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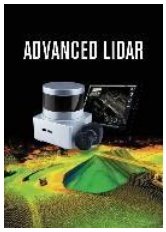

Availability of Iphone 13 Pro Laser Data in 3D Modeling

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Keywords
Lidar,
Photogrammetry,
İphone 13 Pro,
Diyarbakır.

ABSTRACT

Today, photography and, accordingly, photogrammetry approach are used extensively in the documentation of cultural assets and the creation of three-dimensional models. Many advantages such as speed, accuracy and digital processing provided by photogrammetry have been effective in this widespread use. With the developing technologies, the reduction of sensor sizes has opened new doors in digital data production. As of 2020, it has been possible to integrate laser scanning sensors into mobile devices. For the first time, with the iPad Pro and iPhone 12 Pro devices, Apple started to use the built-in LiDAR sensors in its non-professional devices as well as the digital camera. This situation has opened up new opportunities in the documentation of cultural heritage. In this study, three-dimensional models of the historical Aslanlı fountain in İçkale of the Centre Sur district of Diyarbakır province were produced using both photograph and laser data of iPhone 13 Pro and the results of the two data were compared.

1. INTRODUCTION

The preservation and promotion of cultural heritage is becoming more and more popular day by day. For this, promotion is very important. Cultural Heritage makes the city effective in terms of social and representation of the city's identity. When documentation, presentation and communication are used effectively, the city can be promoted correctly. (Korunmaz vd. 2011; Oruç, 2021; Yakar ve Yılmaz, 2008; Alptekin and Yakar., 2020; Alptekin et al., 2019a).

Metric, written and visual documentation provides benefits in determining the problems of cultural heritage and transferring this heritage to future generations. Today, documentation studies have become very rich in terms of method diversity together with technology. In this respect, making the cultural heritage permanent with documentation methods ensures that the city develops and makes it important socially, culturally and economically. (Yakar vd., 2005; Uslu vd., 2016; Yaman & Kurt 2019; Alptekin et al., 2019b; Altuntas et al., 2007; Ulvi and Yakar, 2014).

Recently, many attempts have been reported regarding 3D documentation and modeling of small artifacts using various methods or approaches. The basic feature of digitizing a work as a small object may vary depending on its size. (Yakar vd., 2009; 2010).

Photogrammetry provides significant opportunities for three-dimensional location information, spatial analysis, simulations and visualization for cultural heritage.

3D models created with the photogrammetry method are formed in real size and appearance. Photogrammetric measurement systems allow the real object geometry to be determined as well as modeling the object with its georeference. In addition, these

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technologies allow 3D models with real images, especially since they are processed with the real image of the object (Ulvi vd. 2020; Şenol & Kaya 2019; Yılmaz and Yakar., 2006a; Yılmaz and Yakar., 2006b).

Lidar (Light Detection and Ranging) technology has been used in various fields since it entered our lives. It is used for 3D modeling of structures, restoration, natural disasters, coastal protection, forest management and determining the amount of deformation in bridges. (Alptekin vd. 2019b).

With the laser scanner, millions of points are shot at the object within minutes, and the points that hit the object and return are recorded. There are three types of laser scanners: air, terrestrial and mobile. (Alptekin, Yakar, 2020; Ulvi et al., 2014; Yakar et al., 2009; Yakar et al., 2014)

As a data collection tool, laser scanning devices integrated into mobile phones and tablets have been used in recent years.

In this study, the Aslanli fountain was scanned using the iPhone 13 pro lidar sensor.

2. WORKING AREA

The historical Aslanlı fountain at the entrance of the inner castle, located in the central Sur district of Diyarbakır, was chosen as the application area. 19th century The Aslanlı fountain, dated to the end of the B.C., was built from neatly cut basalt stone. The fountain is enclosed in a low arched niche. At the top, there is a triangular pediment that draws attention on two white short columns, and the fountain is crowned with this pediment. Water flows from the mouth of the lion, which was originally placed in a niche with a three-slice arch. (URL-1)

