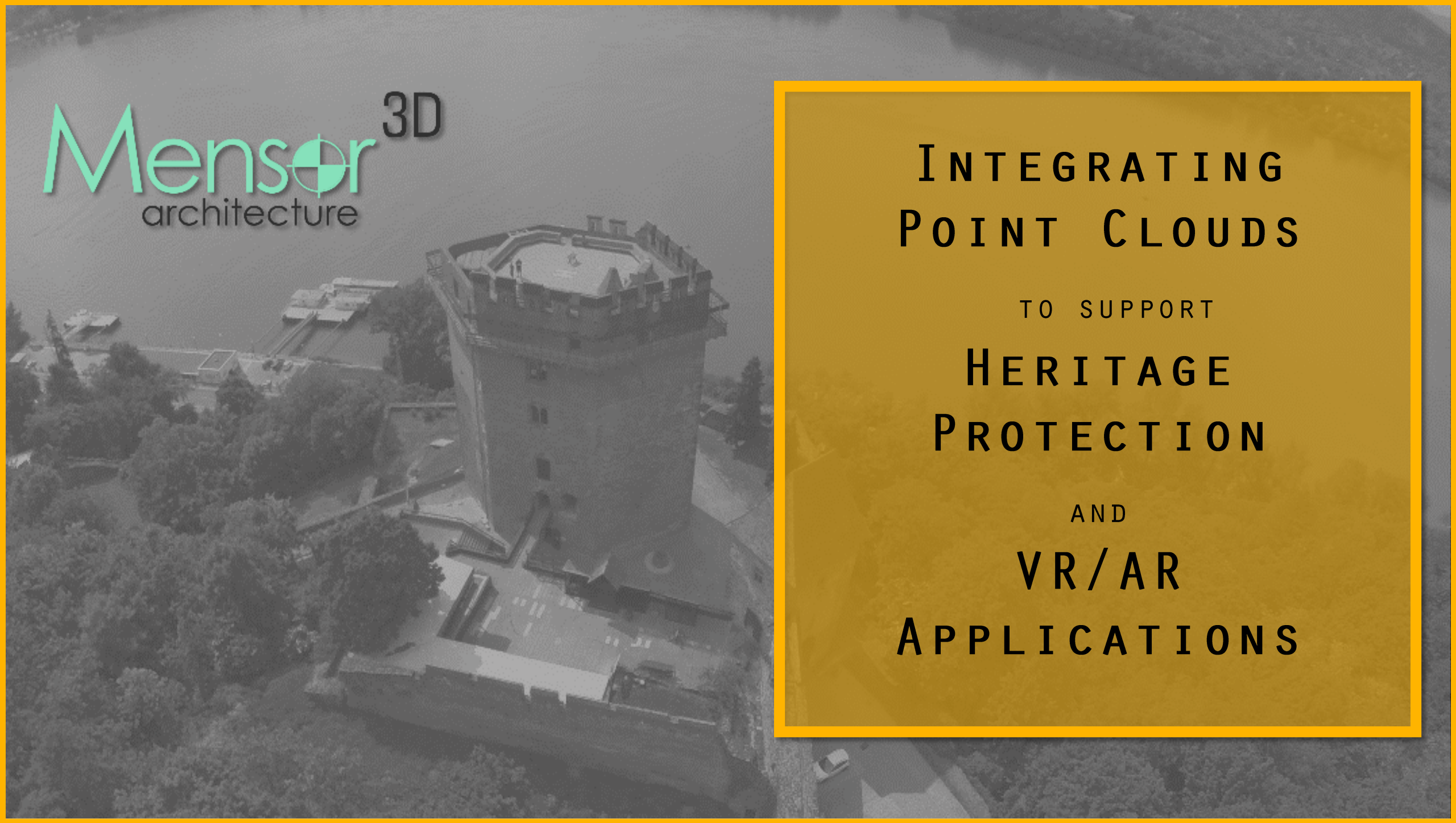


Integrating Point Clouds

to support

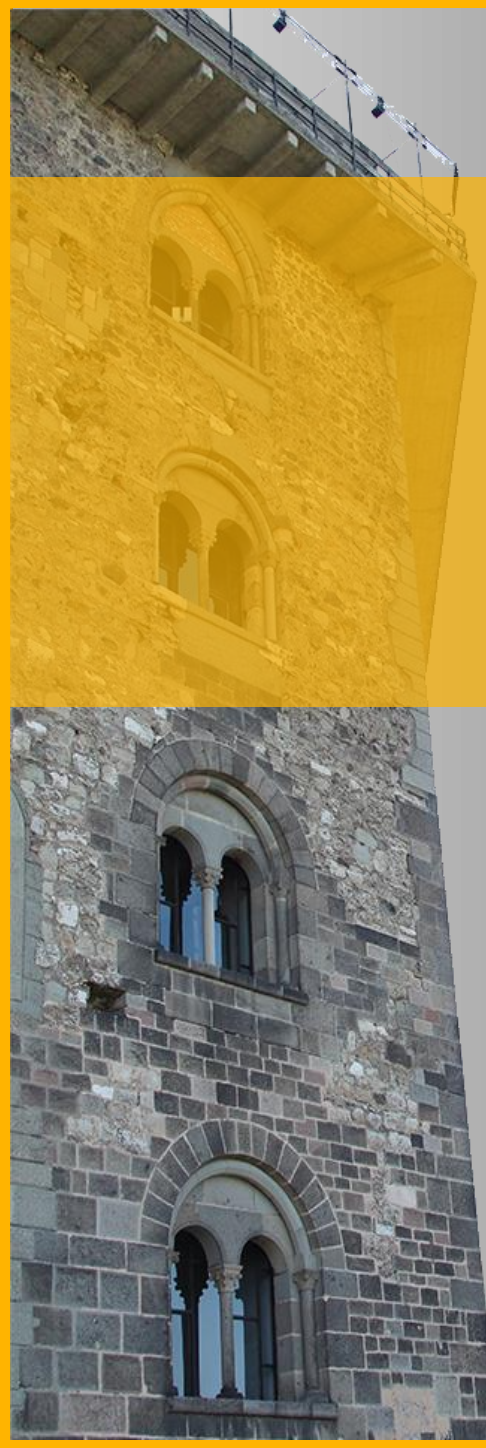
Heritage Protection

and

VR/AR Applications

We at Mensor3D are using advanced 3D technologies during our projects, such as laser scanning, structured light scanning and UAV photogrammetry. We support many application areas from cultural heritage protection, through architecture to mechanical engineering.

Hungary is incredibly rich in cultural heritage, its preservation, documentation and high quality visualization is of common interest.



The primary objective was to digitally document Solomon tower's historical site and its artifacts in 3D

