Cultural Heritage and Science – 2023, 4(1), 31-39

Cultural Heritage and Science

https://dergipark.org.tr/en/pub/cuhes

e-ISSN 2757-9050

Documentation of cultural heritage with technology: Evaluation through some architectural documentation examples and brief looking at AI (Artificial Intelligence)

Adem Yurtsever*[1]

[1]*Anadolu University, Department of Archeology, Eskişehir, Türkiye*

Keywords
Pamphylia
Gymnasium
Digital Cultural Heritage
Terrestrial laser scanning
AI-ChatGPT

Research Article
DOI:10.58598/cuhes.1278735

Received:07.04.2023
Revised:18.04.2023
Accepted:20.04.2023
Published:12.05.2023

check for updates

Abstract

Documenting and transmitting cultural heritage to future generations is an important task and responsibility for individuals involved in the field of archaeology. To fulfill this responsibility, it is necessary to make the most of today's technology. Therefore, it is inevitable to benefit from the documentation methods brought by technology, which has been increasingly prevalent in recent years. The main reason for this obligation is the necessity of documenting cultural assets with the most accurate documentation methods possible. This ensures the protection of cultural assets and excavation sites, as well as the transmission of data to the future. This study will present for the first time the documentation methods used in the Gymnasium structure located in the ancient city of Side in the Pamphylia Region, along with the results obtained. In addition, Artificial Intelligence (AI-ChatGPT) was loaded with examples presented in this study through applications at Side ancient city in Pamphylia Region, and a report was requested on the article. The AI prepared an independent report based on the examples presented in the article. The report has shown that in the future, AI technology will be able to collect and evaluate data to reach a conclusion and prepare an article on the subject. This study is important because it combines the documentation of cultural heritage, the use of technology and the analysis of artificial intelligence.

1. Introduction

Ancient Pamphylia is the region that covers the fertile plains of today's Antalya province, and the Taurus Mountains border this region northward. The Taurus Mountains are an important factor in forming the climatic conditions of the region and in settling. There are important ancient cities in the Pamphylia region and one of these cities is Side, an Eastern Pamphylia city. Its buildings from the Roman and Byzantine periods, most of which are still standing, make this ancient city stand out [1-11].

An important public structure belonging to the Roman Imperial Period, called Gymnasium, was discovered in the ancient city of Side in the Pamphylia Region [3,5]. This building was first identified as the State Agora [3,5, 12-14], then different ideas were put forward about this definition [15-17], and recent studies have shown that this building was a Gymnasium [18-21].

The Gymnasium measures approximately 70 x 90 meters. It is understood that the building is a quadriporticus surrounded by stoai and designed in a Rhodian type peristyle plan. Located behind the East Stoa, there are three closed private places. Although these private places were initially identified as libraries, recent research has shown that the central space was the Emperor's Hall (Kaisersaal). The function of the rooms to the north and south of the Emperor's Hall is controversial. The one to the south was probably the meeting hall of the city's Sacred Gerusia (Banketsaal), while the place located to the north must have been related to the functioning of the Gymnasium [19-21].

With its general characteristics, this building has been dated to the Late Hadrianic - Early Antonine Period based on the style features of the architectural elements. However, findings indicating different construction phases have also been identified, and the use of the Gymnasium continued until the end of the 6th century AD

* **Corresponding Author**

*(yurtsever.adem@gmail.com) ORCID ID 0000-0002-6727-9873

Cite this article (APA);

Yurtsever, A. (2023). Documentation of cultural heritage with technology: Evaluation through some architectural documentation examples and brief looking at AI (Artificial Intelligence). Cultural Heritage and Science, 4(1), 31-39

- the beginning of the 7th century AD. After this date, the use of the structure ended [20] (Figure 1-2).

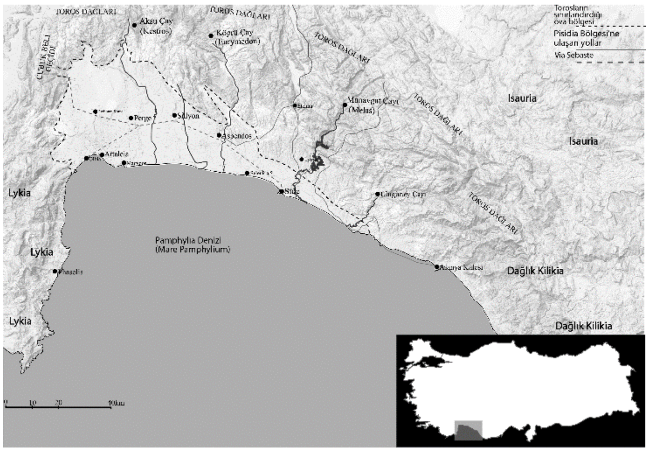


Figure 1. The Map of Ancient Pamphylia Region

Figure 2. Perspective-free aerial photograph of the Gymnasium in Side, obtained with Agisoft Metashape.

