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3D modeling of Mersin Sarisih Caravanserai with wearable mobile LIDAR

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Abstract

A 3D model was produced by scanning the Sarşıh Caravanserai in Tarsus, Mersin with a Wearable Mobile LIDAR (GML). In the study, it has been seen that the effect of disrupting the SLAM algorithm in areas where walking is difficult due to terrain obstacles is reduced by using Ground Control Point (GCP). Cultural heritage can be documented with GML and in this way, our immortal culture can be inherited to future generations with its 3D model.

Introduction

Sarisih Caravanserai is our cultural heritage, which is thought to have been built during the Principalities Period. Sarisih Caravanserai is located in the Sarisih neighborhood of Çukurbağ village, approximately 50 km north of Tarsus. Its geographical coordinates are at 37012'55'' north latitude, 34048'25'' east meridian, and it is located on the side of the Tarsus-Ankara highway. It is known that the building was used as a factory for soda production for a while. Small boat-shaped pools were built inside the building. It is reported that the building was later used as an animal barn by the villagers. The original state of the interior of the building has deteriorated. It is understood from the changes in the wall thickness of the building, which has eight arches, that the building was repaired at different times, and the difference in the stones used. Horosan mortar was used in the building, the stone top of the building was covered with concrete [1].

Nowadays, it has become a necessity to use modern technologies in documentation studies. Laser scanning, unmanned aerial vehicles and photogrammetric methods are used extensively for measuring historical artifacts and surveying [2-18].

Sarşıh Caravanserai was scanned with GML and modeled in 3D. In the study, SLAM errors were tried to be reduced by using GCP.

Material and Method

The WML Gexcel Heron Wearable 3D Mobile Mapping System we used in this study. Gexcel Heron System was launched in 2015. The system, which uses the SLAM algorithm, can be used wherever a person can walk. The system can be used to measure anything visible to the non-moving eye during scanning. System offers 3D point cloud and 5K panoramic view.

Gexcel Heron WML is a 16-channel Velodyne Puck LITE laser scanner that emits infrared laser beams at a wavelength of 903 nm and provides 300,000 points per second in single rotation mode from 360 degrees horizontal vision and 30 degrees vertical vision, has a range of 100 m. The laser scanner sensor is combined with an XSens MTI, IMU, whose data is used in system trajectory prediction. While surveying, the scan head is mounted on a telescopic carbon fiber pole, connected to a battery and a control unit. The LIDAR scanner head is used by mounting on a pole. Jalon can be carried upright by hand or placed in a pocket attached to a belt [19-20].

The mobile laser scanner used in this study is the Heron wearable Lidar device produced by Gexcel. It is a 16-channel Velodyne Puck LITE laser scanner that emits infrared laser beams at a wavelength of 903 nm and provides 300,000 points per second in single rotation mode from 360o horizontal sight and 30o vertical sight. Its range is 100 m. The laser scanner sensor presents the data by combining it with an XSens MTI, IMU used in system trajectory prediction. While surveying, the scan head is mounted on the fiber mast, connected to a battery and a control unit. According to the manufacturer's specifications, the system provides a local accuracy of 3 cm and a global accuracy of 5 cm [19-20].

For the measurement of the caravanserai, scanning was carried out by creating an open and closed route using and without the Ground Control Point.

Methods of working in the field

A total of 4 GCPs, two GCPs each inside and outside the caravanserai, were established. A controlled method was followed by stopping by the GCP in the form of an open route, considering that the land does not allow passage to go around the structure and the route would be unnecessarily long (Figure 1). Two of the ground control points were measured with GNSS and the other points were measured with a total station (Figure 2).

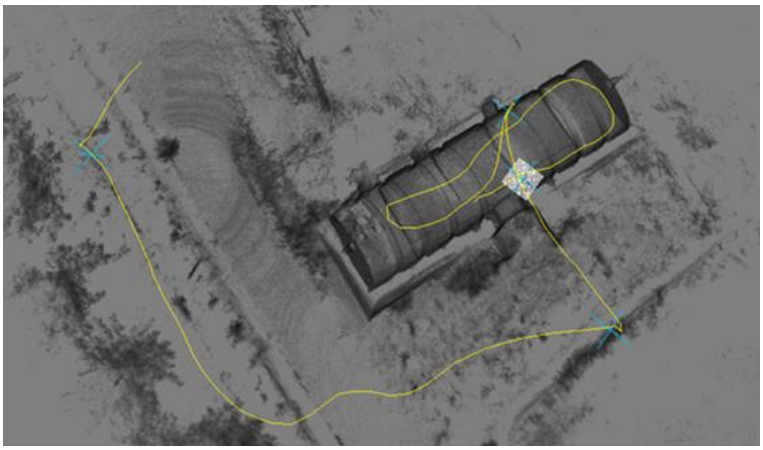

Figure 1. The shape of the route and the caravanserai (marked places GCP)

Images obtained from the caravanserai and field studies are shown in Figure 2.