The goal of this project was to survey, model and document the Solomon tower's historical site and its artifacts to support historical architecture, art historian research and virtual reality museum presentations.

Mensor 3D architecture

The Solomon Tower

CyArk 500 Challenge

Visegrad, Hungary

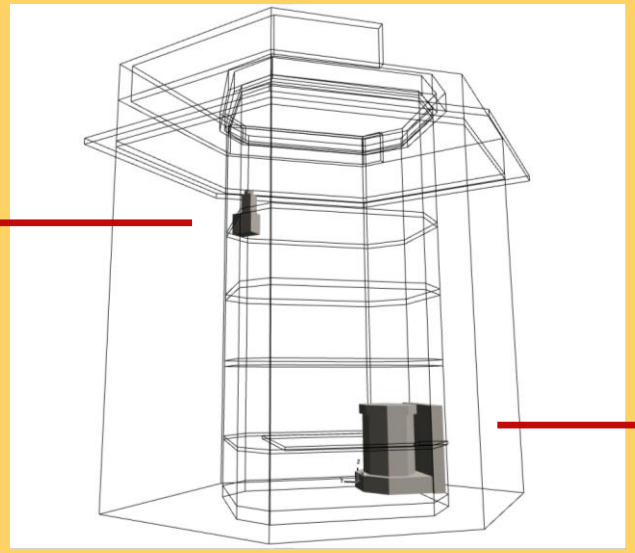
Solomon tower was built on the riverside of Danube. The five-storey, 32 meter high hexagonal tower was built in the 13th century. The tower is part of the Medieval Palace in Hungary, which was selected by the CyArk500 challenge program. The building is currently facing a number of technical problems; renovation of the building cannot be postponed anymore. Planning procedure requires an accurate and comprehensive survey documentation.