In addition to the briefly mentioned characteristics of the Gymnasium of Side, the main focus of this study is the documentation methods performed with different techniques. These documentation methods include aerial photography and terrestrial laser scanning. However, the findings obtained from terrestrial laser scanning have been combined with traditional documentation methods to document cultural heritage. In this study, the documentation method of the structure will be discussed for the first time. However, this research does not aim to explain the working system of terrestrial laser scanning technology. The main aim is to demonstrate how useful terrestrial laser scanning technology can be in documenting immovable cultural heritage and to present the benefits of using scientific methods together in documenting cultural heritage.

2. Material

The material group to be discussed in this study varies. Therefore, first, the outputs obtained by aerial photography and the results obtained by processing these outputs will be introduced. Thus, the first material group consists of the immovable cultural asset itself. The second material group consists of marble blocks belonging to the room named as the Emperor's Hall with an aedicular design. Thanks to the documentation of this marble material with a terrestrial laser scanner, not only the façade design of the Emperor's Hall has been reconstructed, but also a work towards the preservation of the cultural asset has been carried out with accurate documentation.

3. Method

In recent years, the use of aerial photography and terrestrial laser scanning has increased significantly in documenting cultural heritage sites and archaeological areas [22-27].

With rapid developing technology, modern documentation techniques take the place of conventional documentation techniques, and this has provided the improvement of contemporary documentation techniques [28-29]. Spatial applications such as simulation, animation, modeling and field imaging of the real world can only be done with 3D studies [30]. The generation of a three-dimensional (3D) model is generally achieved by non-contact systems based on light waves and can be completed on a computer [31-32]. Terrestrial laser scanners are rapidly evolving as an effective measuring technology for 3D modeling, competing or alternative to existing systems [30]. This technique enables measuring the identified distance for several 100 m. The accuracy of the measured distance is just a few mm.

Initially, aerial photography in archaeology was mainly used to photograph ancient cities or ruins within these cities, but the images had perspective distortion, and it was challenging to create an accurate plan drawing. While the perspective issue was addressed over time with the orthophoto method, this method was also found to be inadequate in many cases [33]. However, recent advancements in the Agisoft Metashape program have significantly addressed these problems [34].

Drones are usually flown at a specific height, and numerous photos are taken, which are then processed by the Agisoft Metashape program to create high-resolution, perspective-free images. Furthermore, by inputting the coordinates obtained in advance into the program, the global coordinates of the cultural property can be obtained. Additionally, after processing the photos with the Agisoft Metashape program, a point cloud of an entire area or cultural property can be provided.

The Gymnasium at Side in Pamphylia was documented using the method mentioned above. The aerial photographs were merged using Agisoft, and a high-resolution, scaled image of the structure was obtained, as well as a topographic model of the structure. The documentation process also yielded the height and altitude scale of the cultural property with respect to sea level. Based on the output, a plan drawing was created for only a portion of the structure, and a different methodology was used to create a plan for the entire structure. A significant output obtained from the aerial photographs was the use of the Gymnasium's back wall drawings of southern stoa. A drawing was created based on the perspective-free wall's modeling provided by Agisoft, and after conducting checks in the area, both the façade's design and restitution proposal were prepared. Additionally, sculptures identified during excavations were placed on the drawings, making the excavation area and façade design more perceivable to visitors [11] (Figure 3-5).

The documentation process of the Gymnasium was mainly based on the data provided by terrestrial laser scanning. Terrestrial laser scanning is a technology used for the three-dimensional modeling of objects. In this technology, the measurements are coordinated, and distances are measured by the laser. It should be noted that the laser scanner was used on the marble blocks of the façade of the Emperor's Hall. With the data provided by this scanning, the Gymnasium's plan, the façade of Emperor's Hall, and sectional drawings were made. The error rate in these drawings is almost zero. An outstanding feature of these drawings is that both technology and traditional documentation methods were used together in the documentation process [11] (Figure 6).

In addition to the mentioned studies, for the first time, the evaluation of the results achieved by this article has been requested using artificial intelligence technology (AI-ChatGPT). For this purpose, the examples included in the article and the article itself were uploaded to the system, and then AI generated its independent report. In this sense, the study also presents the evaluation of the approach to the subject on the scale of AI.