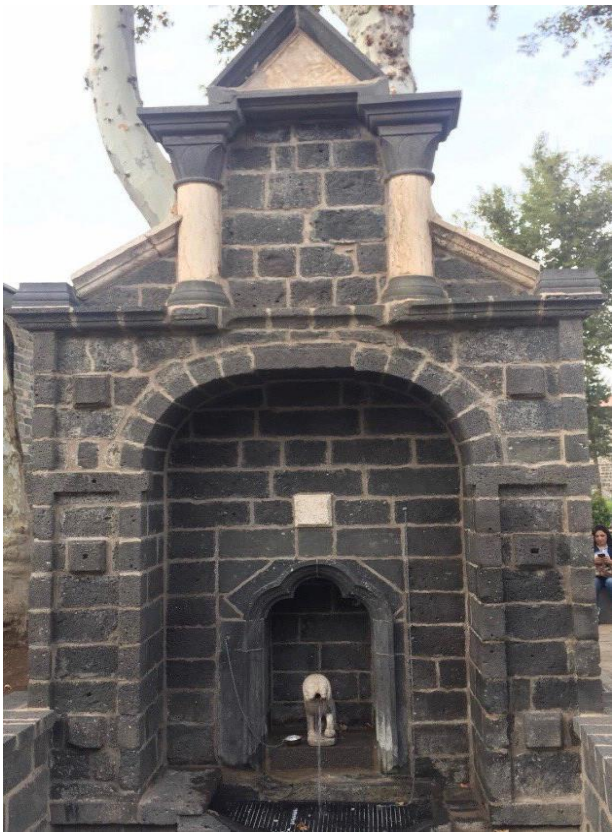

Figure 1. Aslanlı fountain(URL-2)

3. METHOD

In the application, both Photogrammetry and Lidar studies were carried out.

Lidar application was realized with Iphone 13 pro laser sensor. The photogrammetry application was taken with the same device, the iPhone 13 pro camera.