Mensor 3D architecture

The Tower

The Fountain

The Stove

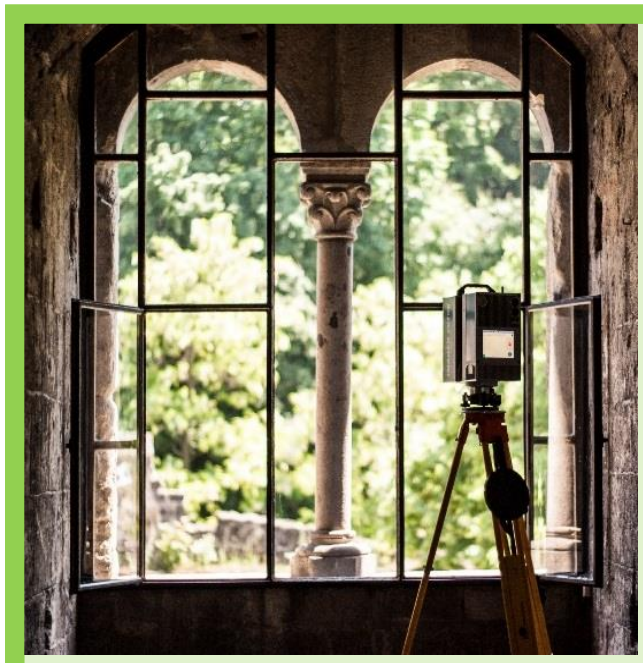


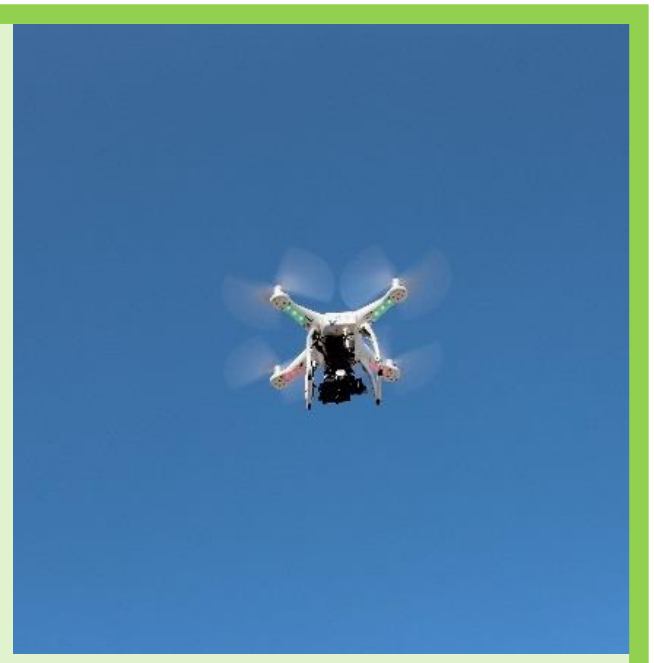
There are two very interesting artifacts in the tower, an Anjou stove and a fountain. These objects had to be surveyed with high resolution and accuracy, but also had to be virtually presented together with the tower.

Mensor 3D architecture

Surveying
The
Tower

- Z+F Imager 5010C (TLS)
- Leica HDS7000 (TLS)
- Nodal Ninja + Canon EOS 600D
- Leica TCR803 Total station
- Leica Viva GS14 GNSS receiver
- Artec EVA (SLS)
- Breuckmann (SLS)
- DJI Phantom, GoPro Hero3 (UAV)
- Bosch laser distance measurer





Several technologies were combined during the data acquisition procedure. The goal of the survey was to create a dataset that enables deriving architectural products (views, layouts and sections) and detailed 3D model for virtual reality presentations. So we used UAV and laser scanning outside, laser and structured light scanning indoor.

Mensor 3D architecture

Surveying
The
Tower

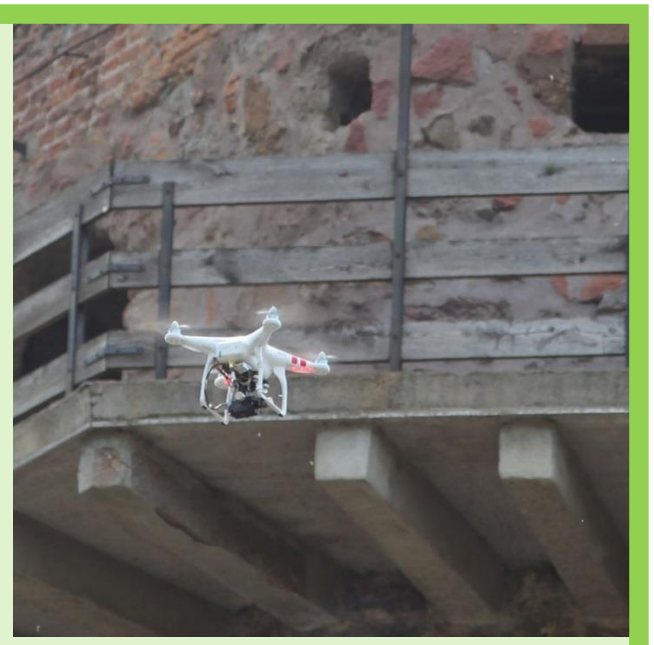
Height	32 m
Floor	1750 m^2
Environment	400 m^2
Staircase	2
Hall	5
Chamber	12

