THE USE OF UAV'S IN TOPO-CADASTRAL MEASUREMENTS

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Abstract

The development of urban economy, which runs in a continuous manner and alert, requires the use of new products and technologies to respond to human and environmental needs and requirements in order to ease people's work. This paper presents the methodology for preparing a 3D model, which is necessary in order to determine the characteristics of real estate. The main purpose of this paper is to highlight the role of terrestrial photogrammetry in the land measurement activity and to provide the ease of working with programs and technologies. Creating a 3D model is beneficial to all those interested in the development of urban and rural research. To achieve the 3D model, low-cost tools for image acquisition and processing were being used, and in order to capture images, we used ultra-light drone that was equipped with a camera, in order to capture details of the area of interest, to achieve aerial images.
For the topographic survey of the area, a Total Station and GPS were necessary. The 3D Model Drawing Program is using images that can be taken from any position, in which the object that needs to be achieved, must be retrieved in minimum two images. As a way of processing, it is based on creating a common point cloud, which in the end was georeferenced. The end product can be imported into other programs for processing, CAD type, or in programs designed to simulate certain situations.

Keywords: *Agisoft PhotoScan, georeference, land measurement, 3D model, U A V.*

INTRODUCTION

The use of three-dimensional models (3D) has experienced a rapid expansion found in many areas. Due to the fact that a clear evidence of immovable property is required, such as the research of their development over time, a complex database of systems has been used, which introduced the concept of GIS (Nițu, C., ș.a. , 2002) that manages to respond to these requirements.

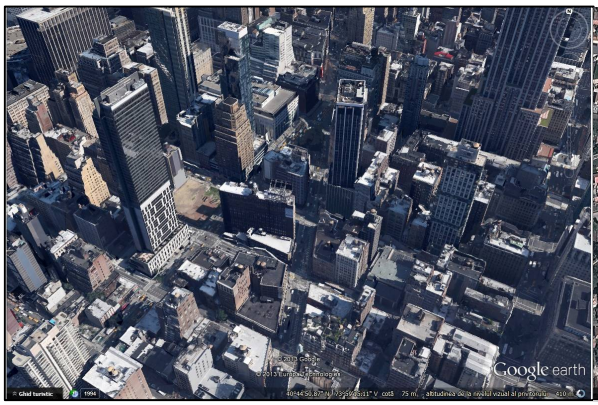

Fig. 1.2 – 3D New York- Google Earth

Fig 1.2 2D Sebes- Google maps

The main importance of the 3D model is shown in 3D, *Fig. 1.2 – 3D New York- Google Earth* where it can be seen, for example, height regime of buildings, its configuration and its inclusion in the landscape area, important elements in the development of the architecture of a metropolis . In *Fig 1.2 2D Sebes- Google maps* we can extract a particular feature, like you can determin the limits of the property, occupied areas, in others you can see the flooded areas, so having 2D model has a great importance. In a narrower sense it can be said that the 2D and 3D models highlight a deeper detailing of the area of interest, permits such decisions that can positively influence human activity.

The main beneficiaries witch are interested of these works are the National Agency for Cadastre and Real Estate Publicity and Public Administrations, witch continuously enhance urban development of administrative-territorial units in real estate. Due to current technical and technological developments, tracing administrative units can be done effectively using digital aerial photogrammetry.

MATERIALS AND METHODS

MATERIALS

Today's technology aims is to achieve the final product with all the details of the object in a short period of time, to results a product that would be more compatible with other programs. For image acquisition we used a digital camera for taking pictures of the ground and a lightweight drone, which is attached a camera with stabilizer, used at taking pictures from the air, ground controlled by a remote control. *Fig.1.3 –Lightweight drone equipped with a camera to photograph-* http://www.dji.com/

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The digital camera witch was used for image acquisition was a Nikon Coolpix L810 (Fig. 1.4. Nikon- www.nikon.com) with the following main features:

- Resolution: Megapixel: 16.1 MP;
- Focus: Select the focus area: Center, automatic face detection contrast detection;
- Focal Length (mm): 35 mm format equivalent, 22.5-58.5 mm;
- Aperture: f / 3.1-5.9; - Lens: Nikkor;
- Lens construction: 12 elements in 9 groups
- Focus range (normal, cm): T: approx. 1.5m to infinity; • W: Approx. 50 cm to infinity;

Fig. 1.4. Nikon- www.nikon.com

In order to make measurements and determine the details of land for determining the coordinates it was used Leica Total Station TCR 805 (Peună, E.I., 2014).