3.1. Lidar Sensor

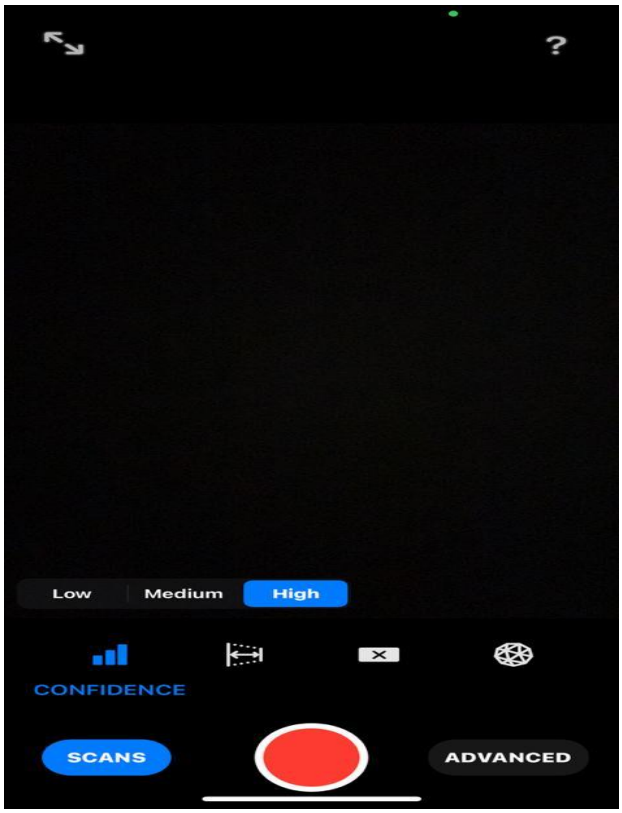

Figure 2. Product quality in lidar measurement

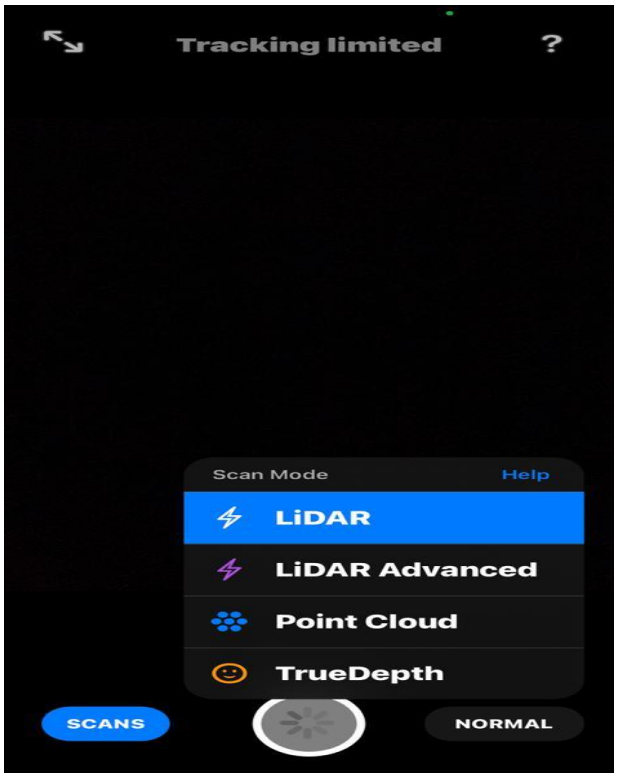

Figure 3. Four different lidar measurement methods

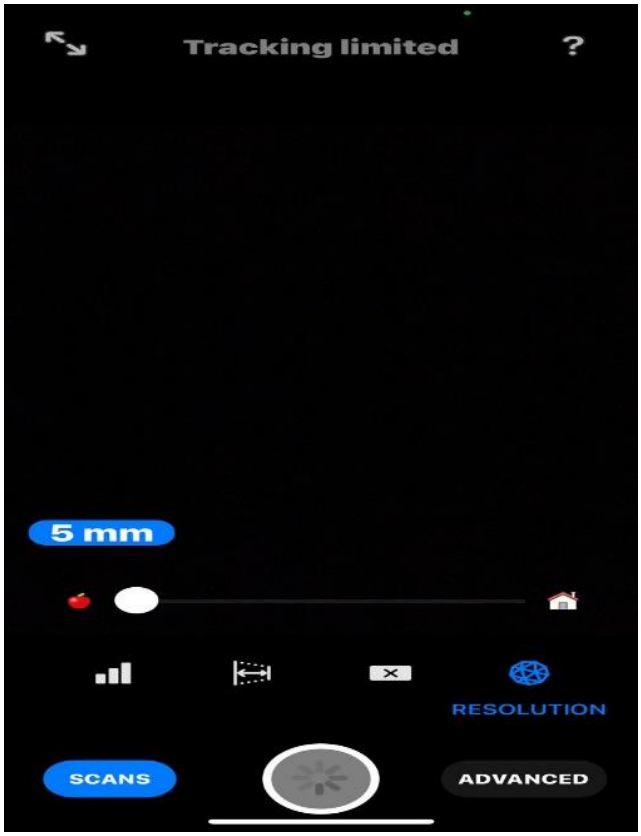

Figure 4. Cloud spacing for smallest object

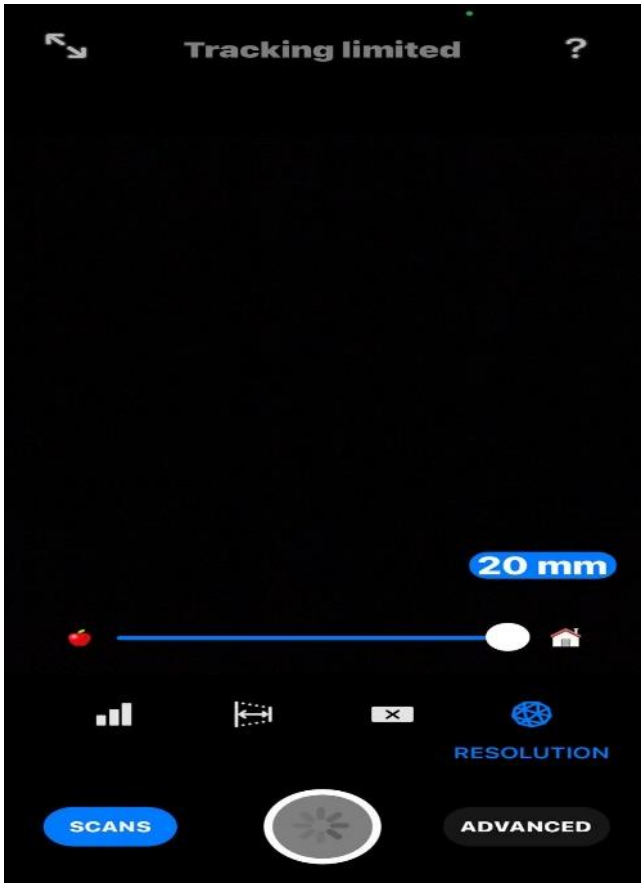

Figure 6. Cloud spacing for largest object

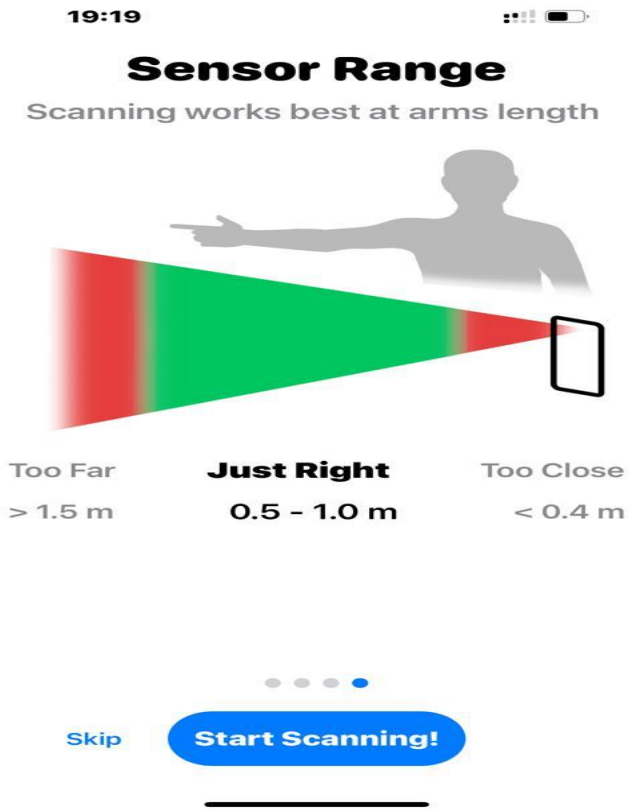

Figure 7. Top quality lidar scan distance range

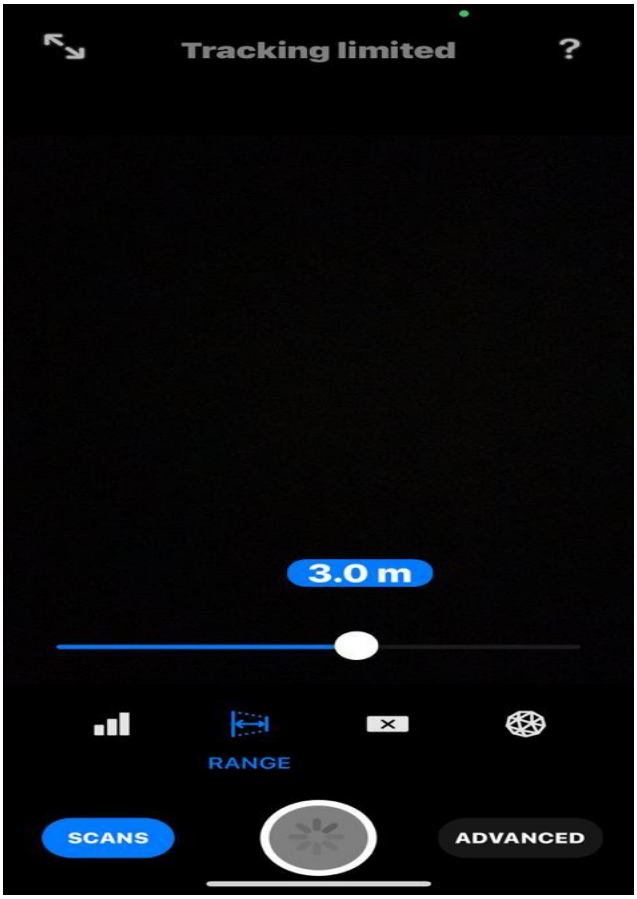

Figure 8. Object scanning distance range 1m-5m

3.2. Camera Sensor

The camera features on the iPhone 13 pro are as follows:
-12 MP Pro camera system: Telephoto, Wide and Ultra Wide cameras
-3x optical zoom, 2x optical zoom; 6x optical zoom range
-Up to 15x digital zoom
-Portrait shooting in Night mode with the help of LiDAR Scanner
-Portrait mode with advanced bokeh effect and Depth Control
-Portrait Lighting with six effects (Natural, Studio, Contour, Stage, Stage Mono, High-Key Mono)