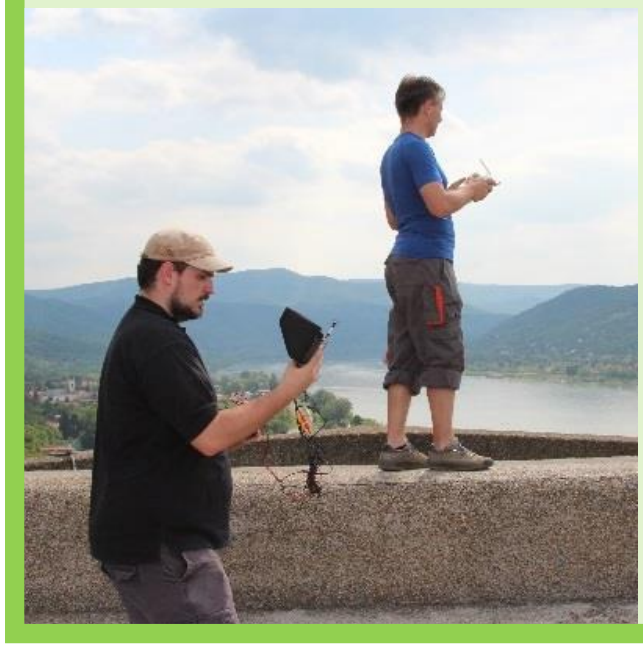
The tower floors inside are connected with narrow spiral staircases, the point cloud registration was supported by measuring the tie points with total station. We used lots of tie points all over the surveyed area.

Mensor 3D architecture

Surveying The Tower

Aerial Image Positions





Since the tower is 32 m high, and below the top of the tower other objects block the line-of-sight, its upper area cannot be captured by the scanner. Therefore UAV was used to complement the laser scanned datasets and to survey the environment.

Mensor 3D architecture

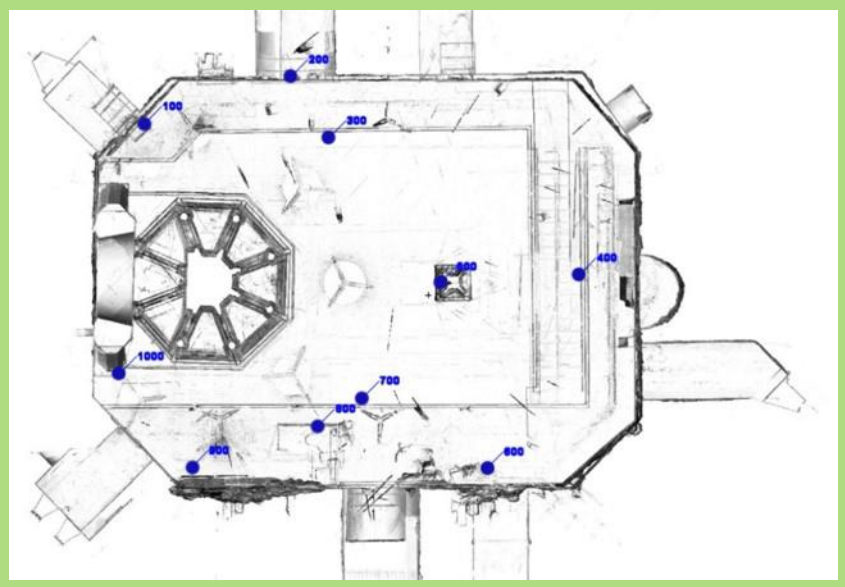
Surveying
The
Tower

Raw images	968
Image for processing	914
MPixel	12
Take-off	3
GCP	6
Point cloud	47 M

