

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 in documentation, such as the ICOMOS Principles For The Recording Of Monuments Groups of Buildings And Sites, 1996. As well as documents focused on the standards for digital documentation, such as the “*3D Laser Scanning for Heritage*” 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 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, the data acquisition plan should consider balancing the time spent on the field with an adequate data resolution that facilitates further scientific analysis. As a result, the data acquisition plan should consider subdividing the survey area to smaller categories based on the degree of architectural or urban details in each category and allocate the appropriate settings and equipment 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 “al- Jallum and al- Aqaba Districts.”

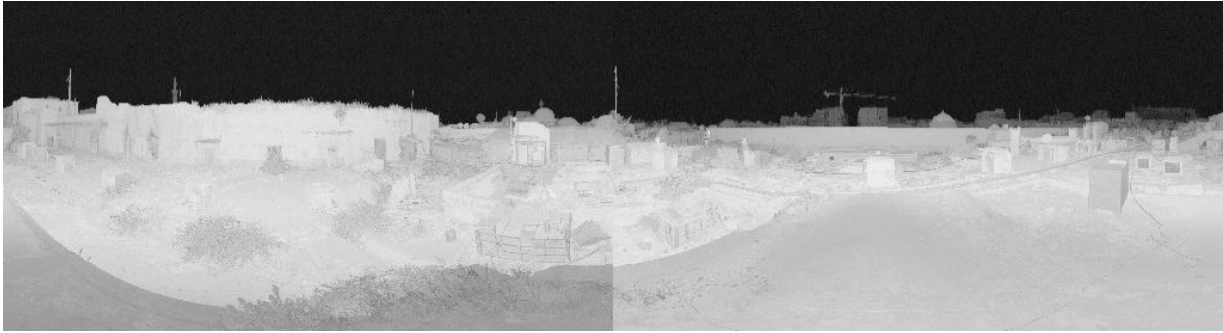


Fig. 1. A laser scan preview of the top of the city's main market. (© Author).

Survey Planning and Workflow

The survey covers an area of 300, 000 m², 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 walls. 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 20th century. Such urban and architectural characteristics provide a starting point 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, an aerial photogrammetry survey of the study area 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 the area (Figure 1), 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 facades of the Umayyad Mosque.

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 10 mm @ 10m

and 7 mm @ 10m; while the lowest quality was around 50 mm @ 10 m. The resolution of choice was based on the following factors:

- The excessive heat caused the repeated overheating of the laser scanner, as well as occasional freezing and malfunctioning. Therefore, the machine was turned off to cool down. This resulted in blurry photos and point clouds that rendered the scans unusable. Sometimes a portion of up to 20% of the scenes was not recorded by the device under extensive heat. A second acquisition was conducted to recapture the affected standpoints.
- The difficulty of restricting the movement of cars and pedestrians in the narrow and twisting streets-network.
- The bulks of rubbles that restricted movement and the possible positioning points for the device and inevitably the workflow of data-capturing and registration. This created several gaps in the recorded data that were compensated for with drone footage.
- The destruction of stairs in some areas made it hard to place the scanner in a transitional standpoint to connect the floors of the buildings. As a result, some roofs were accessed through the neighboring roofs. Moreover, unstable structural elements such as roofs made it dangerous to position the scanner in certain locations.
- Finally, mass vegetation that grew in the buildings and over the rubble after the years of neglect and abandonment, resulted in mass laser shadows that required extensive cleaning of the point cloud.

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.

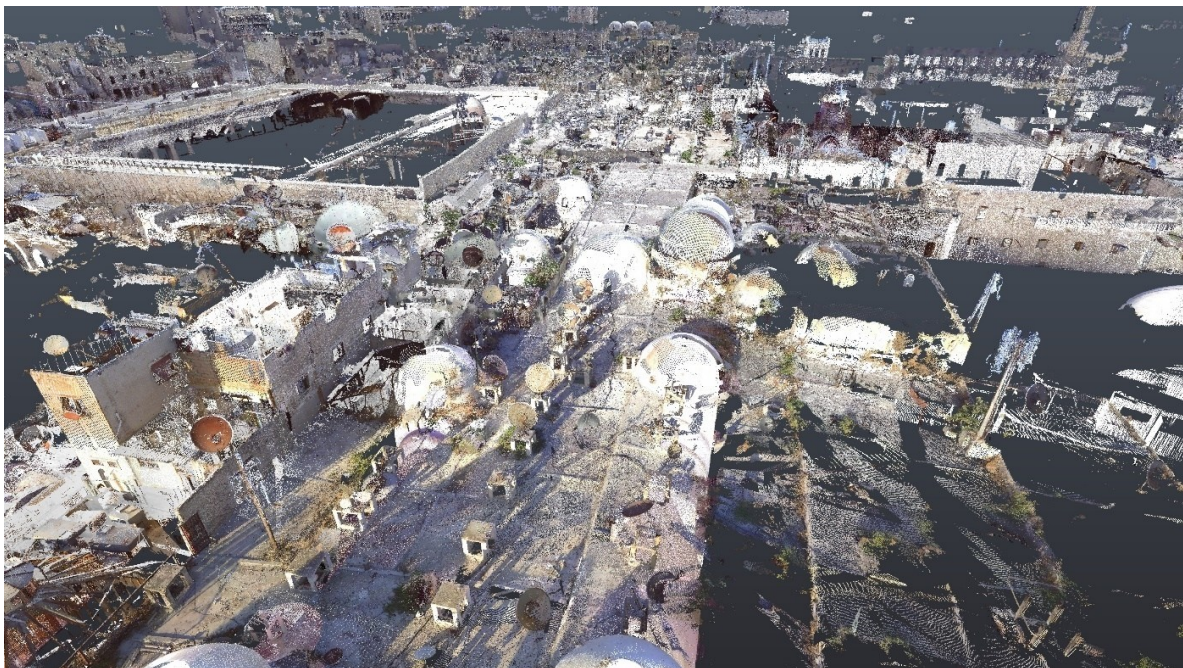


Fig. 2. A view from the laser point cloud from the west above the Souks. (© Author).



Fig. 3. A view from the combined point cloud showing al- Bahramiyya Mosque. (© Author).

As expected, managing the data in 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 big 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 because of 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 (Figures 2, 3).

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Conflict of Interests Disclosure

The author declares no conflict of interest.

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