Figure 2. GCP measurement and GML

3D modeling of the caravanserai using GCP

A clear route was followed across the terrain, passing through all checkpoints. The route was completed in about 6 minutes. As a result of the transformation and balancing, the largest RMS value was 4 cm. The 3D point cloud of the Sarisih caravanserai is shown in Figure 3.

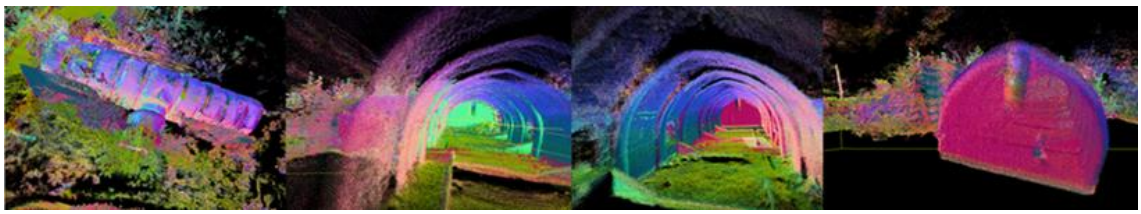

Figure 3. Sarisih Caravanserai 3D point Cloud

The distance between two opposing columns in the field was 7.00 m. The same length was measured as 7.01 m on the 3D model, and 6.99 m in the horizontal section taken on the point cloud. In the field, the distance between two adjacent columns was measured as 3.83 m. The same length was measured as 3.82 m on the 3D model, and 3.85 m in the horizontal section taken on the point cloud. The distance between two opposing columns in the field was 6.97 m. The same length measured 6.93 m on the 3D model. The average of the wall thickness on the façade, where the south entrance door of the building is located, was measured as 1.50 m in the horizontal section (Figure 4).

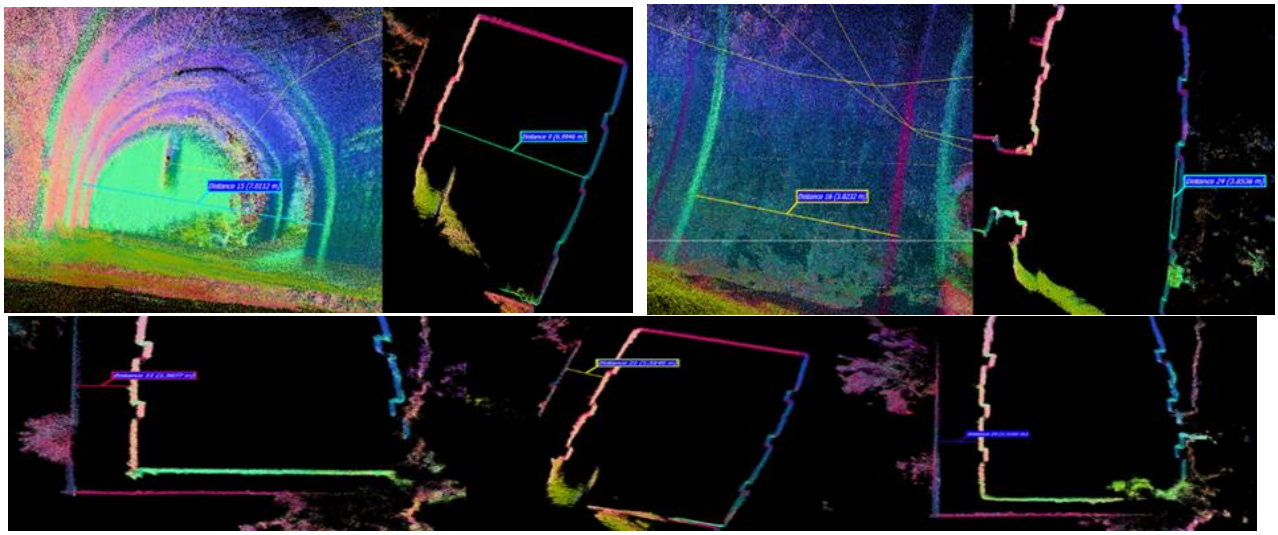

Figure 4. Length measurement in section and 3D models

Results

Comparing the lengths measured in the field with the lengths measured from the model, it was calculated below 5cm.

Discussion

In the process stages of the study, it was observed that the faults in the defected lands and the vineyards grew. in this case, errors are reduced when using the GCP point.

Conclusion

In order to obtain the correct data in documentation studies, documentation studies have now left their place to modern documentation techniques with the developing technology. One of these technologies is GML technology.

In this study, as a result, it has been seen that it is possible to document and map the historical heritage in 3D with GML technology using the GCP point.

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