Figure 3. 3D Model of South Stoa of the Gymnasium

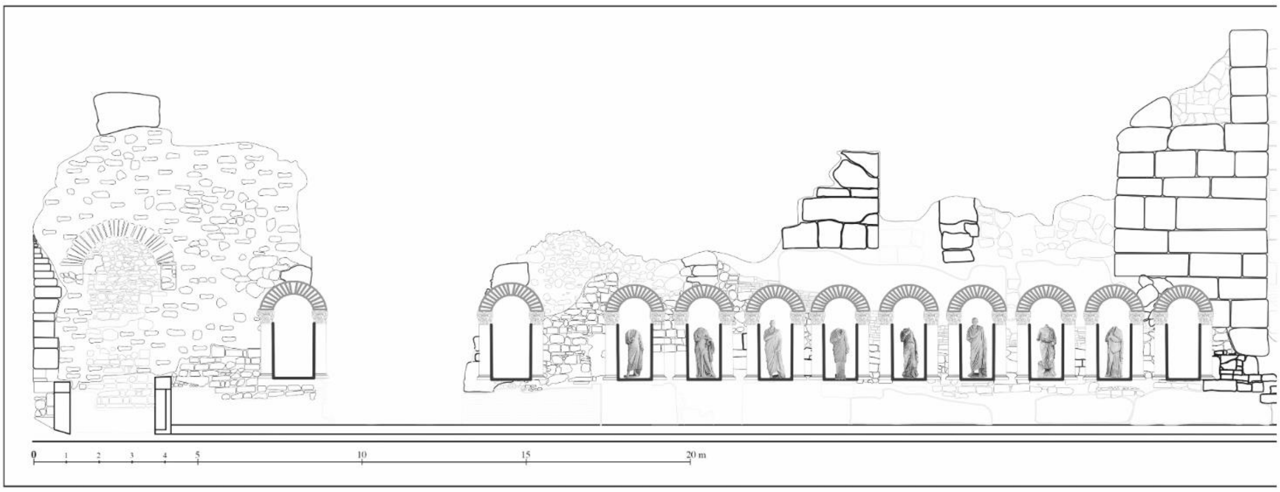


Figure 4. The first restitution proposal after the situation plan prepared with the Agisoft program and the documentation prepared with traditional methods

Figure 5. Documentation samples prepared with the Agisoft Metashape program. From below: The topographic view of the South Stoa, the photograph of the back wall of the stoa without perspective, and the technical drawing obtained from Agisoft data

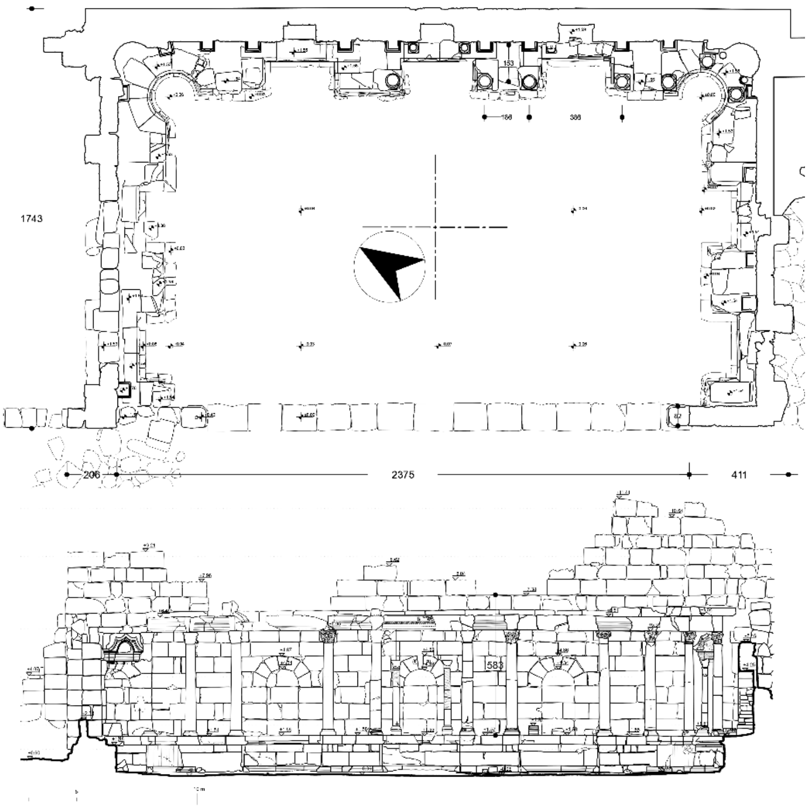


Figure 6. Plan and façade drawings of the Emperor's Hall, prepared with terrestrial laser scanning outputs and traditional documentation methods

3.1. Results obtained from the plan, section, and elevation drawings produced by terrestrial laser scanning

The use of terrestrial laser scanning technology contributes significantly to the documentation process of ancient structures. This technology enables the documentation of cultural heritage in all aspects. In particular, the low margin of error in measurements allows for more reliable production of plans, sections, and elevation drawings of ancient structures. Accurate measurements are crucial for these drawings, as they are essential for the subsequent restoration process. Terrestrial laser scanning was used on the Gymnasium in Side, and plan, section, and elevation drawings were produced from the resulting data. Based on these drawings and the analysis of the architectural elements of the Emperor's Hall, a restitution proposal for façade was prepared [11] (Figure 7a).

