

# The Emergency Recording and Public Crowdsourcing of Materials for Cultural Heritage Digitization in Developing Postindustrial Regions of the Historical Cities

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## Abstract

The paper provides an overview of current heritage preservation status in Odessa, a city in the South of Ukraine. The problem with emergency recording is shown from the perspective of countries with low level of implemented digitization processes for cultural heritage preservation. In the cities like Odessa, where postindustrial regions of the historical city need to develop, construction of new buildings often gives rise to conflicts. In the depicted project, photogrammetry is used as a relatively inexpensive method for urgent scanning, and public crowdsourcing of photo materials is applied for finalizing the digitization of demolished cultural heritage.

Everything was built fast and with imperial pomp, although cheap and decorated with plaster and gypsum. Odessa, among other things, was planned as the southern resort, but this whole “imaginary subtropical summertime” was dispelled with winter frosts up to  $-30$  degrees Celsius ( $-22$  Fahrenheit).

Gyps is a plastic material prone to erosion, and about once every 10–15 years facades in the historical center require restoration. It is hard to keep up with all these monograms and sculptures built from the local limestone and lathing in need of recurring cosmetic repairs.

## Cultural Heritage devastation

Nowadays in Odessa, a large number of historic buildings belonging to cultural heritage are in poor condition. Besides, information for their accurate restoration is often absent or incomplete.

As recently as 2007, at least 130 buildings were excluded from the country’s Cultural Heritage Register and deprived of protection due to their severe natural and artificial ruination. Buildings lose authenticity, and with it the status of architectural heritage. It is a sadly common practice for

## Introduction

### City background

In the southern part of Ukraine, Odessa city stands out amongst other sea resorts on the Black sea shore with its distinctive cultural heritage. Founded only 223 years ago, during its rapid development as a seaport and trade center, Odessa was adorned with the works of prominent European architects of the time.



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Each historic building should be preserved not only in archival drawings; it must have photo fixation, color design, and 3D models, assembled in the form of a BIM project, together with other necessary documentation.

them to undergo further demolition or “reconstruction with changes” when height, proportions, and décor of the building are entirely altered.

Moreover, the classic approaches to restoration are still used when authentic decor and facade elements are removed to form physical molds for casting. Due to a manufacturing process where molds are combined from several parts of sculpture and then polished for casting, the final result after restoration is often unsatisfactory.

### Digital passport of cultural heritage

#### Concept of digital passport

Today we see the urgent need to create a new standard for digital storage of architectural monuments. Each historic building should be preserved not only in archival drawings; it must have photo fixation, color design, and 3D models, assembled in the form of a BIM project, together with other necessary documentation.

This documentation can be used for conservation and restoration work. Highly accurate 3D models can be materialized using 3D printing and milling. Furthermore, this digital profile can be used to create small

batches of plastic molds directly from the reversed 3D models, bypassing the process of forming the master model and the necessity for long-term physical storage of molds. This approach reduces the time and cost of restoration work, enhances the quality of its performance, and helps communicate with contractors.

#### ARCH F6 research and scanning project

The absence of a centralized contemporary database of monuments is one of the fundamental problems with cultural heritage that many cities and countries face nowadays. In Ukraine, the public organization Pixelated Realities started the ARCH F6 project to address this challenge in their country. To establish and fill the knowledge base, the team began to 3D-scan the historic buildings with a photogrammetry method for emergency digitization purposes. Using scanned materials, the team creates a database of accurate 3D models of the decor and sculptures, which form a single digital passport of a building.

#### Large scale photogrammetry calculations

The team uses the photogrammetry method not only for filling the database, but also to obtain the locations for virtual reality and

augmented reality apps. Such applications are used to show the problems of location and its potential for revitalization to the public and other stakeholders.

Photogrammetry is relatively inexpensive for public use because it needs only DSLR cameras and a drone to obtain a model of a whole building. The disadvantage of the method is that it requires enormous computing power.

Using a PC, even a relatively small batch of images may tie up the project for weeks

or even months of calculations. A large number of high-quality photos for 3D scanning demands vast data vaults, and model calculation based on these materials requires powerful and stable computing.

