

# Challenges of Applying Reality Capturing Methods in a Post-Conflict Urban Context: The Digital Survey in the Old City of Aleppo.

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## Introduction

The rapid development of the field of digital cultural heritage provides an opportunity to reexamine the elements of heritage, whether they are buildings, sites, or artifacts. Novel and previously unattainable information can be discerned by relying on new technologies such as photogrammetry and laser scanning and their vast toolkits. The acquired data can be critical to understanding the history and development of built urban fabric and can shed light on the undiscovered aspects of heritage. But more importantly, it holds the utmost importance as an integral step of post-conflict strategies as it facilitates the rapid documentation of endangered heritage.

There are different guidelines for the best practices such as the ICOMOS Principles For The Recording Of Monuments Groups of Buildings And Sites, 1996. As well as documents specialized in laser scanning, such as the one provided by (Historic England, 2018). However, working in a post-conflict region demands different considerations when preparing the field survey in terms of data acquisition and management plans. The limited available equipment and infrastructure (such as access to electricity) put a huge pressure on the data acquisition process. Not to mention the fragile security situation, as well as the debris and unstable structures that pose a risk to the life of the team and the integrity of the equipment.

Therefore, speedy and well-calculated acquisition can trump a higher resolution and quality of data every time. As a result, the data acquisition plan should consider subdividing the survey area based on the degree of details in each category and allocate the appropriate setting to balance the time and accuracy of the acquisition.

In this abstract, the studied example is the digital survey conducted in Aleppo in 2018, in preparation for the Ph.D. dissertation titled "Digital Reconstruction of The Urban Morphology of The Old City of Aleppo from the Medieval to the Post-War City: the case of "Jallum and al- Aqaba Districts."

## Survey Planning and Workflow

The survey covers an area of 300, 000 m<sup>2</sup>, stretching from Bab Antakiya in the west to the Umayyad Mosque in the East, and from Bab Qinnasrin in the south to the Umayyad Mosque in the North. The

area was chosen because it incorporates elements that express the character and identity of the city.

The area exhibits the remains of the Hellenistic planning of Aleppo. In addition to two of the four surviving gates, three of the surviving defensive bastions, all connected by the remains of the defensive parameter. Moreover, it encloses an important section of the central markets, at least one example of important commercial, public, religious buildings, and a significant number of houses, some of which are encroaching on the walls of the city. Keeping in mind that the area was one of the least affected areas by the urban development projects of the 20<sup>th</sup> century, this makes it the perfect location to investigate the effects of time, climate, culture, religion, as well as the political atmosphere on the urban development and growth of a Middle Eastern city such as Aleppo.

The fieldwork started in April 2018 and continued until August 2018. During that period, a total of 1823 terrestrial laser scans were recorded using FARO focus 330X. Earlier, aerial Photogrammetry survey of the region was conducted in February 2018. Some terrestrial photogrammetry data was recorded as well, especially for the high-profile feature in important monuments. Yet, they were not included in the final model, since the data collected from the laser scanning and aerial photogrammetry proved to be sufficient for creating an urban 3ds model of Aleppo, and there was no cause to increase the resolution further.

### Challenges during the Laser Scanning Survey

For the survey, the area was divided into two sections. The first is from Bab Qinnasrin to al- Shibani Church in the north, and Bab Antakiya in the west, constituting the district of al- Jallum. While the other started from the borders of the first section until the street of Ibn Qays, which marks the northern edge of al- Aqaba, until souk al- Nahassin in the east and the Umayyad Mosque in the north. Only souk al-Sirmayatiyya and souk Istanbul al- Jadid were included from outside the studied area, in order to fully capture the southern and eastern façades of the Umayyad Mosque.



*Fig. 1. A laser scan preview of the top of the city's main market*

To effectively cover the wide extent of the studied area, multiple scanning resolutions were used: The highest being 1.5 mm @ 10 m, the average resolution is maintained between 10mm @ 10m and 7mm @ 10m. The lowest quality was around 50 mm @ 10 m. The resolution of choice was based on the following factors:

- The excessive heat and the repeated overheating of the laser scanner sometimes led to freezing and malfunctioning of the machine until it was turned off to cooled down. This resulted in shaking photos and point clouds that made the scans unusable. Sometimes under

extensive heat up to 20% percent of the scenes were not recorded by the device. A second acquisition was conducted to record the affected standpoints.