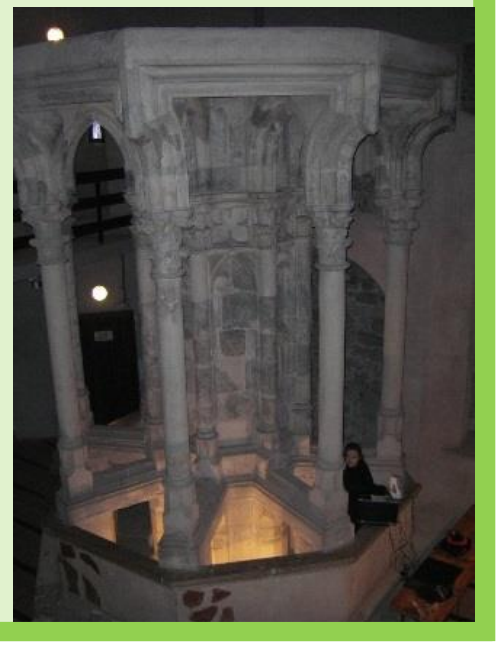
Our UAV couldn't record navigation data, therefore the GNSS coordinates of the ground control points were used for registering the UAV data in geodetic reference system. We used almost one thousand images for post-processing, the result point cloud has 47 million points.

Mensor 3D architecture

Surveying The Fountain



Locations of control points



We also supported the reconstruction procedure of some particular artifacts.
In case of the fountain the structured light and laser scanning technologies were used combined. The main body's geometry was captured by scanner, while Artec EVA SLS scanner was used for surveying the fine details. Some parts of the fountain were not surveyed onsite, but in the museum. Artec scanner is small, light, and easy to move around the objects.

Mensor 3D architecture

Surveying The Stove

Reconstruction of the stove
(Tibor Sabjan's drawing)

The stove – wich is from the same period and place like the originale insite of the tower – is covered by glazed ceramic tiles, it has very shiny surface. Breuckmann 3D structured light scanner was used to capture its geometry. The result is a TIN surface model complemented with texture by using images taken during the scans. Many elements of the stove are stored and presented separately in the museum.

Mensor 3D architecture

CAD

2D Drawings

The Tower

Floor plans	8
Ceiling plans	3
Sections	2
Top view	1
Facade views	6

To support heritage protection the detailed documentation have to be created based on the previously discussed acquired data.

To achieve additional thematic information, the orthogonal point cloud image was used as a layer under the vector drawing that provided information on the surface texture.

Besides the usual drawings, architect also need special products, like ceiling plans.