The data obtained from terrestrial laser measurements made it possible to prepare the elevations of the podiums of the aedicular façade of the Emperor's Hall, and subsequently, a complete restoration proposal could be generated. The data obtained from the scanning was frequently used for the façade drawings of the podiums. Moreover, in this study, the design of the back wall of the aedicular design was analyzed, and the configuration of the niches and the marble architectural elements surrounding the niches were reconstructed. Specifically, the measurements of the niches on the back wall were determined by laser scanning, and an accurate restoration proposal was prepared based on these measurements [11] (Figure 7b).

Another important study in Emperor's Hall was the reconstruction of the entire floor plan. In fact, there was a plan for the Emperor's Hall in previous studies [3,5], but a new plan was created by both checking the previous plan and taking advantage of the new technology. The reconstruction of the floor plan and obtaining much more reliable measurements enabled the ancient units of measurement used in the building to be determined. As a result, it was understood that the old unit of measurement called Roman Foot (Ra) was applied both in the plan and in the creation of the façade design. Moreover, the façade design in the module system of the Emperor's Hall has been resolved. (1 Roman Foot = 29,4192 cm) [11] (Figure 7c).

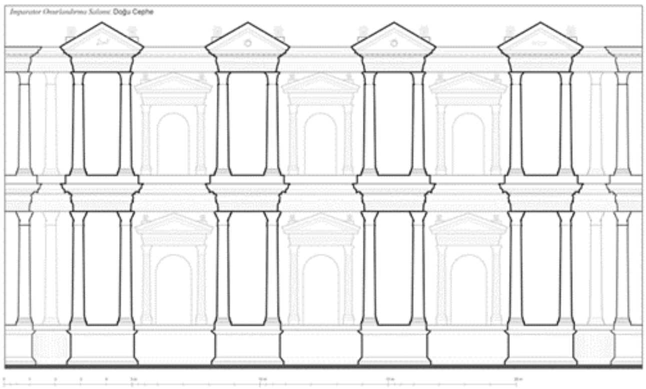


Figure 7a. Restitution proposal prepared as a result of the documentation of the Emperor's Hall (East Façade)