The software that was used in data processing was TopoSys 4.2, an offset program which processed based on two ends of the traverse, CAD software, AutoCad 2006 graphics processing data to obtain site plan and delineation of the property.

For elaborating the 3D model was used specialized software called Agisoft PhotoScan Professional, which used as input digital images taken in the field. Agisoft PhotoScan Professional (*Fig 1.5. PhotoScan Screen Shot)* can process images taken from both metric (calibrated) and uncalibrated cameras, and when processing, the program not take into account the image resolution.

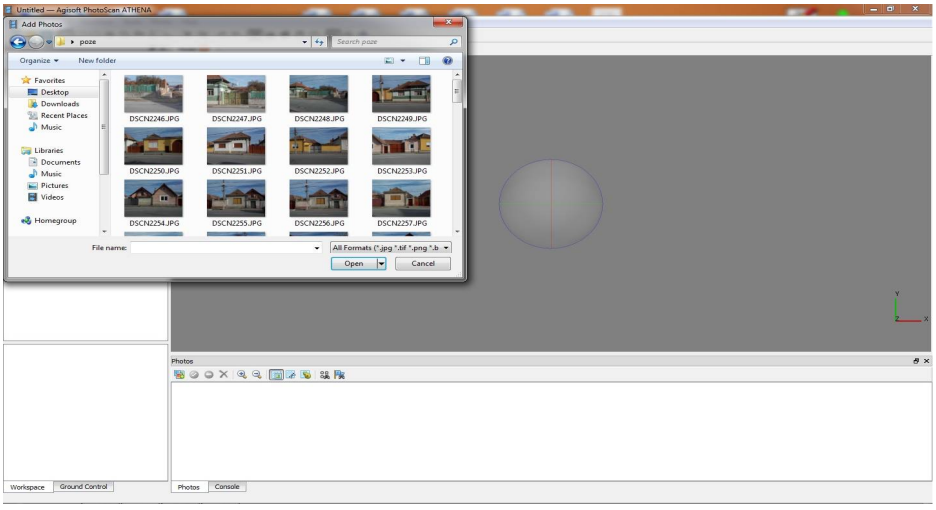


Fig 1.5. PhotoScan Screen Shot

However, the resolution must be at least 5 megapixel because these images are generated based on cloud points. Agisoft PhotoScan estimates calibration parameters of the camera automatically, so no need prior calibration procedure. Because in the work area were conducted road improvement, old topographic terminals were destroyed and had to determine four new points using a GPS brand Target Hi V30 with Getac controller 236 ps.

METHODS

Measurements and observations covered work took place in the city of Sebes, Peună, E. I., 2014). Topographic survey was done with a Leica TCR 805 Total Station, which sideshots were the limit corners and building are breaking, the topographic traverse used in order to raise the buildings was performed in the local coordinate system. Following measurements of determining the end point of the traverse generated a field book downloaded automatically to a special program.

The Total Station discharge was done with Leica Geo Office Tools program. Afret this we can finally proceed to measurements compensation, graphics processing, and documentation graphics. While achieving measurements were determined altitudes of points by trigonometric leveling method. Based on this methodes, it determined the difference in height between points, using observations of vertical angles. As a rule, the difference in level between two points can be determined if it is known tilt angle φ, which makes the direction of the item concerned with its projection on the horizontal plane. For topographical plan drawing was used AutoCAD 2006, in which we used two helpful subprograms TopoLT and Topograph. PhotoScan Agisoft program (Figure 1.7 Agisoft PhotoScan) is a program that has as a final product creation of a 3D model based on images taken from the ground. The program uses pictures that can be taken from any position.

