

Full Length Research Paper

The photogrammetric modeling of Kayseri – Hizir Ilyas Mansion

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One of the provisions for being a modern country is to preserve its history and exhibit that history to the service of humanity. The preservation of 'cultural heritage' created directly by humans or together with nature should be the joint effort of the whole of humanity. Historical artifacts may be damaged or totally destroyed due to neglect or various natural disasters. To maintain history from the past to the present, it is necessary to determine, document, repair and preserve the current situation of these historical artifacts. Different techniques are used in the documentation of cultural heritages in parallel with technological developments. Digital terrestrial photogrammetry has become a particularly important method used in this field in recent years. This study carried out a photogrammetric survey of Hizir Ilyas Mansion, situated in the town of Erkilet in the Kocasinan district of Kayseri. The mansion is situated on a tumulus, presumably built in the Hittites era in 2000 B.C. This mansion is a prominent artifact of Seljuk civil architecture and is presumed to have been built by a person named Ilyas in the 13th century. Photogrammetric measurements of the Hizir Ilyas Mansion were conducted with the digital terrestrial photogrammetry method. Scaled drawings, three-dimensional (3D) outline drawing and 3D photo models of the mansion were acquired from the measurements. This study shows that digital terrestrial photogrammetry provides great convenience in documentation studies regarding the maintenance of cultural and historical heritage; field surveys take a short time and all other work can be completed in the office. This study shows that documentation studies can be completed quickly and cheaply with digital terrestrial photogrammetry and also demonstrates that scaled archiving of historical and cultural heritage could be conducted digitally and 3D models could be obtained. In addition, 3D animation of the mansion was constructed from "AVI" format video files after the photogrammetric assessment.

Key words: Hizir Ilyas mansion, photogrammetry, documentation, Kayseri, cultural heritage.

INTRODUCTION

Turkey has historically been a cradle of civilizations and its history reflects a detailed mosaic of cultures. Turkey is one of the most culturally rich countries and almost every part of the country has important historical and cultural artifacts. According to the records of the Ministry of Culture and Tourism, there are 66251 cultural and natural assets in Turkey registered in the single structure scale, a considerable proportion of which are located in the Central Anatolian Region (KTB, 2005). Documentation,

preservation and, when necessary, restoration of these artifacts are of great importance for handing them to future generations. The documentation of cultural heritage could be defined as "the action of acquiring, processing, presenting and recording the necessary data for the determination of the position and the actual existing form, shape and size of a monument in three dimensional space at a particular given moment in time" (Georgopoulos and Ionnidis, 2004). To hand down and keep alive the history of humanity, great importance should be attached to the documentation of historical and cultural heritage. There are various methods of documentation (Böhler and Heinz, 1999) including

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Figure 1. Hizir Ilyas Mansion.

methods conducted by hand, topographic method, photogrammetric method and scanning method (Böhler and Heinz, 1999; Scherer, 2002). The processes of three-dimensional (3D) modeling and monitoring of items of historical and cultural heritage are multi-faceted and highly complex (Külür, 2005).

The digital terrestrial photogrammetry method provides great convenience in such complicated processes. This method, in addition to the common usage areas is used in determining historical and archeological assets, producing scaled drawings of buildings, preparation and execution of urban preservation plans, determination of cracks, abnormalities and deformations, for damage assessment, pre and post restoration attitude controls and for digitalization of a building through determined coordinates (Yılmaz et al., 2000; Sienz et al., 2000). This study documented Hizir Ilyas Mansion using the terrestrial photogrammetric method, producing exterior façade plans and 3D models of the structure.

LOCATION OF HIZIR ILYAS MANSION

Hizir Ilyas Mansion is located in the Erkilet town of Kocasinan district of Kayseri. Kayseri is an important industrial and commercial center of the Central Anatolia region. In addition to its natural beauty, it is rich in historical artifacts, the most important of which are from the Ottoman and Seljuk periods. Kayseri city has the second highest number of Seljuk artifacts after Konya. The town of Erkilet is located 13 km from Kayseri city

centre; the Erkilet district includes many historical artifacts in addition to the Hizir Ilyas Mansion; unfortunately, most of these historical artifacts have been destroyed and some fell into disrepair due to neglect.

HIZIR ILYAS MANSION

Hizir Ilyas Mansion is situated on a tumulus, presumably built in 2000 B.C. According to an epigraph that did not survive to the present day, the mansion was built in 1241. It has not been established why the mansion was built out of the town. Some researchers think that this mansion was used as a department of chest diseases of the hospital in the Çifte Medrese, while others suggest that Seljuk sultans used it as a place for resting. Hizir Ilyas Mansion has thick walls constructed from cut stone. The detailed marble facades are of particular artistic historical importance. The walls of the mansion were reinforced by round towers on the front and by angular towers on the sides and back (Figure 1). The entrance portal of the mansion was faced with marble and seems to be a monument, spilling out of the main walls. There are two mihrabs placed face-to-face in the portal. The entrance leads into an L-shaped courtyard with a small, square mosque on the right side.