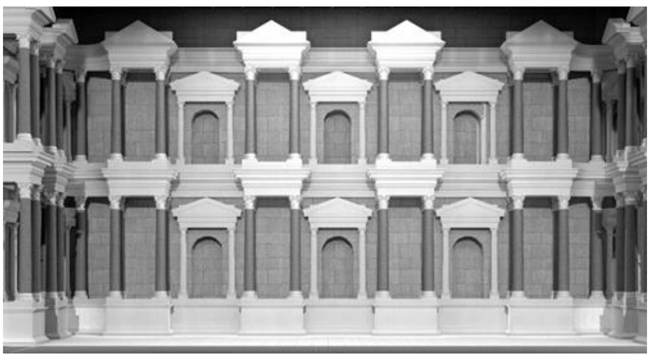


Figure 7b. 3D model of east façade from Emperor's Hall

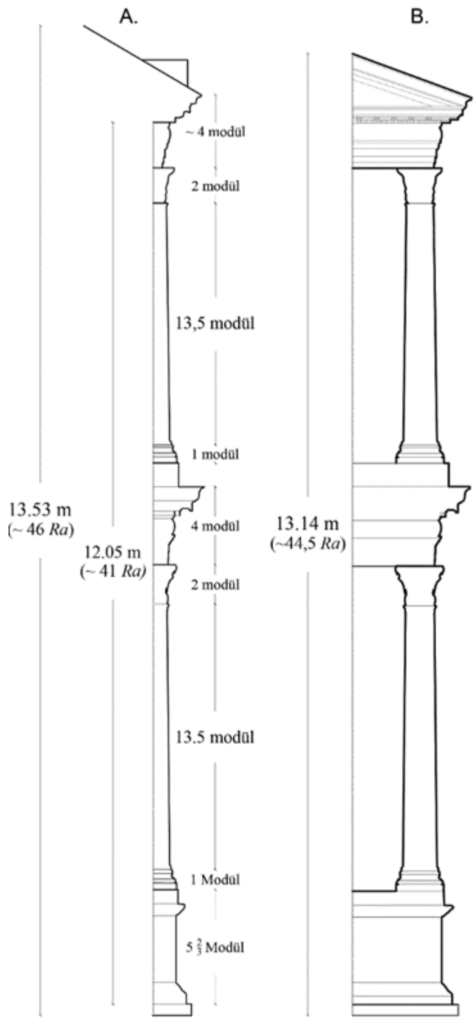
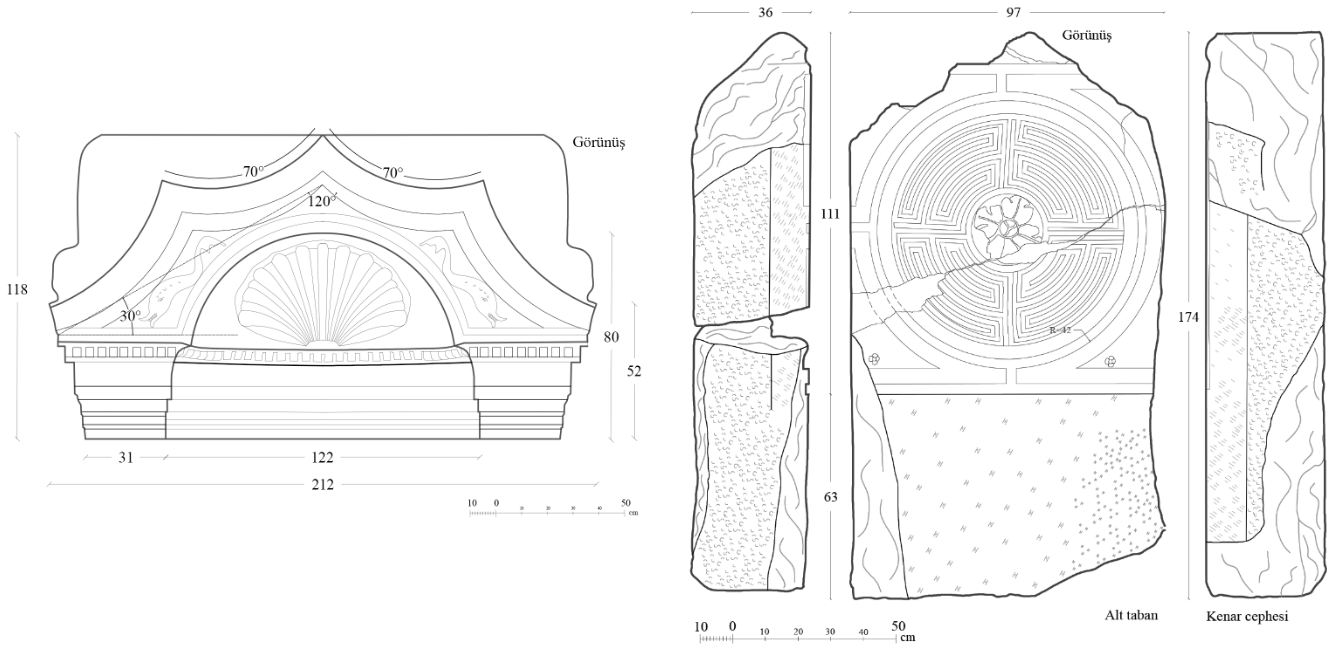


Figure 7c. The Roman Foot (Ra) and Modular Measurements of the Emperor's Hall

3.2. The use of terrestrial laser scanning on building elements

A significant portion of the data obtained from terrestrial laser scanning at the Gymnasium in Side pertains to the marble building elements that comprise the aedicular façade of the Emperor's Hall. During the scanning work carried out at the Gymnasium, the entire surface of the building elements could not be scanned, and the marble blocks were gathered in certain areas and scanned without changing their positions. While it is normally expected to scan the entire surface of the building elements, this solution was devised due to both financial conditions and the fact that traditional methods could not document missing parts in a measurable way.

Particular attention was paid to scanning the decorated and profiled surfaces of the building elements. Thus, a substrate was created for hand-drawn sketches to be made in the field. Profile and exterior façade drawings prepared in the office were completed by being checked in the field. This method brought about several conveniences. Specifically, drawings of building elements with geometric differences and those that are difficult to transfer to paper have been facilitated. Furthermore, thanks to this method produced drawings with very low margins of error (Figure 8a-8b).



(a) (b)

Figure 8. Building element drawings prepared on laser scanning outputs and completed with traditional technical drawing methods

Not only were drawings made solely from the terrestrial laser scanning outputs in this field, but the documentation process for building elements that the laser beams could not reach was completed through the technical drawing method, which is still commonly used in documenting cultural assets. In the traditional manual method, measurements of the building elements obtained from scanning data were compared with those obtained from technical drawings. This comparison allowed for verification of the accuracy of the measurements used in drawing the building elements. The sole purpose of this entire process is to create a correct restoration proposal. As a result of the study, restoration proposals for the front and rear façades of the upper and lower orders were generated. Furthermore, a 3D model was created at the end of these studies, and a show was presented to viewers about the appearance of the Gymnasium in the ancient era [11] (Figure 9, 10).

