iconic sculptures.
- After all – to look at the 3D model we can zoom it to see smallest nuance for detailed research.
- And the last but not least – we can save our heritage for future generations, because we can store digital information in in different servers all over the world.

Benefits for art history research

When we look at a sculpture in person or in a photograph, we usually see it as a whole.
Working with a 3D model, it is possible to study it in detail - for example, the facial features or the wings' structure.

During the development of the project, I made some unexpected discoveries:

1. Comparing the sculptures of the Biķernieki church, you can see differences in the style of the execution of the sculptures, which indicates the work of several sculptors. This means that the sculptor Jakob Ernst Meyer did not work alone, but that several sculptors worked in the same workshop.

2. Comparing the angel in the organ façade of St Jacob church in Riga, bear a clear resemblance to the angels of the Bikernieki church organ balcony. They were both made by the same workshop. Until now, we have not known anything about the sculptors of the organ facade of St James' Church.

Angel from St. Jacob church in Riga

Angel from Biķernieki church

Thank you!