International Journal of Engineering and Geosciences (IJEG),
Vol; 1 , Issue; 01, pp. 1-7, October, 2016, ISSN 2548-0960, Turkey,
DOI: Your DOI number

INVESTIGATION OF THREE-DIMENSIONAL MODELLING AVAILABILITY TAKEN PHOTOGRAPH OF THE UNMANNED AERIAL VEHICLE; SAMPLE OF KANLIDIVANE CHURCH

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ABSTRACT: Cultural heritages due to have different natural characteristics, have different sizes, and heir complicated structure should be measured and requires a more sophisticated measurement tools and techniques to documentation. One of them aerial photos taken by UAV pictures to use in architectural photogrammetry.In this study, Photogrammetric study was conducted in the ancient church next to the pothole. The study was completed with photographs taken from the air with UAV and close range photogrammetry. The images obtained from both methods adjusted in photogrammetric software and obtained a three-dimensional model of the church. Photography by UAV has proved to be a technical supporters of close range photogrammetry. Also coordinates of the reference points on the images obtained through photogrammetric software and compared with terrain coordinates. Point position accuracy of points mxyz = 2.1 cm were found. In order to protect the world heritage of cultural heritage IHA help to be sensitive enough to measure derived from aerial photographs taken, can be used as a base to work from different professional disciplines, The UAV was concluded in anywhere near the height can be used for photogrammetric.

Keywords: *UAV Photogrammetry, Precision,3D model*

1. INTRODUCTION

In many of cultural heritage documentation work could not be registered for reasons such as the lack of, cost, technology insufficieny, qualified staff and time constraints. (Hunt et al from., 2014).Although Turkey is an important country in terms of archaeological and cultural heritage, the lack of efficient work in the field work or be very limited,of the studies can not always be carried out with sufficient accuracy and lack of documentation however, due to a misunderstanding of the scope,not being able pass on to future generations is in danger. This troubled situation of new technologies in order to produce solutions in this area in order to prove the availability of terrestrial laser scanning technology and Unmanned Aerial Vehicle (UAV) is used in this context. Cultural heritage of different natural features, are required to have a different size and detail can be measured due to the complex and sophisticated measuring tools and techniques to document. One of them is the Unmanned Aerial Vehicle (UAV) technology.

1.1 Unmanned aerial vehicles (UAV)

UAV's can be defined as fixed and rotary wing aircraft which is on the fly without a human being (Eroglu, 2013). These vehicles by remote control, semi-automatic, automatic, or have all of these capabilities (EISENBEISS, 2009). The academic resources were analyzed, we come across dozens of similar statements about the UAV. They are also considering unmanned aerial vehicles (UAVs) could make the definition as follows: Which can be controlled from the ground, flight planning capabilities which, with fixed or rotary wing, military and used in civilian areas on a pilot system for non Unmanned Aerial Vehicle (UAV) is called

1.2 UAV Benefits

Against manned system,The biggest advantage of UAVs; UAV in risky situations without risking human life and inaccessible areas of the low-altitude flight profile and it is close to the ends of the object and can not be used in place manned system.

For example, natural disaster areas, mountainous and volcanic areas, flood plains, earthquake and accident scenes and desert areas, areas that are difficult to enter, are used. (Ulvi A., 2015)

In addition to these advantages, the mapping activities and architectural applications, and are also used frequently in archaeological sites.

2.STUDY AREA

Kanlıdivane is in the rural area of Erdemli district, which is a part of Mersin Province. It is 18 km (11 mi) to Erdemli and 55 km (34 mi) to Mersin. Its altitude is approximately 230 m (750 ft). It is close to the town Kumkuyu at the coast and just few hundred meters to Çanakçı rock tombs.Kanytelleis-Kanlıdivane ruins Mersin-Silifke highway since the 50th km, the resort is located 3 km north of Ayas. The first settlement on the ruins of the old name Kanytelleis BC It was built in the late 3rd century. A tower of the period to the Hellenistic city has kept its existence until the 11th century."Kanlı-Bloody Divane", the pothole within the city, former offenders, among the people because of the belief that gnawed by wild animals, as is known. The church is next to the pothole (Figure 1).