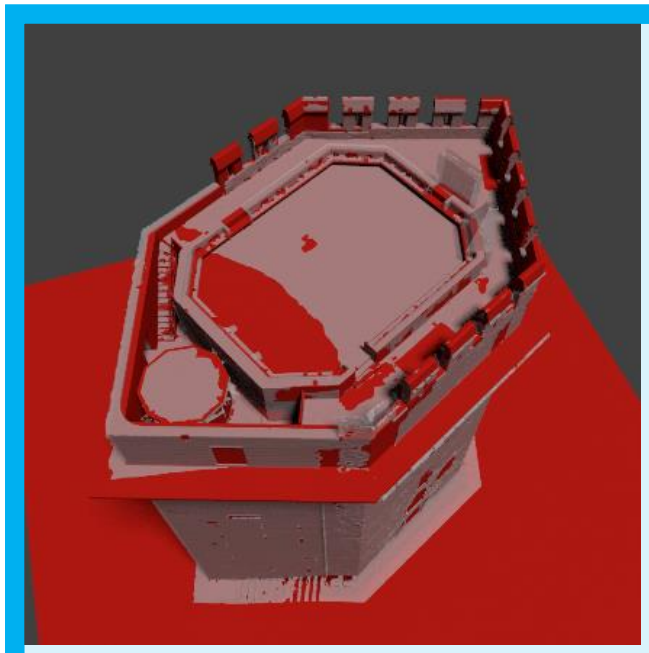
Mensor 3D architecture

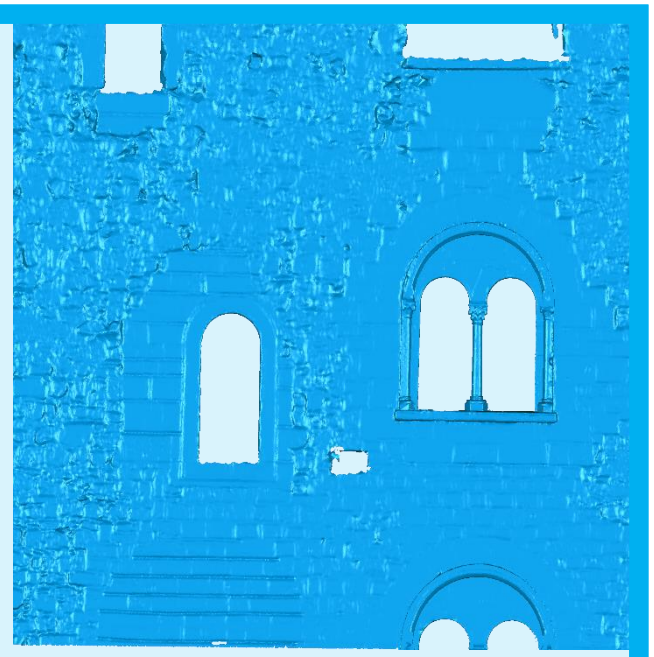
CAD

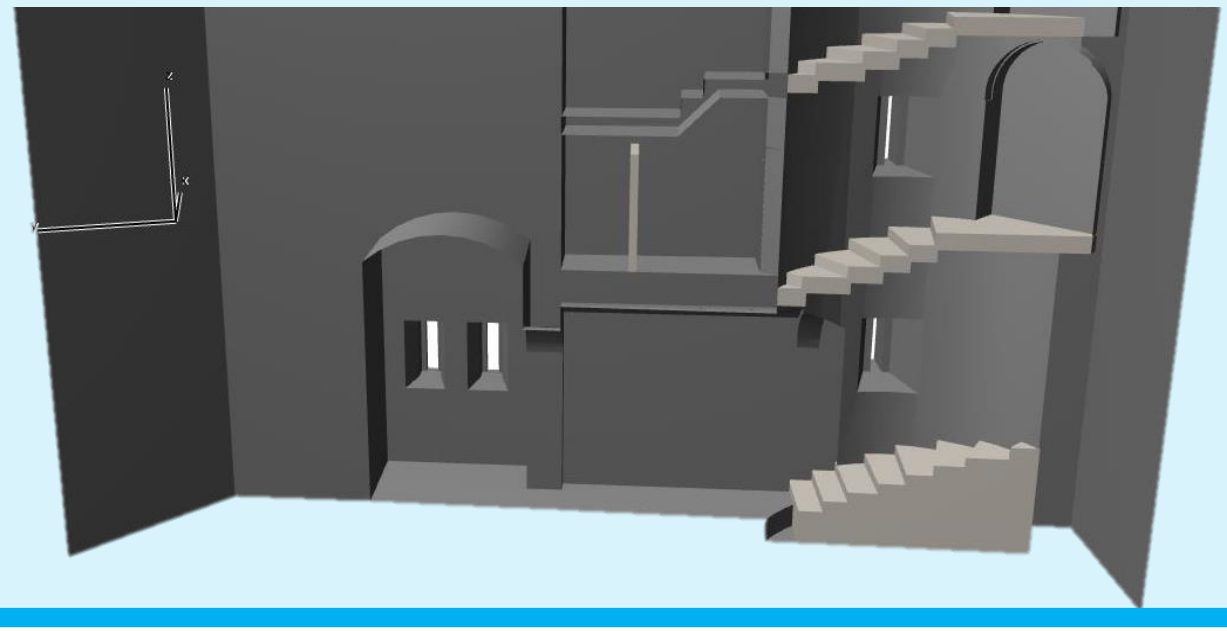
Modeling

The Tower

- BIM
- Visualisation
- 3D Print
- Research





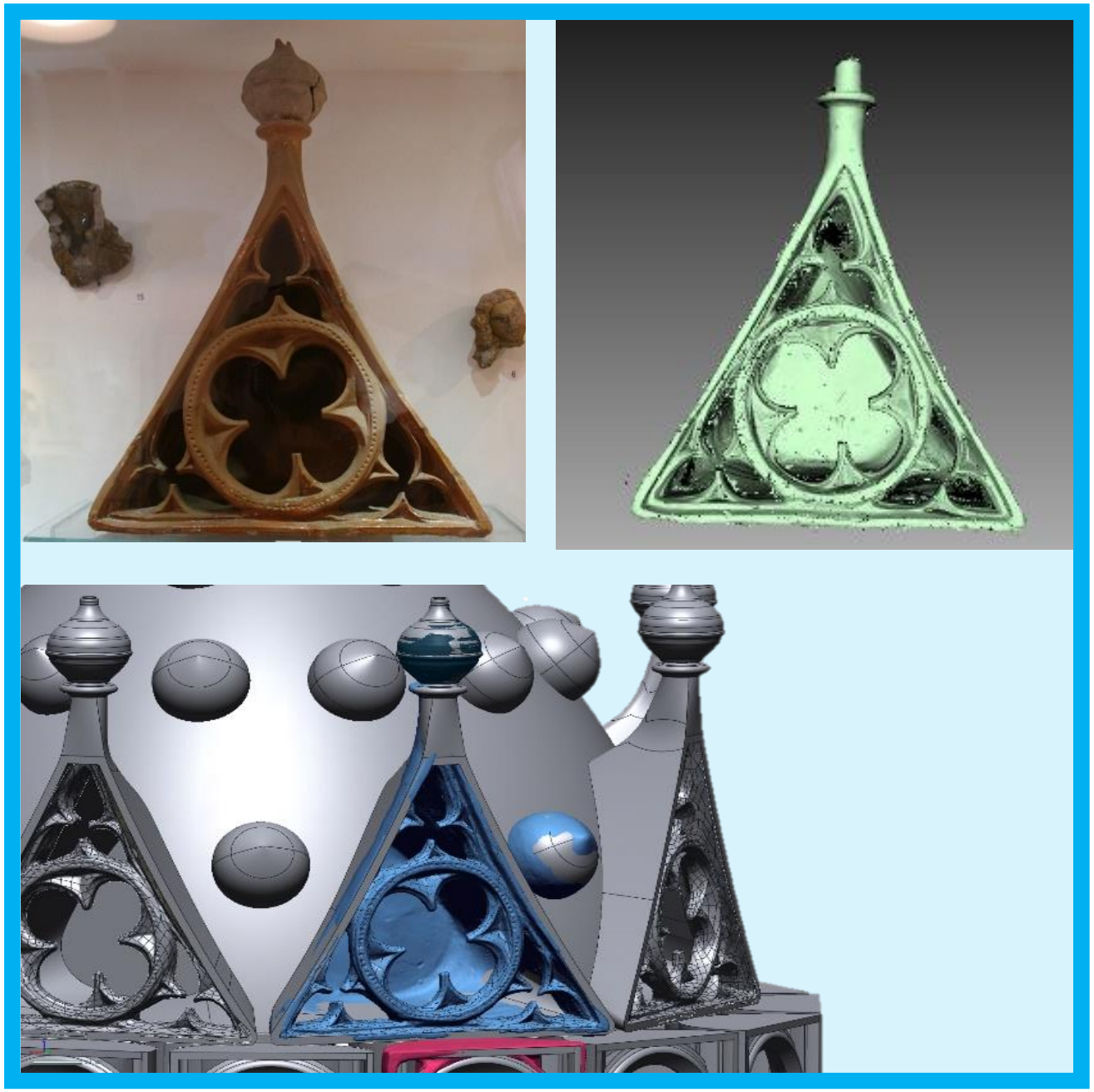


The 3D model of the building was also created based on the surveying. To achieve this goal the point cloud was cut to separate parts before modeling. The outer shell of the building, the staircase and the floors have been separated. The high point density enabled to create