- The difficulty of restricting the movement of cars and pedestrians in the narrow and twisting streets-network.
- The bulks of rubbles restricted movement and the possible positioning of standing points for the device and inevitably the workflow of data-capturing and registration. This created several gaps in the recorded data that were compensated through the use of drone footage.
- The destruction of some stairs in several buildings made it hard to place the device on the stairs to connect the floors of the buildings. As a result, some roofs were accessed by moving from neighboring roofs. This can also include unstable structural elements such as roofs that made it dangerous to position the scanner in certain locations.
- Finally, the mass vegetation that grew in the buildings and over the rubble after the years of neglect and abandonment of the buildings. Which led to mass laser shadows and will require extensive cleaning of the point cloud. Suitably, point cloud segmentation is an ideal method to remedy this situation.



*Fig. 2. A view from the laser point cloud from the west above the Souks.*

### **Processing and On-field Data Management.**

Before the commencement of the survey, an initial CAD plan was prepared for the anticipated laser scanner standpoints. It considered the degree of the damage of the building/ street, the distribution of important monuments, and the corresponding important architectural elements.

As expected, managing the data on the field proved to be challenging. Due to the overheating of the scanner, each of the scans had to undergo a quality check. An initial alignment was also conducted to ensure a proper overlap and good alignment result, which was also challenging because of the situation of the electricity and the bulky size of the data. The software used for the alignment of the

scan is Autodesk Recap. Four overlapping subfiles were created to facilitate the testing of the scans while maintaining reasonable file sizes and processing times. When corrupted scans were identified, a replacement scan was conducted, and the new scan replaced the corrupted one in the raw-data folder.

Unsurprisingly, processing the photogrammetry point cloud and combining it with the one from the laser scans could not be conducted in the field given the lengthy period of processing that could not have been maintained due to the electrical blackouts.

Digital documentation has proved to be a crucial element of preparedness planning and a valuable tool for post-conflict rapid risk assessment. Eventually, despite the discussed challenges, it is possible to conduct an efficient survey with an old laser scanner, a camera, and one medium-priced laptop.

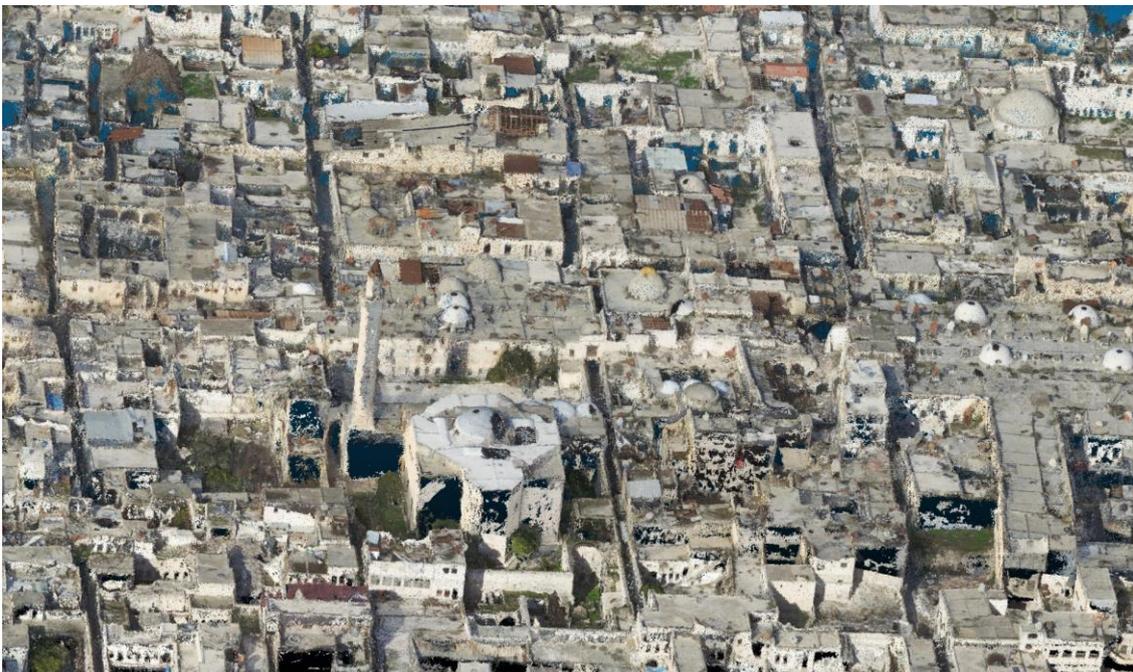


Fig. 3 A view from the combined point cloud showing al- Bahramiyya Mosque.

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## Conflict of Interests Disclosure

The author declares no conflict of interest.

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