Figure 1. Kanlıdivane Church overview

3.MATERIAL METHOD

3.1. Pre-work preparation

Used in the application H (Figure 2), digital camera (figure 3), total station (Figure 4) and a ground control plates used in the evaluation of the photograph obtained from the UAV (Figure 5), paper targets affixed to the wall (Figure 6) and the image transmission system, (Figure 7) are provided.

Figure 2. DJI Phantom UAV

Figure 3. Canon PowerShot A810

Figure 4.Total Station Topcon GPT 3007

Figure 5.Graund Control Point

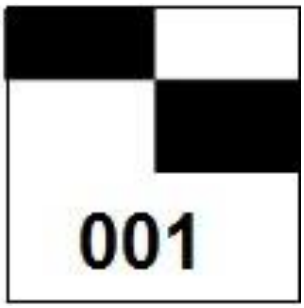

Figure 6.Target

Figure 7. FatShark

3.2. Field study

Ground control points have been established as a homogeneous field in the application (Figure 8).In this application 8 Ground control points has been installed.While for establishment of ground control points, point of care has been taken to distribute to completely cover the work area and to see each other.

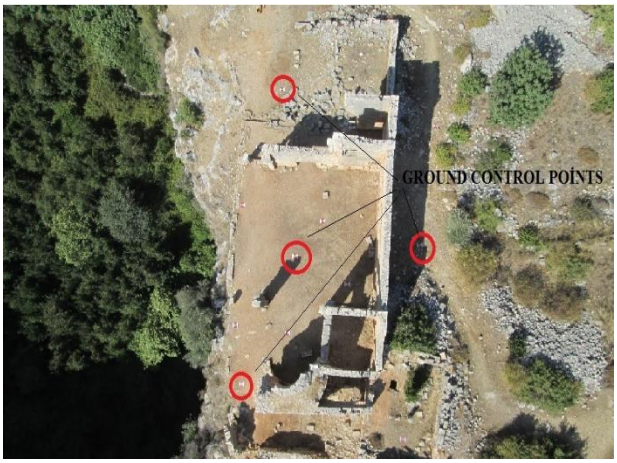

Figure 8. Distribution of ground control points in field

Georeferencing operation of ground control points were made by Topcon GPT 3007 reflectorless total station (Figure 9).
Around of applications, making closed traverse was calculated coordinates of ground control points.ground control and coordinates of the feature point is measured in the local system (Figure 10).

Figure 9. Surveying with Topcon GPT 3007

Figure 10. Measuring point operations, and UAV Ground Control Points overview

After measurement and rectification process, UAV flight madefinal checks have been completed (Figure 11-12-13).

Figure 11. UAV, FPV control and image transfer system

Figure 12. performed the final pre-flight checks

Figure 13. Flying with UAV

After the flight the UAV, the aerial photography work has been completed. Aerial photographs obtained is exemplified below (Figure 14-15).

Figure 14.Taken photograph with UAV

Figure 15.Taken photograph with UAV

After this process is completed, work has started on the office using data obtained..

3.3.Office work

The coordinates of the traverse used for field measurement is shown in Table 1.

Table 1. traverse coordinates

N.N.	Y	X	Z
P.1	1000.000	1000.000	1000.000
P.2	1000.000	1021.225	1001.583
P.3	1035.587	1027.236	1005.679
P.4	1052.584	1014.728	1002.668
P.5	1026.608	1007.357	1001.568
P.6	1028.650	1019.729	1001.710

Photos taken from the ground, and obtained from the UAV photos was combined in Photomodeler photogrammetry software and adjustedand made ready for drawing (Figure 16).

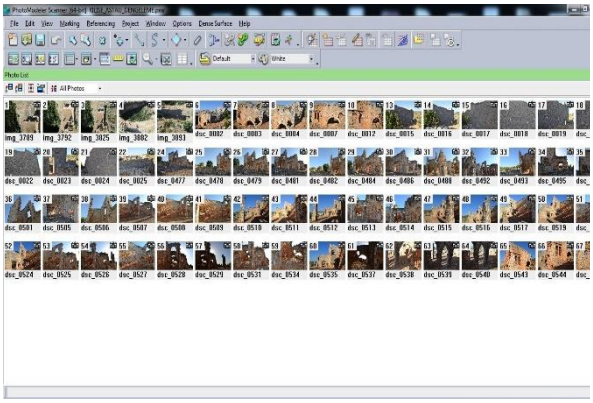

Figure 16. Regulation of photographs obtained in the field and to be ready drawings

3D drawing of the church through adjusted images is completed (Figure 17).