3D image processing procedure includes four main steps:

- Align the image, which means that the program seeks images taken with a common portion, and unites them. The program detects the position of the camera for each image, also causing the camera calibration parameters.
- After aligning pictures, results a point cloud and the camera position, from which the image was taken.
- The next step is building geometry, a procedure that is based on determining the position of the camera, then the result is the surface of design.
- After it is built geometry, follows texture application on the object;
- Export.

To get results closer to reality, the program runs fine on any computer that meets the following minimum requirements: Intel Core 2 Duo or equivalent processor, 2GB of RAM. The number of images that the program Agisoft PhotoScan can process depends on the computer's RAM and processing parameters used. Assuming that the image resolution is 10 megapixels, and the computer memory is 2 GB of RAM, the program can process about 20 to 30 pictures.(www.agisoft.ru)

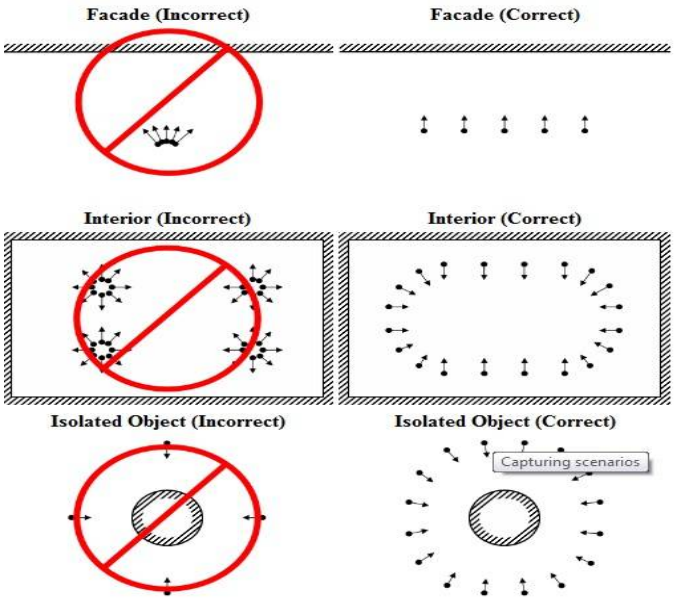
An important element in achieving a successful outcome in the creation of a 3D model is to obtain high-quality images (Ionescu. I, 2005). Images can be retrieved with any digital camera. To create a good model, it is advisable to use a camera of at least 5 megapixels, but should be avoided if possible, surprise flat objects that have a high degree of refractive or bright.

The best 3D models are those in which the subject is static. In order to obtain a model as detailed as possible, it is necessary to use a large number of images.

Each image must be as clear as possible, to be displayed in an appropriate manner and to have an adequate overlap with the previous picture.

The light is one of the most important factors. Is also the most difficult to control. According to this indicator and of the contrast degree of the image, it is shaped the object of interest. A disadvantage of too strong light, is that shadows occur, that prevents the selection

of the common points in those areas, so it prevents the creation of 3D model in a most rigorous way.



It is recommended that photos be made in a time where there are minimal shadows, being preferred cloudy days.

Regarding, taking pictures, should take into account the following issues: (*Fig 1.6 Retrieving images*)

Images to be aligned as accurately, it is advisable that they overlap of 60%. (Fig.1.9 Image overlay).

Fig 1.6 Retrieving images

The photographs were taken using drone Dji Phantom (*Fig. 1.7 Picture taken with Dj*) and using the camera Nikon Coolpix L810 (*Fig. 1.8 Picture take with a Nikon camera*). The first step that must be performed is to configure the program settings. Access the Tools menu where you choose the Preferences submenu. In the resulting window, you should see if all boxes whit CL devices are checked .

Fig. 1.7 Picture taken with Dj

Fig. 1.8 Picture take with a Nikon camera

Loading Images

This is an element that runs behind the main program, being recommended to be enabled to improve the speed of calculation, of processing.

The next step is to upload images taken with the drone and with the camera (*Figure 1.9 Inserting images print screen*). Choose the Add Photos button to add images by selecting the path from where they will be imported, and also select which images will be brought. It is beneficial to take into account the number of pictures that can program process, that depends on computer capacity.