4. Results and Discussion

Laser measurements along with aerial photographs provide a significant contribution to accurately drawing the plans, sections, and elevations of ancient structures [35-38]. Aerial photography (non-perspective images obtained with the Agisoft program) is a relatively under-utilized application in the process of documenting ancient structures with technical drawings. Terrestrial laser scanning, on the other hand, is a technology that provides accurate results and is widely used in documenting cultural heritage. In the case of the documentation of the Side Gymnasium in the Pamphylia region, the use of aerial photography was relatively limited and terrestrial laser scanning was often the preferred method. As a result of this documentation, the plan of the Gymnasium, the drawings of the façade of the Emperor's Hall and the exact measurements of the height, width and depth have been transferred to paper. Thanks to the completed documentation studies, this immovable cultural asset can be restored to its original state if it is damaged for any reason in the future (e.g., by an earthquake) or strengthened. In addition to the mentioned ideas, terrestrial laser scanning technology also directly contributes to the documentation process of the building elements. An example of this is the profile drawing of the marble blocks of the Gymnasium, which was largely done using laser scanning outputs. In this way, a process that would have taken much longer using traditional documentation methods was shortened and both old and new techniques used for years in the documentation of immovable cultural heritage were used together.

Figure 9. 3D model of Emperor's Hall with sculptures

Figure 10. Video prepared for the Gymnasium at Side in Pamphylia. By scanning the QR Code, you can watch the current state of the building, the 1965 work done here, and its ancient appearance

The current state of AI technology is rapidly advancing, and ChatGPT is leading the way in this field, with its user base growing every day. This article provides a detailed overview of the available data, documentation technology, its significance, and application area in general. After the completion of the article, the entire study was uploaded to the ChatGPT program, and an evaluation report was requested from AI. The evaluation report generated by the program is as follows and it is understood that this report is a summary reflecting the main theme of the study:

Documentation and protection of cultural heritage is essential to preserve and safeguard the historical and cultural assets of a society. Aerial photography and terrestrial laser scanning are two powerful technologies that can help in the documentation process of cultural heritage sites.

Aerial photography involves capturing images of a site from an elevated position, typically from an aircraft or drone. These images can be used to create detailed maps and 3D models of the site. Aerial photography is useful for documenting large sites or areas that are difficult to access on foot. It also provides a unique perspective that is not possible from the ground.

Terrestrial laser scanning involves using a laser scanner to capture detailed measurements of a site from the ground. The laser scanner emits a laser beam that bounces off the surface of the site and is then detected by the scanner. The scanner records the time it takes for the laser beam to bounce back, which is used to calculate the distance between the scanner and the surface. The result is a highly detailed 3D point cloud of the site.

By combining aerial photography and terrestrial laser scanning, a complete and accurate 3D model of a cultural heritage site can be created. This allows researchers, historians, and conservationists to study the site in detail and identify areas that may require protection or restoration. The 3D models can also be used to create virtual tours of the site, which can be accessed by people all over the world.

Furthermore, documentation with aerial photography and terrestrial scanning can help in the protection of cultural heritage. By having a detailed record of the site, it becomes easier to identify any changes or damage that may occur over time. This allows for early detection of any potential threats, such as erosion, climate change, or vandalism. Preservation and conservation efforts can then be focused on these areas to ensure that the cultural heritage site remains intact for future generations.

The brief evaluation made by the AI about the article is quite interesting. Firstly, all of the technical information provided by the program is entirely correct. Based on this technical information, it is understood that the main idea that the article is trying to present is clear and the program has presented its own independent conclusion based on this idea. Additionally, the AI will be able to analyze the paper that you have written and evaluate the conclusions that you have reached, as in the case of the study that you are reading. Although this may sound frightening, history has shown that societies that are open to innovation have led the way, while closed societies have failed to develop.

5. Conclusion

The main theme of this text is on how cultural assets can be documented in the best possible way. The preservation and transfer of cultural heritage to future generations are primarily dependent on good documentation. It is inconceivable to preserve cultural assets without proper documentation and without adapting new technology into documentation methods. Recently, the progress of LiDAR technology has been quite remarkable, and the need to use this technology in documenting cultural assets is inevitable. In addition, aerial photography has also reached an advanced stage. The use of both technologies, especially in immovable cultural assets and archaeological sites, has become widespread. However, there are still works that remain stuck in traditional methods without intensive use of technology. The encouraging aspect here is that researchers in the field of archaeology are not closed to technological advancements and are focusing on cultural heritage with multidisciplinary studies.