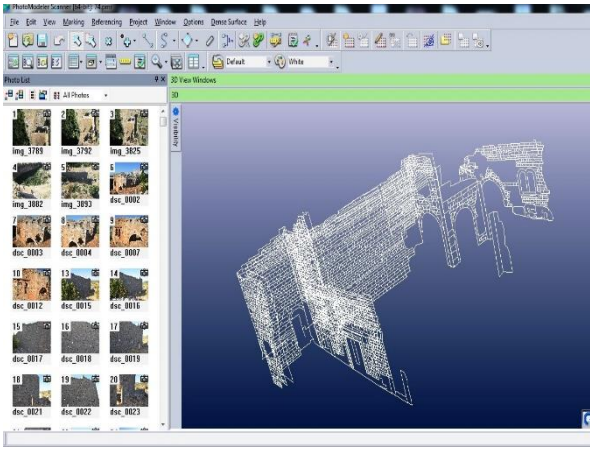

Figure 17. 3D drawing of church

After the drawing, the sensitivity study was conducted on thirty points determined on the church. Coordinates obtained from the land of this point, been accepted as absolute coordinates. The coordinates of the reference point on the adjusted images, obtained through photogrammetry software and compared with terrain coordinates.

Point position accuracy of points mxyz = 2.1 cm were found (Table 2).

4. RESULTS

Especially in the field of architecture photogrammetry, UAV usage began to hold an important place, increasingly widespread, providing significant advantages in terms of cost time,and effort. for users.
In order to protect the world heritage of cultural heritage, with the help of UAV Aerial photographs taken, the measurement obtained

-sufficient accuracy as in,

-can be used as a base to work from different professional disciplines,

-UAVs can be used for photogrammetric anywhere near heights

It concluded has been reached.

For documenting the historical and cultural heritage, the use of close range photogrammetry together with the UAV is considered to give a new impetus to the work done in this area.
In addition, this model of UAV 's help made using photogrammetric techniques, photographing opportunities increase, and with reason, allows documentation to be more comprehensive and realistic (Toprak AS, 2014)