PHOTOGRAMMETRIC STUDIES

The basic feature of photogrammetry is to perform the



Figure 2. Topcon 3007 total station tool

measurements from a photogrammetric projection instead of the object itself. Therefore, photogrammetry is an appropriate measurement technique used successfully in viewing, measuring, drawing and assessing everything that could be illustrated (Kocaman, 1998). The documentation of historical and cultural artifacts using photogrammetric methods is done in two stages. Some parts of the work are conducted in the field and other back in office. During field studies, the coordinate system of the object location is determined, control points are measured on the object and pictures of the object are taken; office procedures involve camera calibration, transfer of the digital reference images to a computer system, and assessment and drawing procedures.

Field work

First, a meticulous reconnaissance survey was conducted around the mansion. The location of the polygon points was established and an appropriate polygon mesh was created. A Topcon GPT 3007 geodetic total station was placed on the polygon points

and the measurements were conducted (Figure 2). The data were processed and the polygon calculation was performed. The coordinate system used is the national coordinate system realized by GPS observation at each polygon point. It is necessary to use control points with known coordinates (X, Y, Z) on the object, in order to proceed with the photogrammetric work (Tüdeş, 1998). For this purpose, 10 × 10 cm plaques prepared in appropriate colors and shapes were placed in detail points (window frame or on the surfaces of objects) where the pictures could be seen and measurements could easily be made (Yakar et al., 2009). The number of points was chosen between 7 and 15 according to the size of the surface. Readings were made using the Topcon GPT 3007 geodesic measurement tool. The mansion was photographed from all sides using a Canon A11 digital camera and overlapping photographs (60 to 70%) were taken from different angles (Figure 3).

Photogrammetric work

There are various photogrammetric software packages available to process digital images and produce the final



Figure 3. Canon A11 digital camera.

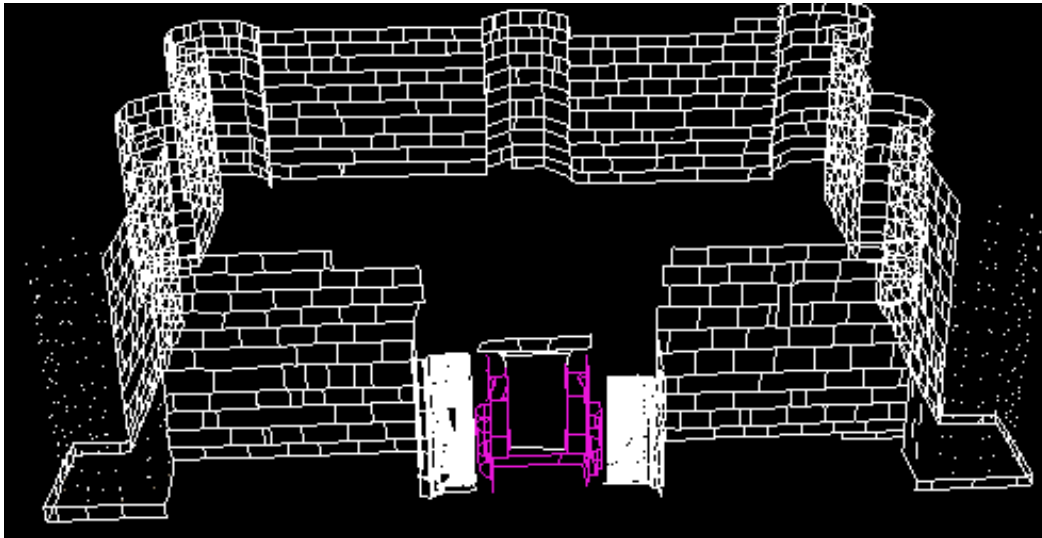


Figure 4. 3D model of Hizir Ilyas Mansion.

model. PhotoModeler photogrammetric software was used in this study. PhotoModeler is a Windows-based Eos System that is used to make 3D modeling and metrical measurements of an object from digital images. In this software, the 3D model is composed of a set of points, corners and/or curves. Textural data and sides or surfaces can be added to the basic framework model to create a realistic, solid model. Due to these features of the software, distance measurements and other metrical operations are made easily. 3D models can be transferred to a computer aided design (CAD) environment in 'dxf' or other formats (Figures 4 and 5). Drawing and measurement of all details are performed through this software (Figure 6).

CONCLUSION

Historical and cultural artifacts have been gradually abraded and worn away due to natural processes and human-induced damage and the majority were destroyed. Preservation of such artifacts is of great importance for the history of humanity. It is necessary to conduct documentation studies and to create a digital archive of cultural heritage sites for both preservation and restoration of these artifacts. Digital terrestrial photogrammetry is an effective and efficient method for the documentation of objects and sites of cultural and historical value. 3D photo-models of these documented artifacts are produced by adding textural data to the 3D