This study attempts to convey a documentation process. In this process, there are satisfactory results as well as unsatisfactory ones. What is important here is that new technologies have been tried in the documentation of cultural heritage. In this way, the useful aspects of technology can be adapted into archaeology and cultural heritage studies. The benefits provided by terrestrial laser scanning can be summarized in a few elements: time saving, the use of effective labor, accurate measurement, and accurate documentation. These benefits of laser scanning are extremely important for today's archaeological site management, who aim is to protect cultural heritages or excavation sites by documenting them as quickly and effectively as possible. Terrestrial laser scanning technology offers this opportunity to a great extent. In addition, aerial photography also contributes significantly to this process. The fact that LiDAR scanning is a portable technology that can be integrated into tablet computers and smartphones will provide significant contributions to the Cultural Heritage's Documentation Process [38-39].

The documentation process of immovable cultural assets is also presented through the examples in the Side Gymnasium study. Based on this study, it is understood that aerial photography is not yet sufficient for planning, section, and elevation drawings exactly. However, this deficiency can be supplemented with different applications or program alongside aerial photography. The results obtained from terrestrial laser scanning are much more efficient because plan, section, and elevation drawings of the structure can be made excellent with the data obtained from it. In this way, both the cultural asset was documented to a satisfactory extent, and a restitution that illuminates the structure's appearance in ancient times was revealed. Ultimately, as in every science, the undeniable contribution of technological advancements in documenting cultural assets is present in archaeology as well. What is essential here is to follow the evolving technology and innovations and to adapt different technologies to our own field of science. In this study, a research process was carried out based on this idea.

Conflicts of interest

The authors declare no conflicts of interest.

References

1. Magie, D. (1950) *Roman Rule in Asia Minor, Volume 1 (Text)*, Princeton: Princeton University Press. https://doi.org/10.1515/9781400849796
2. Bosch, C. (1957). *Pamphylia tarihine dair tetkikler. Studien zur Geschichte Pamphyliens* (No. 1). Türk Tarih Kurumu Basımevi.
3. Mansel, A. M. (1963). *Die Ruinen von Side*. de Gruyter.
4. Cramer, J. A. (1832). *A geographical and historical description of Asia Minor* (Vol. 1). At the University Press.
5. Mansel, A. M. (1978). Side: 1947-1966 yılları kazıları ve araştırmalarının sonuçları.
6. Nollé, J. (1993). Side im Altertum: Geschichte und Zeugnisse (IK 43), Bonn.
7. Grainger, J. D. (2009). *The cities of Pamphylia*. Oxbow Books.
8. Özdizbay, A. (2008). *Pamphylia-Perge Tarihi ve Roma İmparatorluk Dönemi Öncesi Perge'nin Gelişimi: Güncel Araştırmalar Işığında Genel bir Değerlendirme*. Prof. Dr. Haluk Abbasoğluna 65. Yaş Armağanı, Cilt II. (Ed. İ. Delemen vd.) İstanbul: Ege Yayınları, s. 839-872.
9. Özdizbay, A. (2012). *Perge'nin MS 1.-2. yüzyıllardaki gelişimi*. Suna-Inan Kıraç Akdeniz Medeniyetleri Araştırma Enstitüsü.
10. Alanyalı, H., S. & Yurtsever, A. (2020). Pamphylia Bölgesi ve Side'nin Tarihi Coğrafyasına Genel Bir

