USE OF ORTHOPHOTOIMAGES IN ORDER TO ACHIEVE THE ZONAL URBAN PLAN IN VULCAN AREA, DEVA MUNICIPALITY, HUNEDOARA COUNTY

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Abstract. *The studies presented in this paper were carried out in the western part of Romania, on the administrative territory of Deva Municipality, in the Vulcan area, in order to achieve a zonal urban plan. The purpose of the study is the acquisition of GIS data related to the realization of the plans for the technical approval for the Vulcan zonal urban plan. To achieve this plan, by default a GIS database, we used the LEICA TS02 total station with the measurement accuracy of 1 mm / km for distances and 2 seconds for angles, GNSS GPS rover RTK South S82T equipment to determine the points marked on the route that is to be traversed by the eBee senseFly drone, which helped with time management. Regarding the detailed topographic surveys, made with the help of GNSS equipment, total and aerial photography stations, the use of aerial photography technology is a real advantage, by reducing the working time, the investigated area and the complexity of the acquired data. The accuracy of these measurements is up to par with that from the usual equipment used. The advantages of using geographical information systems and their applicability in many fields has led to the spread of this concept. Most institutions, companies working with spatial data have initiated a GIS project. Once all the information from the field is collected, the office part follows, where all the collected information is gathered and a plan is made in AutoCad, respecting the layer levels. At the same time, the data taken with the aircraft is downloaded, thus making an orthophotoplan. The orthophotoplan is aligned on the points taken over with the GNSS equipment or the total station, during the measurements. After making this plan, it is loaded into AutoCAD to complete the database with information on postal numbers, street name, green areas in that area, street width. Some information will be retrieved automatically, but other will be entered manually for each entity. This working method offers a short working time while not compromising data accuracy.*

Keywords: *AutoCad, Postflight Terra3d powered by Pix4D, Orthophotoplan,*

INTRODUCTION

If at the beginning the implementation of a geographical information system meant the acquisition of hardware and software, now there is an increasing emphasis on data collection and implementation of customized geographic information systems (HERBEI ET AL., 2018; HERBEI, 2015).

Customized Geographic Information Systems have been developed for various uses: inventory of technical and municipal cadastre, environmental applications, pollution and impact studies, financial analysis and strategies, applications for monitoring technical and municipal networks, disaster prevention applications, tourism applications , monument protection, routing applications, public and private inventory applications, urban applications, precision agriculture (HERBEI AND SALA, 2014; HERBEI ET AL., 2016) etc.

With the implementation of new technologies in almost all important areas of daily life, it was only a matter of time before the influences of modernization would appear in the cadastre.

Undoubtedly, one of the most important achievements in terms of cadastre was the creation of a digital database. By creating this database, a complete record is ensured, easily accessible but also resistant over time.

In the analysis of the geographical space in the last years, the “satellite” approach is observed more and more, following different aspects, through various techniques and means. Both GIS techniques, used in previous research (SIMON, ET AL., 2017), and CAD techniques (SIMON ET AL., 2017), provide a complex analysis, with results clearly superior to classical methods used in the past.

In recent years, the number of sensors and data collection systems has grown considerably. In addition to total stations and GNSS systems, the most used topographic equipment, today, there are several options available for data collection, both topographic and for other fields of activity, from several different sources (CHATZISTMANIS, ET AL., 2018) such equipment is drones, aerial photography equipment.

For example, the eBee airplane drone, manufactured by Sensefly, collects information in the form of point clouds together with stereographic images, by scanning from a height. Depending on the need, the “range” of the camera can be established, but it cannot penetrate beyond solid obstacles or into another plane (TUCCI, ET AL., 2018).

All the data obtained with the help of these equipments are complementary and the final result will be an Orthophotoplan of the Vulcan area.

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MATERIAL AND METHODS

All the data obtained with the help of these equipments are complementary and the final result will be an Orthophotoplan of the Vulcan area.

The research presented in this paper was conducted in Deva, Vulcan area, Romania. The municipality is located on the banks of the Mureș River. The case study presented below was performed in the Vulcan area (fig. 1). The study area is located along Iosif Vulcan Street in Deva. The street structure is uniform, a main street that branches into related streets. The buildings and buildings are on either side of the main street with various positions. Most are lined up on the street, but there are many homes set aside.