Photos accepted in the program can be of JPG, TIFF, PNG, BMP, PPM, OpenEXR and JPEG Multi-Picture Format (MPO). If you want to delete one of the images, select it and click the Delete button on the keyboard. We have introduced a number of 150 pictures.

Aligning images

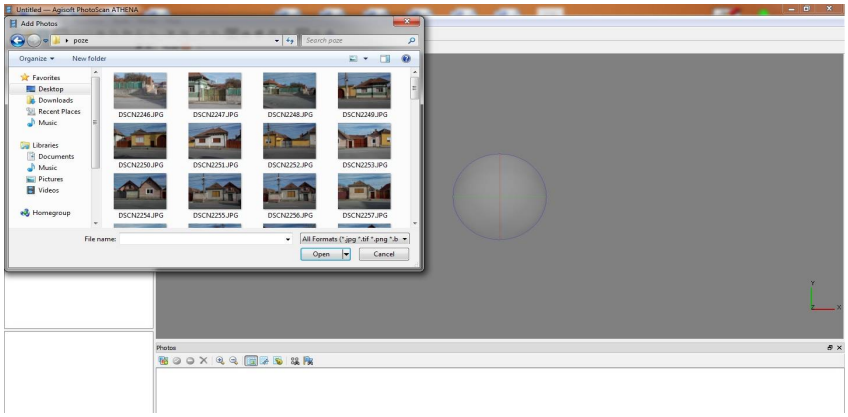


Figure 1.9 Inserting images print screen

Once inserted the images, they must be aligned in order to generate a point cloud (*Fig.1.10 Aligning images- print screen*). From Workflow menu must be selected the command Allign.

It should be selected a higher accuracy in the selection common points from photos, pairs preselection of points being on General mode. The alignment of the large sets of images can take a long period of time. A significant part of this time is spent on matching features detected in images.

Building geometry

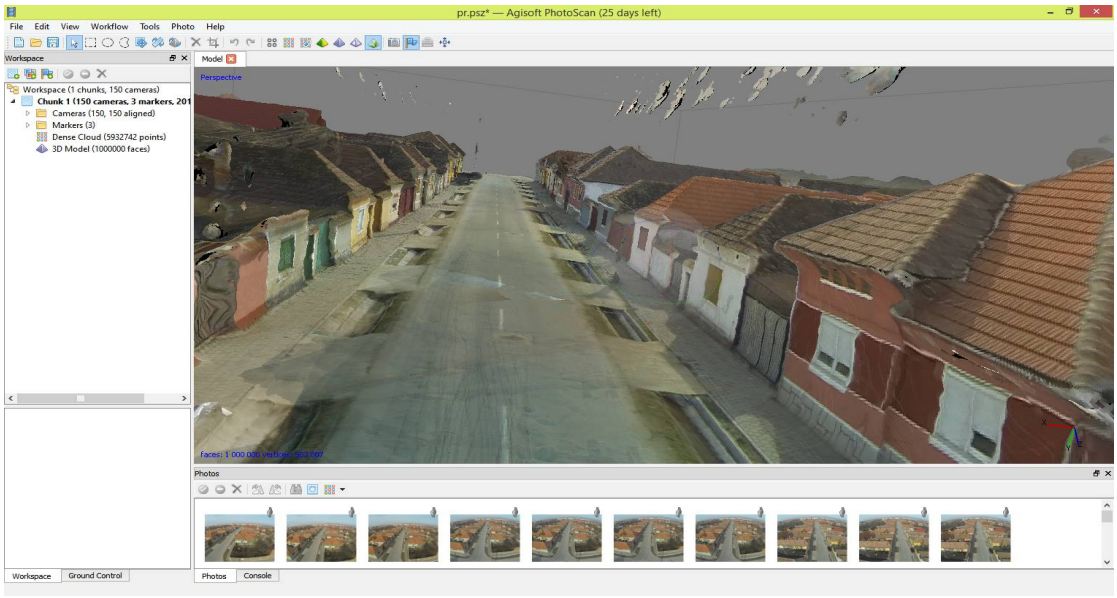
Reconstruction of the 3D model may take a long time depending on the quantity and resolution of uploaded images. It is recommended to save the project before building geometry, because it occupies a fairly large space in computer memory. Choose the Workflow and then chose Build Geometry.