Pixelated Realities PO collaborated with Glushkov Institute of Cybernetics of NAS of Ukraine to obtain access to their supercomputer (Malenko, 2012). Due to the stable server and clusters with Tesla graphic cards, the team managed to calculate 3D models from up to 20000 images per project (Fig. 1).

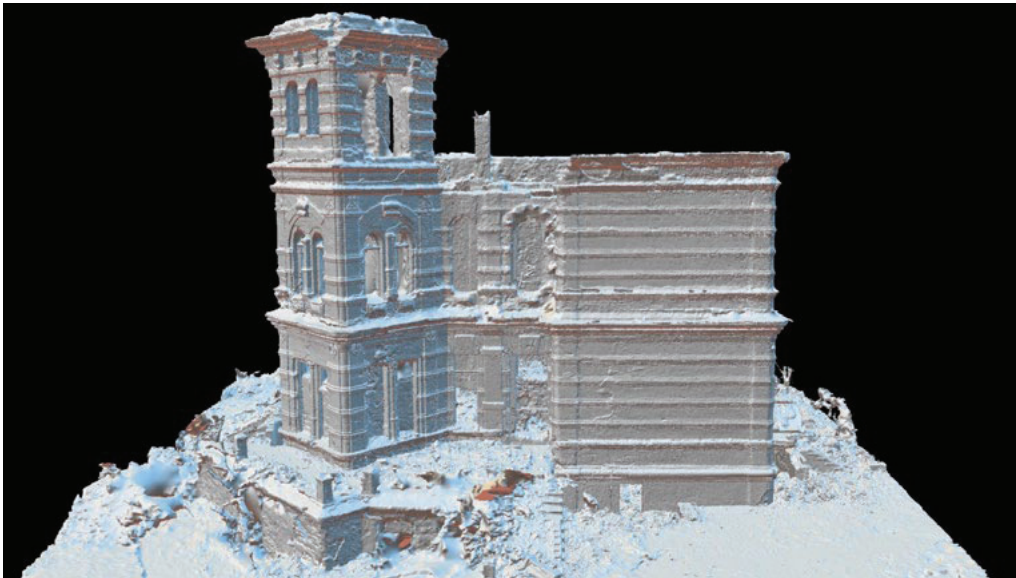


Fig. 1. Summer residence of Doks, mesh acquired from point cloud



### Emergency scanning use case

The first building to start the ARCH F6 project and receive a digital revival was the summer residence of Doks, a famous citizen of Odessa. The building was removed from the Cultural Heritage Register in 2007 and had to be demolished in the autumn of 2016 to build a new multi-storey building. In an extremely short time frame, the team shot over 5000 photos in three days.

Unfortunately, the building was ruined too early, and there was no opportunity to obtain aerial data. Activists called photographers and drone pilots of Odessa to

crowdsource aerial photography of the city to finish the digitization of the Doks residence. Luckily there were some video shootings and photos, which made it possible to align 3500 more pictures in the scanning project. The materials were calculated on the cluster to create a 3D model with the density of more than 1 billion triangles, which took about five days to finish (Fig. 2).

The decimated model was then put in an AR app for Android. In the application, an image triggers a full-scale 3D model of the building, which has positional tracking in the area the camera sees.



Fig. 2. Summer residence of Doks, textured mesh acquired from point cloud

Then the team put the postcard at the place where the Doks residence stood and shot a video with an augmented app launched where the building was positioned in its original place to address the ignorance about its demolition. The video supported the public discussion of the problem, and was widely shared by local media and citizens.

## Conclusions

This particular example shows how an emergency recording and public crowdsourcing can be used to preserve authenticity in developing postindustrial regions of the historic cities. The goal of the ARCH

F6 project is to research international experience of digitization use cases and create the unified open source standard of digital passport for cultural heritage database. Such a passport should be used as a role model for rapid crowdsourcing digitization of local sites, to further implement such methods in Ukrainian restoration processes, as well as push it into a country-wide standard.

## References

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