a mesh from the tower walls without gaps which is perfect for visualization purposes.

Mensor 3D architecture

CAD Modeling

The Stove

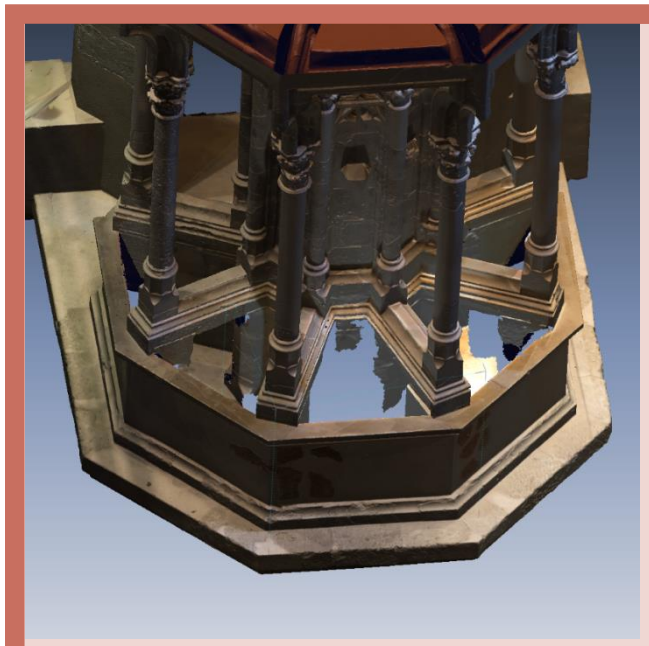


We also created the 3D CAD model of the stove and we virtually reconstructed it to its original state. Many parts of the stove are missing, we created sample CAD model and put them together into an integrated model. Each stove element was surveyed separately, the integrated model was created by the instructions of the art historian expert, Edit Kocsis.