Choosing the type of item to be arbitrary, can be used for shaping any kind of object. The options can be selected for closed objects such as statues, buildings, streets, in the present case. The resulting image in such detail occupies more memory to your computer.

Adding texture

As for adding texture, must be selected the best options for a definite result. Proper selection of the mapping mode helps to achieve optimum texture, so a better quality visual of the final model. Making a comparison between the real and the resulting 3D model, (*Fig. 1.11*

Fig.1.10 Aligning images- print screen



Model- print screen) it can be concluded that it can simulate an accurate 3D model that can be used in various projects.

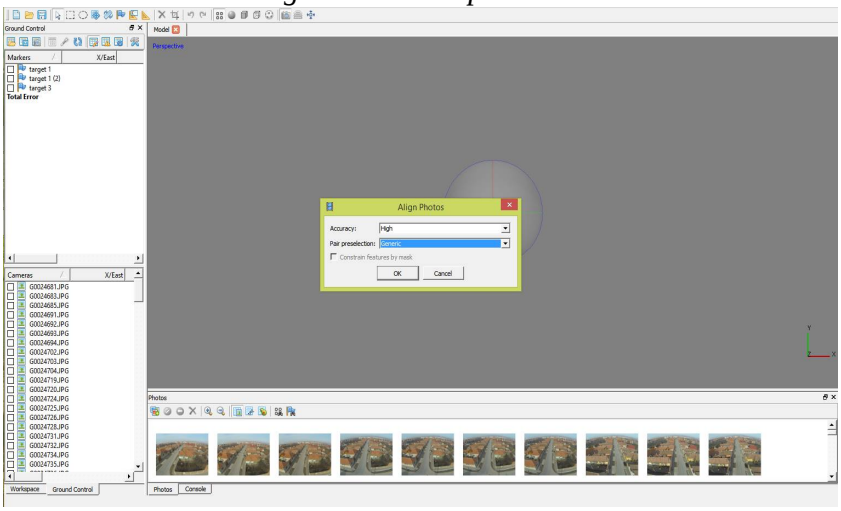
Placing markers and entering coordinates

Finally, to scale the model are introduced markers placed in at least two images. Markers are used to create a coordinate system for measuring distances in the scene. The model can be located either in the local Euclidean coordinates either georeferenced coordinate. Depending on requirements, the model uses the coordinates of position, coordinates of a camera, or both.

Export 3D model

PhotoScan supports export to different representations: rare and dense point clouds, calibration data of the camera, 3D models. Orthophotos and digital elevation models can be obtained according to user requirements. Clouds of points and calibration data of the camera can be exported immediately after image alignment is done. All other export options are available after the geometry is constructed. PhotoScan allows to export ortho-photo in different plane projections. PhotoScan can upload directly to other software platforms

Fig. 1.11 Model- print screen



destined 3D models that aim to develop the concept for the purposes of creating 3D animation such as platform or Verold Sketchfab.

The most important export feature is that the program allows export to CAD programs, exporting triangular grid-based on a point cloud format. Export advantage is the fact that the problem can be combines with other areas. For example, you can make various simulations on the property concerned.

CONCLUSION

The research will develop continuously to get more and more accuracy in less time, in low-cost design, so this model can be used for various technical and non-technical purposes.

This is a public consultation tool which can help visualize its urban design and its planning.

Provides results to help architects and building designers in order to develop the unoccupied buildable area in a manner most beneficial to the population.

Helpful in evaluating the applications development for new buildings, allowing precise fixation and simulating how the building will look like in the City.

Illustrates the location of heritage sites and other important public facilities and attractions.

In the last period of time the 3d model has expanded focusing increasingly on it.

This method of obtaining the model is relatively cheap because it uses images taken with a camera, images that are fed into a processing program.

Current trends are to use laser scanning technology which obtain results in a much faster way and more accurate, but this method is expensive.

Books

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