3D Modelling Creating Tool for Landscape Design: Camera

Ahmet Benliay[1], Isa Eren Akbiyik[2]

[1]Akdeniz University Faculty of Architecture, Landscape Architecture Department, Antalya/Turkey · benliay@akdeniz.edu.tr
[2]Akdeniz University Faculty of Architecture, Landscape Architecture Department, Antalya/Turkey · isaerenakbiyik@gmail.com

Abstract: Advancements in the field of reality capture technology are transforming the process of obtaining digital spatial data of our environment. 3D scanning software are initially born as simple touristic 3D visualization (e. g. Photosynth) of archaeological and/or architectural sites or cultural assets (e. g. statues, fountains and so on), nowadays allow to reconstruct impressive photorealistic 3D models in short time and at very low costs. This paper will discuss how the geometry and texture of landscape objects (such as trees, statues, furniture and etc.) can be automatically constructed, modelled and visualized from digital imagery using a basic camera and freely-available open-source software called 123D Catch by Autodesk. In terms of 3D modelling study illustrate a fully automatic approach for the alignment of scans without the need for any artificial markers or manual interaction. The results of 13 landscape elements derived from software package are compared with reference data in order to analyse the accuracy and reliability of such objects in landscape design modelling.

Keywords: Landscape design, 3D modelling, 123D catch, camera

1 Introduction

The inverse of the preceding technology is the increasing presence of tools and techniques for capturing digital models from analogue objects and landscapes. 3D digitizers, whether on fixed arms, or in airborne platforms, are transforming the process of getting digital data into computer memory to begin with. LIDAR surveying promises to deliver highly detailed (sub-centimeter resolution) digitized models of 3D reality, whether seen from above for incredibly detailed digital elevation models, or from the side, for robust 'point-cloud' representations of buildings, trees, bridges, etc. (ERVIN 2003).

Desktop and web-based packages offer the opportunity to exploit the power of cloud computing in order to carry out a semi-automatic data processing, thus allowing the user to fulfil other tasks on its computer; whereas desktop systems employ too much processing time and hard heavy approaches (SANTAGATI et al. 2013).

Camera-based systems offer a cost-effective, simple and flexible alternative that can be immediately implemented. Some software process 3D reconstruction using only structured photos data set (Autodesk Recap Photo, Agisoft Photoscan Pro, ARC3D, 123D Catch, Hyp3D, my3Dscanner) and some other software use both structured and unstructured photos data set (VisualSfM, PhotoSynth) for example downloaded from Flirck.com (KERSTEN & LINDSTAEDT 2012).

Autodesk 123D Catch software can be freely downloaded and is currently free to use for non-commercial purposes. Software can be used by mobile devices and PC's. It simply requires the user to supply a minimum of three images of an object, which are then uploaded

Journal of Digital Landscape Architecture, 1-2016, pp. 78-83. © Wichmann Verlag, VDE VERLAG GMBH · Berlin · Offenbach. ISBN 978-3-87907-612-3, ISSN 2367-4253, e-ISSN 2511-624X, doi:10.14627/537612009.

to a server for processing, presumably involving PVMS methods (Patch-based Multiview Stereo). No restrictions appear to be placed upon camera type or focus setting, so some form of camera calibration is being conducted (CHANDLER & FRYER 2013).

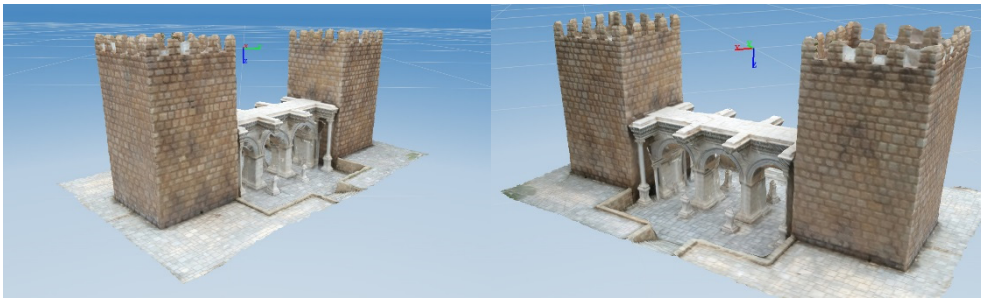

Fig. 1: Antalya Hadrianus gate 123D capture sample scene

The standard workflow for 123D Catch models calls for the following steps:

1) Taking of multiple digital photos with any standard digital point-and-shoot camera;
2) Upload of photos in an image file format (jpg) via 123D Catch software – to a cloud server for stitching and processing. The software automatically downloads the results in a Photo Scene data file format (3dp). The cloud server mesh engine processes a high quality 3D model from the collection of overlapping photos. Provided that the system is fed with an extensive, well-taken set of photos, the resulting model will be spatially and dimensionally accurate. Via manual stitching – adding or removal of photos that had not automatically been included – the results can be adjusted;
3) Saving of the project as a video animation, or export of the underlying wire frame (model) into standard 3D formats (obj, dwg) for further editing in various 3D programmes (REKITTKE et al. 2012).

2 Material and Method

2.1 Material

Mesh creating software such as Autodesk Recap Photo, Agisoft Photoscan Pro, ARC3D, 123D Catch, Hyp3D, my3Dscanner software have been evaluated for the study. Freely-available open-source software 123D Catch has been selected as the processing software for the study for the easy and user friendly interface.

The capturing of the photographical data was performed by a mobile phone's camera and AR Drone 2.0 HD camera. The processing of the data has been held on a notebook computer which has an Intel Core I5-3317U CPU @ 1.70 GHz. 8 GB of RAM. 70 photographs have been captured for 13 landscape elements because of the limitation of the application. These are 4 plants, 4 statues, 4 street furniture and a person. Samples have been selected for their detail level, colour and cavity information to compare the efficiency of the software (Figure 1).

Fig. 2: Landscape elements

Ficus species have been selected to detect the output changes in different shapes as same type of plant. Also, white and grey coloured statues which create a significant contrast with landscape, have been selected for the study (Table 1).

Table 1: Landscape elements properties

ID	Name	Type	Material	Detail	Colour	Cavity
1	Ficus *benjamina* (Outdoor)	Plant	Leaves +	High	Green	High
2	Ficus *retuza* 'Nithida'	Plant	Leaves +	High	Green	High
3	Ficus *benjamina* (Indoor)	Plant	Leaves +	High	Green	High
4	Strelitzia *nicola* (Outdoor)	Plant	Leaves +	High	Green	High
5	Three leaves	Statue	Limestone	Low	White	Low
6	Lying knot	Statue	Marble	Medium	White	None
7	Round tower	Statue	Marble	Medium	Grey	Low
8	Girl on Sealion	Statue	Marble	High	White	Low
9	Bench	Furniture	Wood	Medium	Green	Medium
10	Picnic bench	Furniture	Wood	Medium	Brown	Medium
11	Garbage can	Furniture	Plastic +	Low	Green	Low
12	Lighting fixture	Furniture	Steel +	Low	Grey	Low
13	İsa Eren Akbıyık	Person	Cloths +	High	Multi	Low

2.2 Method

In a total of 360º degree, 45 sequential photographs in 8º degree increment with an eye-line view and 30 sequential photographs in 12º degree increment with an isometric view for each

landscape elements have been captured. Some of the overexposed photographs have been eliminated to create more solid mesh models. In a total of 70 photographs for each landscape elements have been uploaded. These data have been processed by the software and 3D models have been created as DWG, FBX and OBJ formats.

All models have been evaluated for the requirements especially in terms of geometrical, measurements and details accuracy that has to be in a 3D landscape design presentation. Those models have been compared with photographical data for 360º degree view in 8 sights for geometrical accuracy analysis and they have been measured in AutoCAD 2014 software to calculate measurement accuracy analysis.

Finally, all models and landscape elements properties have been compared in detail level, colour and cavity information and some suggestions have been developed for an efficient 3D modelling solutions.

3 Results

In the study, models have created without the need for any artificial markers or manual interaction. It turned out that all models are not suitable to meet the requirements especially in terms of geometrical accuracy and details that has to be in a 3D landscape design presentation. Also none of the models have represented as the original size in measurement analysis. Problems were caused also by shadows, perspective distortions or sun rays. Also green featured objects such as trees cannot be processed as required. But some models can be used directly in a 3D landscape modelling. Those models are the person and all of the statues that have been created (Figure 3).