Table 2. Comparison of point coordinates and differences

	Araziden Elde edilen (Kesin Koordinatlar)			Resimlerden elde edilen Koordinatlar			Farklar		
N.N	Y	X	Z	Y	X	Z	Y(m)	X(m)	Z(m)
1	1022.155	1012.437	1002.439	1022.141	1012.428	1002.425	0.014	0.009	0.014
9	1023.585	1024.625	1003.644	1023.574	1024.614	1003.633	0.011	0.011	0.011
16	1005.794	1025.177	1001.568	1005.782	1025.175	1001.561	0.012	0.002	0.007
28	1013.200	1003.236	1002.686	1013.190	1003.224	1002.673	0.010	0.012	0.013
29	1013.426	1011.582	1001.702	1013.418	1011.591	1001.713	0.008	-0.009	-0.011
30	1011.285	1010.104	1001.703	1011.281	1010.117	1001.688	0.004	-0.013	0.015
33	1014.052	1024.595	1001.635	1014.059	1024.601	1001.623	-0.007	-0.006	0.012
37	1012.413	1028.761	1001.638	1012.406	1028.750	1001.650	0.007	0.011	-0.012
39	1008.660	1036.831	1001.754	1008.651	1036.818	1001.741	0.009	0.013	0.013
40	1013.754	1036.155	1001.723	1013.734	1036.142	1001.711	0.020	0.013	0.012
41	1010.803	1042.134	1001.667	1010.790	1042.146	1001.652	0.013	-0.012	0.015
42	1018.076	1029.970	1001.713	1018.062	1029.962	1001.726	0.014	0.008	-0.013
45	1018.132	1047.474	1003.755	1018.121	1047.481	1003.741	0.011	-0.007	0.014
46	1013.834	1019.238	1003.808	1013.821	1019.250	1003.800	0.013	-0.012	0.008
47	1018.445	1019.955	1003.266	1018.459	1019.948	1003.255	-0.014	0.007	0.011
53	1026.290	1041.783	1005.373	1026.276	1041.771	1005.385	0.014	0.012	-0.012
56	1005.509	1018.912	1001.218	1005.491	1018.900	1001.234	0.018	0.012	-0.016
300	1017.743	1013.358	1009.448	1017.754	1013.374	1009.441	-0.011	-0.016	0.007
301	1013.415	1014.301	1009.440	1013.405	1014.289	1009.454	0.010	0.012	-0.014
302	1013.518	1018.706	1011.609	1013.507	1018.692	1011.604	0.011	0.014	0.005
303	1013.137	1018.776	1007.152	1013.123	1018.789	1007.140	0.014	-0.013	0.012
304	1007.322	1019.947	1007.128	1007.313	1019.956	1007.113	0.009	-0.009	0.015
305	1009.922	1019.425	1004.038	1009.911	1019.439	1004.022	0.011	-0.014	0.016
306	1011.838	1019.024	1004.046	1011.822	1019.029	1004.030	0.016	-0.005	0.016
307	1015.085	1018.335	1003.434	1015.073	1018.333	1003.424	0.012	0.002	0.010
308	1016.427	1018.039	1003.436	1016.438	1018.042	1003.423	-0.011	-0.003	0.013
309	1014.619	1018.466	1008.562	1014.629	1018.452	1008.548	-0.010	0.014	0.014
310	1015.557	1018.242	1008.565	1015.546	1018.230	1008.582	0.011	0.012	-0.017
311	1014.587	1018.444	1006.723	1014.574	1018.456	1006.710	0.013	-0.012	0.013
312	1015.556	1018.242	1006.739	1015.546	1018.229	1006.727	0.010	0.013	0.012

Vy(cm)	Vx(cm)	Vz(cm)	VyVy(cm)	VxVx(cm)	VzVz(cm)
1.4	0.9	1.4	2.0	0.8	2.0
1.1	1.1	1.1	1.2	1.2	1.2
1.2	0.2	0.7	1.4	0.0	0.5
1.0	1.2	1.3	1.0	1.4	1.7
0.8	-0.9	-1.1	0.6	0.8	1.2
0.4	-1.3	1.5	0.2	1.7	2.2
-0.7	-0.6	1.2	0.5	0.4	1.4
0.7	1.1	-1.2	0.5	1.2	1.4
0.9	1.3	1.3	0.8	1.7	1.7
2.0	1.3	1.2	4.0	1.7	1.4
1.3	-1.2	1.5	1.7	1.4	2.2
1.4	0.8	-1.3	2.0	0.6	1.7
1.1	-0.7	1.4	1.2	0.5	2.0
1.3	-1.2	0.8	1.7	1.4	0.6
-1.4	0.7	1.1	2.0	0.5	1.2
1.4	1.2	-1.2	2.0	1.4	1.4
1.8	1.2	-1.6	3.2	1.4	2.6
-1.1	-1.6	0.7	1.2	2.6	0.5
1.0	1.2	-1.4	1.0	1.4	2.0
1.1	1.4	0.5	1.2	2.0	0.2
1.4	-1.3	1.2	2.0	1.7	1.4
0.9	-0.9	1.5	0.8	0.8	2.2
1.1	-1.4	1.6	1.2	2.0	2.6
1.6	-0.5	1.6	2.6	0.3	2.6
1.2	0.2	1.0	1.4	0.0	1.0
-1.1	-0.3	1.3	1.2	0.1	1.7
-1.0	1.4	1.4	1.0	2.0	2.0
1.1	1.2	-1.7	1.2	1.4	2.9
1.3	-1.2	1.3	1.7	1.4	1.7
1.0	1.3	1.2	1.0	1.7	1.4
		[VV]=	43.4	35.7	48.7

$$m = \pm\sqrt{\frac{[v \cdot v]}{n}}$$

	1.2	1.1	1.3
mxyz =	2.1		

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