3D Modelling of Kizildag Monument

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Abstract. The most important cultural property that the nations possess is their historical accumulation, and bringing these to light, taking measures to preserve them or at least maintain the continuity of transferring them to next generations by means of recent technic and technology, ought to be the business of present generations. Although, nowadays, intensive documentation and archiving studies are done by means of classical techniques, besides studies towards preserving historical objects, modelling one-to-one or scaled modelling were not possible until recently. Computing devices and the on-going reflection of this, which is acknowledged as digital technology, is widely used in many areas and makes it possible to document and archive historical works. Even virtual forms in quantitative environments can be transferred to next generations in a scaled and one-to-one modelled way. Within this scope, every single artefact categorization belonging to any era or civilization present in our country can be considered in separate study areas. Furthermore, any work or likewise can be evaluated in separate categories. Also, it is possible to construct travelable virtual 3D museums that make it possible to visit these artefacts. Under the auspices of these technologies, it is quite possible to construct single virtual indoor museums or also, at the final stage, a 3D travelable open-air museum, a platform or more precisely, to establish a data system that spreads all over the country on a broad spectrum. With a long-termed, significant and extensive study and a substantial organization, such a data system can be established, which also serves as a serious infrastructure for alternative tourism possibilities. Located beside a stepped altar and right above the Kızıldag IV inscription, the offering pot is destructed and rolled away a few meters to the south slope of the mould. Every time visiting these artefacts with our undergraduate students, unfortunately, we observe more demolition. This case study aims to construct the extensive data system mentioned above, and in the context of historical artefacts it aims-which is the lowest stage of such a study gathering information about the Kızıldag findings using the previously mentioned technologies. This paper will explain how the geometry and texture of historical objects can be automatically constructed, modelled and visualized from digital image processing software. In this context, the second research has been conducted, aimed to obtain the visuals of the Hittite hieroglyph inscriptions located in Kızıldag by using digital photogrammetry technique. After obtaining the visuals, they will be evaluated in a photogrammetric software which endues the finally constructed 3D virtual product with its original texture. In this way, the current destructed artefacts mentioned above can be handed down to the next generations in form of scaled, virtual models. We consider this to be of particular importance.
1. Introduction
Kızıldağ, 55 km North of Karaman, is a volcanic mount that stands between Suleymanhançı, Adakale village; and newly settled Acigol and Hotamis swamp (Figure 1). On the top of the mountain, there are remainings from the iron age, Roman age and Byzantine age. As archeologic materials were handled elaborately in lots of publications, only little information about them will be given. On the west side of the mountain, Kızıldağ 1 inscription is in historical sources of (Ramsay-Bell 1909, figure 371A-376; Hrozný 1933-1937, 437-441; Güterbock 1947, 52-55, figure 63-68, Meriggi 1964, 42-58; Börker-Klähn 1977, 260-266; Alp 1974a, figure IV) and it’s emboss (Figure 2) Kızıldağ 2 inscription (Figure 3) [1], castle wall remaining (Figure 4), multi-stage rock monument and Kızıldağ 4 inscription (Figure 5) are located.
On Kizildag 1 emboss, Hartapus holding a glass in his right hand and grasping staff in his left hand, and on another emboss on the mountain he names himself as a Grand King and Mursili’son [2, 3]. Other tablets of this king are known to be in Karadağ and Aksaray-Burunkaya.

In the light of Elbistan Karahoyuk tablet, it was put forward that Karadag, Kizildag and Burunkaya inscriptions may be in connection and thereby an idea of extending Hartapus Kingdom to Elbistan Karahoyuk is possible.

Archeological remaining [4] that was found there could not finalize properly in terms of not dating the hieroglyph inscriptions [4, 5] and relief. Last, this mountain was tried to be state’s capital before II. Muwattalli’s Hittite-Egypt war [6]. Highly rich in terms of historical fabric, our cultural existence on the soils of Anatolia witnessed great devastation by human intervention or nature, thus it vanishes. At Kizildag, the matter in hand, previous reports were taken about Hittite hieroglyphs consisting of five blocks. Nevertheless, today, only three of them remained on the mountain [6].

2. Work Flow

Classic two dimensioned photogrammetric applications fall short for lots of applications. Within the scope of today’s information systems running studies geographic field’s three-dimension calculation, interrogation, analysis, simulation and picturing has become much more important [7]. With today’s CAD technology, a geography field’s perspective view can be obtained, three-dimension picturing opportunity can be provided, flying to a city and wondering in any place can be possible. In the real world being a close to eternal, there are also very complicated topological relationships among them. To represent eternal-like entity and geographic field close to ones on the earth, to model this represent and identify automatically are needed [8].