Mensor 3D architecture

Surveyed Data to Augmented Reality

Visualisation techniques enable the realistic and interactive presentation of the current and past objects



The fountain was also surveyed and modelled. The result is a realistic, high resolution 3D model, which can be used for presenting it in virtual or augmented reality.

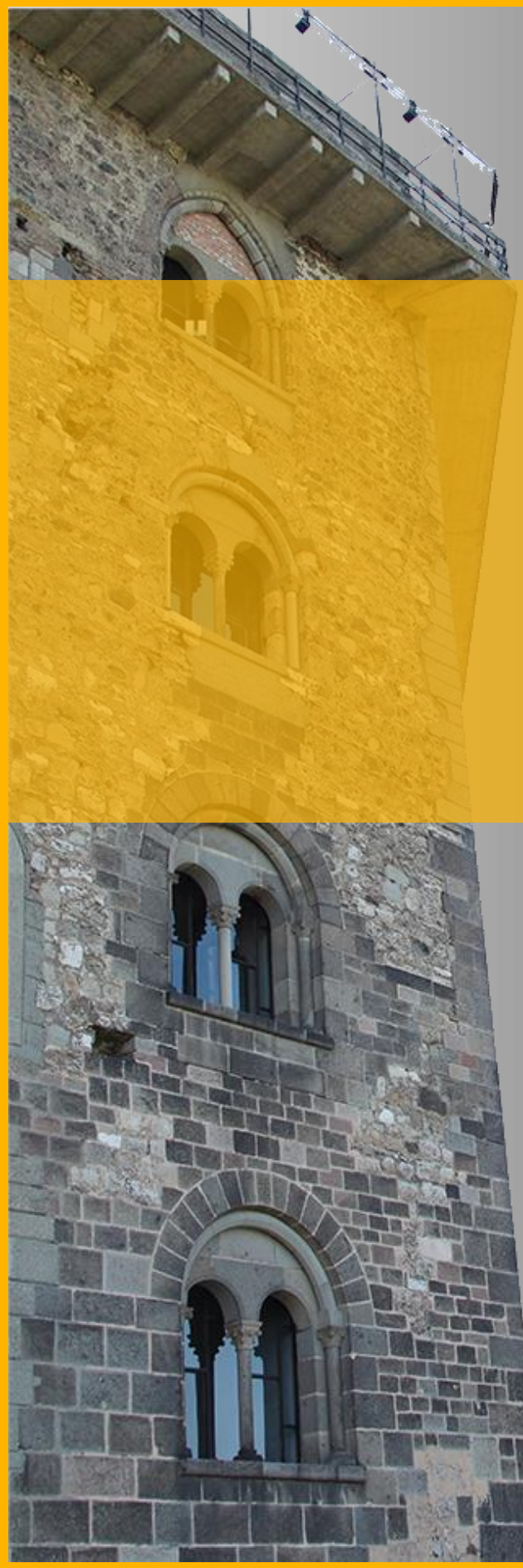
Mensor 3D architecture

Surveyed Data to Augmented Reality

- Researchers
- Educators
- Students
- Tourists
- Impaired people

Our objective is to share and introduce these scanned datasets and models and to create an interactive presentation. The model can be a virtual reconstruction of the present or even a previous state of the object. The colors and textures are very important, we can create very realistic models. These VR presentations can be extremely helpful to broad audience. This screenshot of a mobile application that enables seeing the fountain in 3D on you mobile's display.

Mensor 3D architecture



In our project we proved that the applied spatial surveying technologies (TLS, SLS, UAV) can effectively complement each other and therefore capable of providing a complete, state-of-the-art solution for engineering or other documentation tasks.

Mensor 3D architecture

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ASPRS Annual Conference, 2016, Fort Worth, Texas
http://conferences.asprs.org/Fort-Worth-2016/Conference/Proceedings