-Sensor-based optical image stabilization (Wide)
-Six-element lens (Telephoto and Ultra Wide); seven-element lens (Wide)
-True Tone Flash with Slow Sync
Panorama (up to 63 MP) (URL-3)

4. RESULTS

4.1. Photogrammetric analyzes

-Photogrammetric point cloud 4128860 points.
-Photogrammetric point cloud is denser (average 320 nkt/m2)
-There is no access to the battlement in front of the fountain.
-Data collection and processing takes longer.
(no device heating and battery restrictions)
-There are too many unnecessary points in the areas outside the object.
-Object integrity is broken in areas that cannot be photographed.

Figure 9. Photogrammetric point cloud

4.2. Lidar application analysis

-Point cloud with iphone 13 lidar, 504126 points.
-Less dense than photogrammetric point cloud (average 40 nkt/m2)
-Laser beams reach into the loophole in front of the fountain
-Data collection and processing is shorter.
(there are device heating and battery limitations)
-Less due to unnecessary point orientation in non-object areas.
-Object integrity is broken in areas that cannot be scanned.

Figure 10. Point cloud with lidar

As seen in the figure below, the point cloud distance between the two applications is 11 cm.

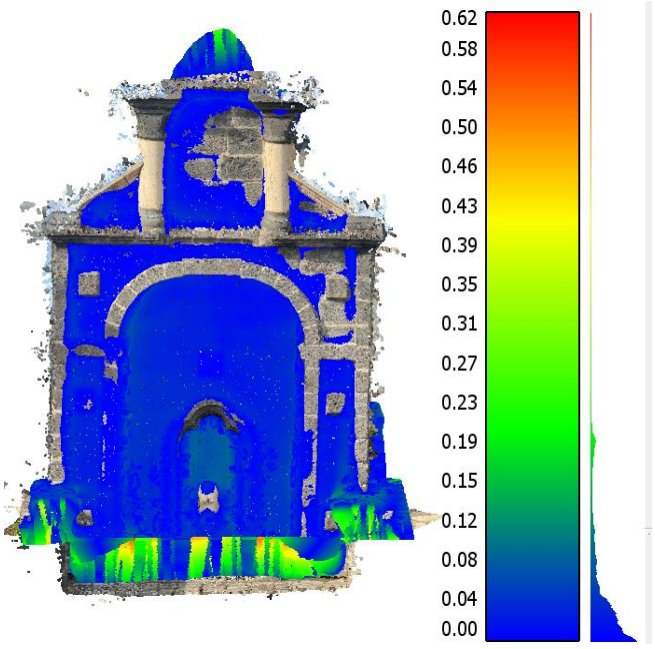

Figure 11. The average distance between two point clouds is 11 cm.

5. CONCLUSION

-The iPhone 13 lidar sensor can be used to collect data on short-term outdoor objects.
-Repeat scanning is possible to increase data density.
-It can be used integrated with the photogrammetric point cloud.
-It can be used in 3D models due to the built-in camera integration.

Author contributions

The authors contributed equally.

Conflicts of interest

There is no conflict of interest between the authors.

Statement of Research and Publication Ethics

The authors declare that this study complies with Research and Publication Ethics

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URL-3 https://www.apple.com/tr/iphone-13-pro/specs/.