Fig. 3: Created 3D models

The study shows that colour information and cavity is important for creating 3D models with the use of 123D Catch software. High contrast differences between object and the foreground enables to create more sufficient 3D models. Also compact and monoblock objects can create geometrically correct 3D models. Results shows that unless there are any holes in the structure, detail of the object is not significantly important (Table 2).

Table 2: 3D model properties

ID	Name	Geometrical	Measurement	Detail	Usability
1	Ficus *benjamina* (Outdoor)	% 21	% 63	Low	None
2	Ficus *retuza* 'Nithida'	% 24	% 52	Low	None
3	Ficus *benjamina* (Indoor)	% 11	% 71	Low	None
4	Strelitzia *nicola* (Outdoor)	% 40	% 35	Medium	Low
5	Three leaves	% 92	% 96	High	High
6	Lying knot	% 95	% 89	High	High
7	Round tower	% 93	% 75	High	High
8	Girl on Sealion	% 97	% 95	High	High
9	Bench	% 72	% 63	Medium	Low
10	Picnic bench	% 65	% 25	Medium	Low
11	Garbage can	% 83	% 50	Medium	Medium
12	Lighting fixture	% 10	% 80	Low	None
13	İsa Eren Akbıyık	% 86	% 92	High	High

Analysis shows that geometrical accuracy is not related to measurement accuracy, nor is detail level related to 3D model products usability. 3D plant models that used in the study is not suitable for a detailed work. Also lighting fixture model cannot be used in landscape modelling works. But created models of statues have % 92 – % 97 geometrically accurate and have high detail ratio. Those models can be used in a detailed landscape design project.

4 Conclusion and Outlook

Trying to identify methodological deficits surrounding practices related to the digitization of landscape, new applications such as 123D Catch, not only be used by professional landscape architects, but also must be a part of our education system and encouraged to be used.

Innovation implies the acquisition of digital skills by the professors and their training to be in step with the new media languages, in order to effectively and consciously integrate them in the teaching of their discipline (GALIZIA & SANTAGATI 2013).

The article presented an open-source set of tools for accurate and detailed image-based 3D reconstruction and web-based visualization of the metric results. The image processing for 3D reconstruction is fully automated. We are still continuing to test and refine our assumptions with new landscape elements. By doing so we will not only improve the capture quality of the models, but also understand how to choose element which can create usable 3D modelling outputs in specific design projects.

Although Autodesk 123D Catch offers improved usage possibilities, items such as plants, benches or structurally amorphous shapes (lighting fixtures, flagpoles, etc.) cannot be fully recognised by the software yet. Also these objects can be obtainable by 3D model libraries or can be easily modelled by the professional users. But objects such as unique statues, topographical or geological features can be created easily by the use of this technique. The study shows that camera can be a powerful modelling tool.

References

AUTODESK 123D CATCH (2012), http://www.123dapp.com/catch (Feb. 2012).

CHANDLER, J. & FRYER, J. (2013), AutoDesk 123D Catch: How accurate is it? Geomatics World. Low cost digital photogrammetry, 32-33.

ERVIN, S. M. (2003), Trends in Landscape Modeling. In: BUHMANN, E. & ERVIN, S. M. (Eds.), Trends in Landscape Modeling. Proceedings at Anhalt University of Applied Sciences 2003. Wichmann, Heidelberg, 1-7.

GALIZIA, M. & SANTAGATI, C. (2013), Low cost image-based modeling techniques for archaeological heritage digitalization: more than just a good tool for 3d visualization. Virtual Archaeology Review, 4 (9), 123-129.

KERSTEN, T. P. & LINDSTAEDT, M. (2012), Image-based low-cost systems for automatic 3-D recording modelling of archaeological finds of objects. Proceedings of EuroMed 2012 to, International Conference on cultural heritage.

REKITTKE, J., PAAR, P. & NINSALAM, Y. (2012), Foot Soldiers of GeoDesign. In: BUHMANN, E., ERVIN, S. M. & PIETSCH, M. (Eds.), Peer Reviewed Proceedings of Digital Landscape Architecture 2012 at Anhalt University of Applied Sciences. Wichmann, Berlin/Offenbach, 199-210.

SANTAGATI, C., INZERILLO, L. & PAOLA, F. D. (2013), Image-Based Modeling Techniques for Architectural Heritage 3d Digitalization: Limits and Potentialities. International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences, Volume XL-5/W2.