3D modelling of all geographic entities which has different features in definite coordination system, datum and topologic relationship among them, namely to identify mathematically is very time consuming, expensive and very complicated. For example, to store definite buildings' roofs or buildings, definite trees or plants etc. in database and calling them out automatically process has been being done since 1990s. 3D picturing has been used for various purposes; to decide accurately in planning environment, city and geographic places; to settle telecommunication receiver/acceptor for geologic structure accurately, spatial picturing for tourism, in mining, hydrology etc. animation studies, animation works, to produce interactive 3D projection for future (building abutment, skyscraper), virtual reality studies. Another field of applying three-dimension picturing today is to model historical and cultural heritage which is our concern now and to picture three-dimensionally. Also called as Close Picture Photogrammetry, these techniques are measuring technologies used for gathering three-dimension
location information about an object. Besides, similar to air photogrammetric, it makes use of object's photos in measuring instead of measuring an object directly [9]. In digital photogrammetry, it is a must to take photo from different stations successively and corbelled to acquire three-dimension data and reach high accuracy. Best mathematic model for the process should be selected and camera order should be designed for this must. Besides, proper optimization method should be used in high measurement precision preachment, camera line design namely how much camera, where and how should be located. In the process of taking pictures, different techniques are used along with historical object and property of place. Kızıldağ monument [11] and inscriptions [12], as written above, are in the west side and at the top of the mountain. As these objects are in a proper side for ground-photo taking from proper locations which surrounds monuments on the top the mountain, photos subjecting to 3D evaluation were taken, [13]. It became possible to bind these taken photos depending these locations to each other and model details of these objects. We tried to take photos from places posing stereotype view whenever possible. Best pictures were used in texture mapping also. To form three modelling photos were tried to be obtained by 60% corbelled for each model. In order to georeference the model, laser total station is used to give coordinates on the monument. Laser total station is a device which performs length and angle measurement without reflector. Total station must be situated vertically over a point which its position must be known (Figure 6). To create reference vector, total station must be oriented second known point to calculate other point coordinates.

Figure 6. Total station measurement

3. Visualisation of the 3D model

The current topographical photogrammetric evaluation software appears to be a programmed that grounds on the bunch balance technique, and is based on the operating system MS Windows. While evaluating, it constructs 3D models by using pictures with a certain over thrust ratio. The evaluation process and the generating of 3D models begin with starting a project by inputting the approximate object size and the calibrated camera values and photos. In addition to the project, a text file is created and added that is accepted by the photogrammetric evaluation software, including coordination hailing from checkpoints which are assessed geodesic and are seen on two or more photos. Afterwards, the evaluation process continues as these points are assessed on the photos and their extroversion is realized according to the checkpoints. After this, also the tie points on the monuments and inscriptions are measured. These measured points are combined with lines that complete monuments and inscriptions and approximately 50-60% over thrust rates are referenced. The surfaces between points and lines are completed by the help of convenient geometric shapes. In order to model the object, one switches to the process step. Since the objects located on three different places, a separate model was constructed for each object. After the photogrammetric evaluation and modelling, the covering of the real photo is
realized at the visualization step of the implementation. In order to obtain the real appearance of the object, a texture mapping needs to be conducted by the help of the taken photos. If required, an ortophotograph of the texture can be generated (Figure 7, 8).

![Figure 7. Ortophotograph of the texture](image1)

![Figure 8. Ortophotograph of the texture 2](image2)

4. Conclusions

According to the results, digital photogrammetry need to be jointly used for the documentation of historical artefacts in further researches, and it also shows that, for the presentation, analysis and questioning of the data collection and model construction, a geographical information system is required in terms of unification. The Digital topographic photogrammetry technique implemented in this study shows that, once again, this technique plays an important role in the documentation of historical artefacts. It provides important advantages in terms of time, cost and visually. Due to local conditions, some problems were encountered while capturing visuals, appropriate photo reception, generating the 3D model and texture mapping. These were resolved by adding photos to the evaluation that were taken from convenient locations. To overcome these obstacles, at the modelling and connecting the photos stage, the previous visuals mentioned above were used and while covering the real ones, the photos where the monuments and inscriptions which provided clearly and sharply sight were taken.

Historical heritages need to be preserved for next generations. There are lots of documentation techniques available for documentation of any historical site. The technique we applied in this study is necessary for big structure. With the help of this model, we can measure any distance, area or volume on the model with desirable accuracy. We are going to start the research underneath the monument with ground penetration radar. There must be some remains from the settlers so we decided to create underground map without archaeological excavation. Our objective is to merge 3D digital model and digital underground map of the monument. With this product we can clearly investigate all the aspects of this monument.

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