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# 3D Reconstruction & Traditional Illustrations, a Non-Invasive Resource for the Practice and Teaching of Conservation and Restoration of Cultural Heritage

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**Abstract**

Photogrammetry is the practice of determining the geometric properties of objects from pictures. Currently there are several techniques of photogrammetry, both in two and three dimensions that can also be used with video instead of images [1]. This paper seeks to bring traditional reconstruction techniques (through technical illustration) with new photogrammetric techniques focusing on Altarpieces restoring. Combining both we will obtain greater operability when watching and intervening the work, because such intervention will have been evaluated and supervised by a multidisciplinary team that will have contributed to the project design.



*Keywords:* Cultural heritage; 3D modelling; Illustration; Augmented reality; Teaching

## 1. Introduction

At the time of undertaking a study of morphological, structural and therefore the conservation status of an altarpiece to assess their possible intervention, the conservator-restorer needs to know the details of the piece. Photogrammetric reconstruction provides data in scale and in a more visual and clear way (especially for future professionals we teach today).

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Altarpiece is the architectural structure, painting and sculpture, which stands behind the altar in Catholic churches. The etymology of the word comes from the Latin retro tabula ("behind the altar"). To designate the same term is often used the expression "pieza de altar" (altarpiece) or Italian “Pala d’altare”.

For altarpieces, it is not possible to get a 360º reconstruction due to its architectural structure itself, forcing it to rest on the wall of the building where it is hosted. In these cases, we can only access to the area of the bank and obtain two-dimensional images from it.

These two-dimensional images can create a misconception of the location and composition of the work in its original context due to the distortion created by the lens when there isn’t enough distance to get the pictures.

## 2. Methodology

Using infographic specific software, it is relatively easy to create a three dimensional image from a series of snapshots of the object from different points of view. Thereby, we obtain a coordinate network with the main points in three-dimensional space but what about the backside? This will be carried out by traditional illustrations.

The standard methodology for Photogrammetry is:

- Camera calibration
- Data collection
- Image rectification
- Drawing
- Export to different formats

Fig. 1. Front view. Results obtained using traditional methodology

Methodology improved/modified for better understanding:

- Camera calibration
- Data collection: we included measures and colorimetric data
- Image rectification: using image-editing software we modified appropriately those pictures that have been taken out of the required parameters.
- Drawing: we created digital illustrations on the original images. Then we applied the colorimetric data obtained using a colorimeter with a suitable illuminant and within the parameters of colorimetric science. Thus, the images resulting from this mix will contain data and real appearance regarding the

human eye, allowing a better understanding of the piece, its state of preservation and the need to intervene or not on it.

- Export to different formats: in this case, the software Autodesk® ImageModeler™ allowed us to apply the enhanced images as new textures once the lifting and 3D modelling of the piece had been made. But obviously there is an endless of available software to perform the infographic task.
  We finally export the results to Autodesk® 3ds Max®, that provided a comprehensive 3D modelling, animation and rendering.
- Apply AR to results: finally, using a free application of AR, students were able to see the status of the piece through the 3D reconstruction of it, but this time with 360° and being able to handle it in space thanks to a code that we assigned previously to the modelling.

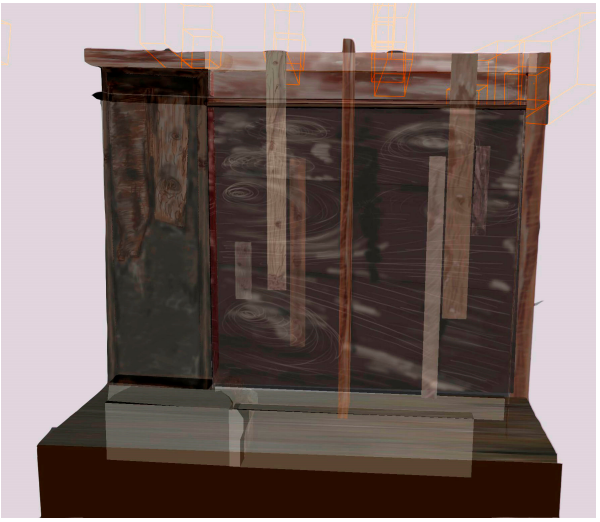

Fig. 2. Backside view

## 3. Results and discussion

Collaboration and user interaction: promoting remote collaboration between students or professionals means that each user controls his own independent viewpoint, but at the same time the displayed data can be different for each viewer. If we consider the differences between the existing restoration criteria, we could afford a virtual brainstorming about a virtual intervention so results could be better accepted by the professional community.

The work resulting from this will contain data and real appearance (remember that we have applied colorimetric data and actual measurements), allowing a better understanding of the piece, its state of preservation and the need to intervene or not on it.

### *3.1. Unsolved problems*

Creating objects manually in a 3D package produces excellent results but is time-consuming [2]. Fortunately this could be solved with greater collaboration between university departments.

Infrastructure problems: what kind of classroom context is needed to perform the educational potential of AR in it? Today students are gifted in hardware and software but it can happen that classrooms are not; therefore, a good review prior to these can help us avoid problems during practice.

## 4. Conclusions

Combining traditional techniques with 3D virtual resources we will obtain greater operability when watching and intervening the work [3], because such intervention will have been evaluated and supervised by a multidisciplinary team that will have contributed to the project design.

Regarding the educational context, it is time to practise what we preach. For decades we listened and learned that it is necessary to work in multidisciplinary teams and collaborate, but rarely becomes a reality in people's working.

On the other hand we are teaching by using various topics like: capacity for spatial vision, drawing, modelling, colorimetric aspects… This means that we manage students to solve multidisciplinary exercises to develop multidisciplinary projects.

Applying these techniques and resources in the classroom, we are not only teaching another way to work, but also encouraging these values and indirectly helping to an improvement in the quality of future Heritage interventions.

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