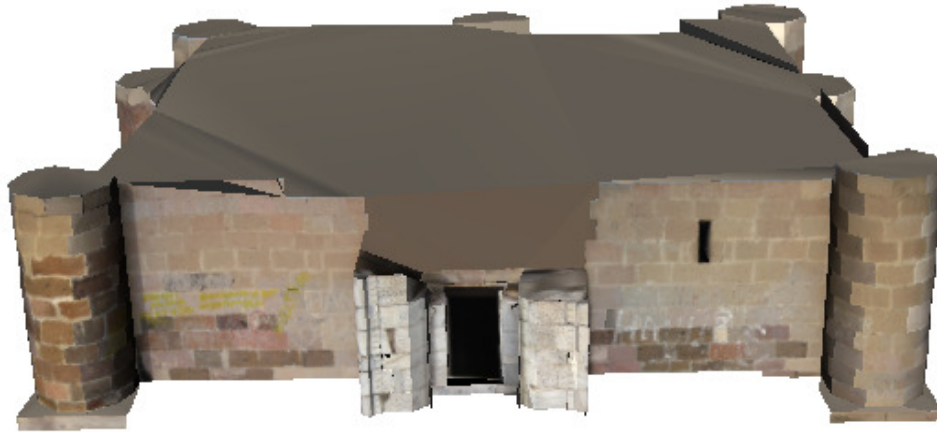


Figure 5. 3D model of Hizir Ilyas Mansion with surface and textural overlay.

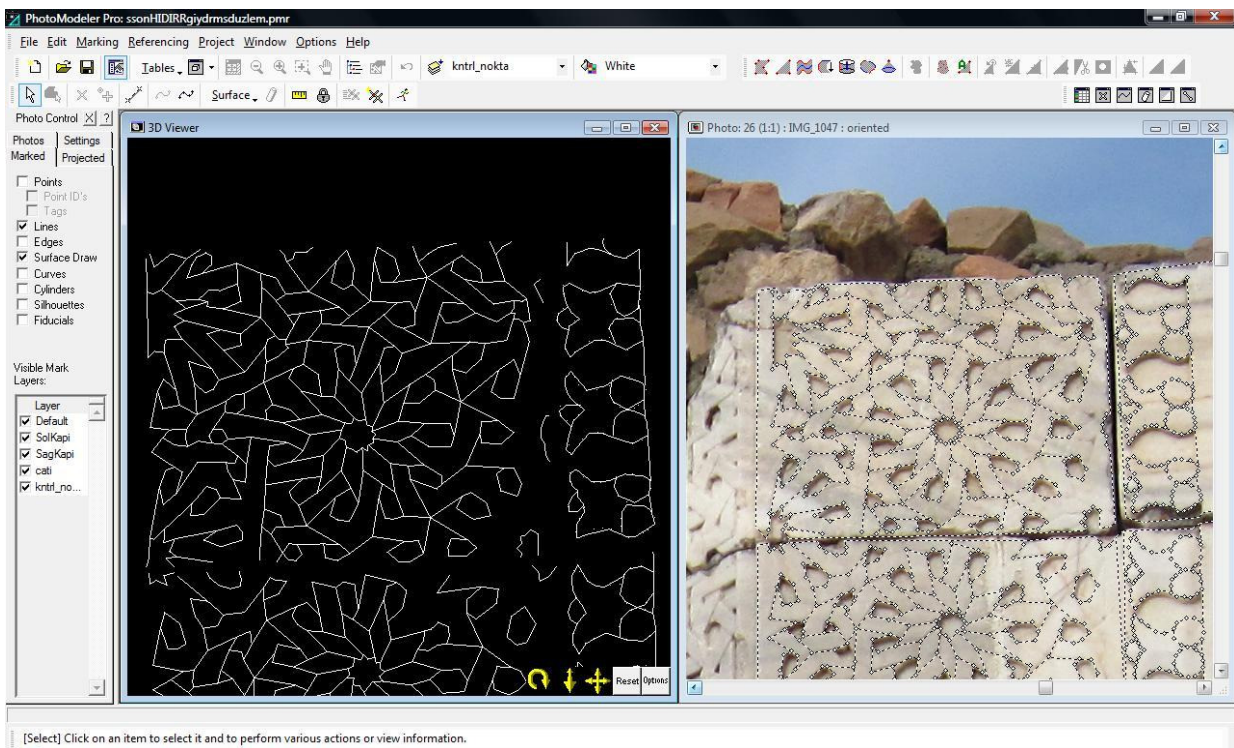


Figure 6. Detailed drawings of Hizir Ilyas Mansion.

coordinate-models. The data obtained through photogrammetric methods is enduring and cannot be changed. Therefore, they can be used as references in restoration projects and studies examining the ongoing weathering and erosion sustained by the objects. Turkey has been a cradle of many great civilizations and still accommodates thousands of historical and cultural artifacts. However, many artifacts are at risk of

disappearance due to natural disasters and neglect. Documentation studies that will make great contributions to the preservation of these artifacts can be conducted quickly and economically using photogrammetric methods. The photogrammetric method used in this study uses only images of the objects which are then processed using mathematical equations. Photogrammetric methods therefore eliminate the

measurement risk associated with many other methods.

All of these characteristics demonstrate that photogrammetry is an effective method that can be easily applied to documenting sites of historical and cultural heritage and to 3D modeling.

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