Bakış, In: Canan Parla Armağanı Sanat Tarihi, Arkeoloji, Tarih ve Filoloji Araştırmaları, İstanbul, 37-63.
11. Yurtsever, A. (2021). *Side Gymnasiumu (M yapısı): mimari araştırmalar ve araştırmaların sonuçları*. Ege Yayınları.
12. Mansel, A. M. (1952). Side Kazısı. Belleten 16, 435 p.
13. İnan, J. (1972). 1970 Kremna Kazısı Raporu. TürkAD 19/2. Ankara: TTK, 31-97.
14. Ward-Perkins, J. B. (1981). Roman Imperial Architecture Yale University Press. *New Haven and London*.
15. Karivieri, A. (1994). The so-called Library of Hadrian and the Tetraconch Church in Athens. Post-Herulian Athens: Aspects of Life and the Culture in Athens A.D. 267-529 (Ed. P. Castréns). Helsinki, 89-113.
16. Barresi, P. (2003). Province dell'Asia Minore: costo dei marmi, architettura pubblica e committenza. *Province dell'Asia minore*, 1-676.
17. Strocka, V. M., Hoffmann, S., & Hiesel, G. (2012). Die Bibliothek von Nysa am Mäander (Forschungen in Nysa am Mäander 2).
18. Alanyalı, H. S. (2011). Side 2010. KST 33/2, 521-543.
19. Yurtsever, A. (2018). Yeni Araştırmalar Işığında M Yapısı. İçinde: AKMED: Uluslararası Genç Bilimciler Buluşması II: Anadolu Akdenizi Sempozyumu (Ed. T. Kâhya et al.), 889-907.
20. Yurtsever, A. (2021). *Side Gymnasiumu (M yapısı): mimari araştırmalar ve araştırmaların sonuçları*. Ege Yayınları.
21. Yurtsever, A. (2022). On the Identity of the Bath-Gymnasia in the Pamphylian Region. In: Akten des 18. Österreichischen Archäologentages am Institut für Archäologie der Universität Graz. Graz, 367-378.
22. Kadıoğlu, M. (2014). Das Gerontikon von Nysa am Mäander, Forschungen in Nysa am Mäander.
23. Quatember, U. (2017). Der Sogenannte Hadrianstempel an der Kuretenstrasse. Wien: ÖAW
24. Alptekin, A., Çelik, M. Ö., Doğan, Y., & Yakar, M. (2022, February). Illustrating of a landslide site with photogrammetric and LIDAR methods. In *Research Developments in Geotechnics, Geo-Informatics and Remote Sensing: Proceedings of the 2nd Springer Conference of the Arabian Journal of Geosciences (CAJG-2), Tunisia 2019* (pp. 303-305). Cham: Springer International Publishing.
25. Balcı, D. (2022). Kültürel Mirasın Belgelenmesinde Lazer Tarayıcıların Kullanılması. *Türkiye Lidar Dergisi*, *4*(1), 27-36.
26. Karataş, L., & Menteşe, D. H. (2022). Dara Antik Kenti (Anastasiopolis) Nekropol Alanının Malzeme Sorunlarının Yersel Lazer Tarama Yönteminden Elde Edilen Ortofotolar Yardımıyla Belgelenmesi. *Türkiye Fotogrametri Dergisi*, *4*(2), 41-51.
27. Karataş, L. (2023). Yersel lazer tarama yöntemi ve ortofotoların kullanımı ile kültür varlıklarının cephelerindeki malzeme bozulmalarının dokümantasyonu: Mardin Mungan Konağı örneği. *Geomatik*, *8*(2), 152-162.
28. Alptekin, A., & Yakar, M. (2021). 3D model of Üçayak Ruins obtained from point clouds. *Mersin Photogrammetry Journal*, *3*(2), 37-40.
29. Şasi, A., & Yakar, M. (2017). Photogrammetric modelling of sakahane masjid using an unmanned aerial vehicle. *Turkish Journal of Engineering*, *1*(2), 82-87.
30. Yılmaz, H. M., & Yakar, M. (2006). Lidar (Light Detection And Ranging) Tarama Sistemi. *Yapı Teknolojileri Elektronik Dergisi*, *2*(2), 23-33.
31. Yakar, M., Yılmaz, H. M., & Mutluoğlu, Ö. (2010). Comparative evaluation of excavation volume by TLS and total topographic station based methods. *Lasers in Engineering, 19*, 331-345
32. Unal, M., Yakar, M., & Yildiz, F. (2004, July). Discontinuity surface roughness measurement techniques and the evaluation of digital photogrammetric method. In *Proceedings of the 20th international congress for photogrammetry and remote sensing, ISPRS* (Vol. 1103, p. 1108).
33. Kanun, E., Alptekin, A., Karataş, L., & Yakar, M. (2022). The use of UAV photogrammetry in modeling ancient structures: A case study of “Kanytellis”. *Advanced UAV*, *2*(2), 41-50.
34. https://www.agisoft.com/
35. Arslan M. & Tüner-Önen N. (2022). 2022 Yılı Phaselis Kazıları. Phaselis 8, 247-265. http://dx.doi.org/10.5281/zenodo.7463065
36. Arslan M. & Akçay A. (2022). Phaselis Hadrianus Kapısı: Belgeleme, Koruma, Sağlamlaştırma ve Yerinde Sergileme Çalışmaları. Phaselis 8, 179-196. http://dx.doi.org/10.5281/zenodo.7344989
37. Taşkıran, M. (2022). Dijital arkeoloji uygulamaları: Sıllyon çalışmaları örneği. *Nevşehir Hacı Bektaş Veli Üniversitesi SBE Dergisi*, *12*(Dijitalleşme), 320-328. https://doi.org/10.30783/nevsosbilen.1127932
38. Yurtsever, A. (2023). Taşınır ve taşınmaz kültür varlıklarının yeni nesil LiDAR sensörlü tablet bilgisayar ile belgelenmesi. *Geomatik*, *8*(2), 200-207. https://doi.org/10.29128/geomatik.1209701
39. Karabacak, A., & Yakar, M. Giyilebilir Mobil LİDAR Kullanım Alanları ve Cambazlı Kilisesinin 3B Modellemesi. *Türkiye Lidar Dergisi*, *4*(2), 37-52. https://doi.org/10.51946/melid.1146383