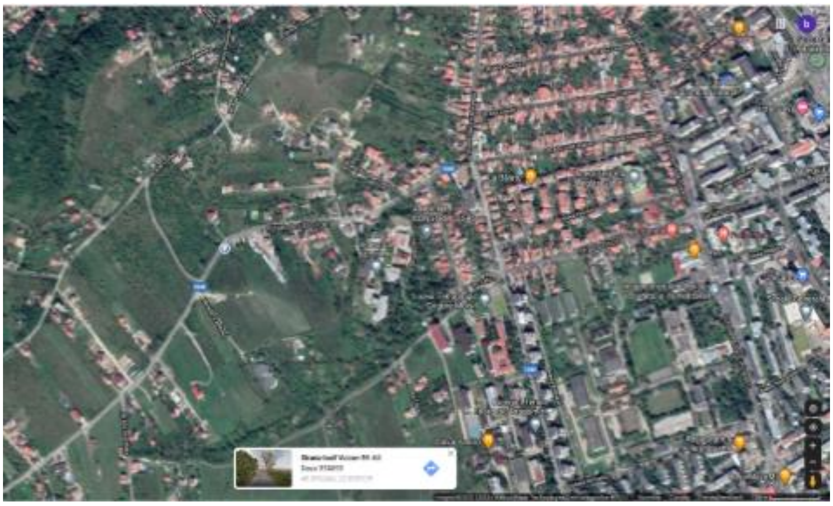

Figure 1. Location of the study area

The working methodology that was the basis of this study was divided into several stages and is summarized in the following list:

- Realization of the flight plan in the eMotion program and establishing the area to be measured
- Taking data from the field
- Processing of data taken with topographic and aerial photography equipment from the field
- Data entry in the AutoCad and Postflight Terra3d program powered by Pix4D
- The orthophoto image obtained after processing is aligned according to the data taken with GNSS equipment. Preparation of documentation for obtaining the technical approval from the Office of Cadastre and Real Estate Advertising.
- Elaboration of the zonal urban plan.

With the help of the GNSS GPS rover RTK South S82T receiver, points were measured on which the orthophoto image generated with the PixflD-powered Postflight Terra3d program will be georeferenced. The points measured with the GNSS receiver were marked with concrete nails and reflective spray.

The next step is to plan the mission of the eBee senseFly aircraft. Flights in the eMotion program are scheduled according to the specifications of the aircraft, the operator having to select only the coverage area, the flight altitude from the take-off point and the desired accuracy. Depending on these, the software generates a flight path and a required number of frames to be taken during the flight. Using the aircraft I shortened the time spent on the field. (fig 2.)

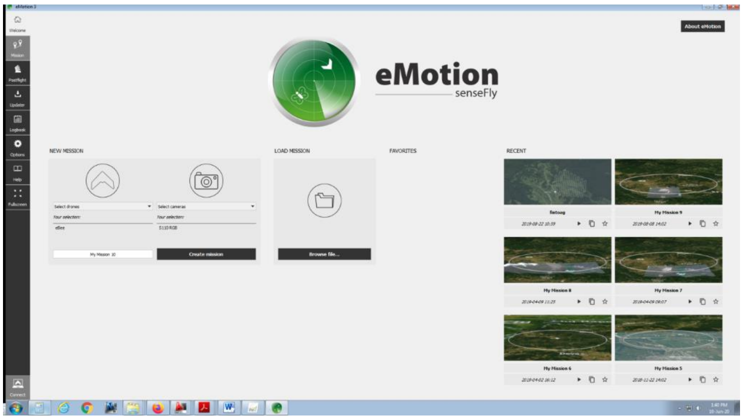

Figure 2. Flight scheduling

Equipment used

- *Tools used for data collection (fig. 3)*

Designed to capture the surrounding realities quickly and easily, the eBee SenseFly drone makes the actual measurement a simple procedure. The equipment is a platform for sensors to capture reality. EBee Classic is the easiest-to-use mapping drone on the market, captures images and lands on its own, no piloting skills required. Given that the scanning process results in millions of dots representing the exact position of all objects in the scanned area, the scanning process allows a better use of resources because in case of omission of details is not necessary another field visit. All determinations were made in the 1989 European Terrestrial Reference System (ETRS89), introduced in Europe as a geodetic reference system, but were automatically transformed due to the implementation in the receiver used of the eTransDat software in the 1970 National Stereographic Reference System (STEREO 70). (fig. 3.1)

Rompos South S82-V RKN GNSS with real-time work possibilities, with internal radio on the frequency of 433 MHz and 4GB memory, has an integrated post-processing software and offers high measurement accuracy. The selectable antenna and the customized frequencies are optimized for applications specific to the job in question. (fi 3.2)

The GNSS positioning technique was used to determine the points marked on the network. The determinations were performed with Rompos South S82-V RTSS GNSS receivers, which allow the determination of the spatial position of a point of interest using the RTK (Real Time Kinematic) method. The system ensures fast positioning with a high accuracy of up to 2 cm depending on the number of visible satellites, the GSM signal and the corrections from the Romanian Position Determination System (ROMPOS). This system is based on Global Navigation Satellite Systems (GNSS) including GPS-NAVSTAR and GLONASS, providing complementary data needed to improve positioning accuracy to the order of a few millimeters.

To determine the points along Iosif Vulcan Street, in the first phase we used the total station LEICA TS02, with routes from known points. (fig. 3.2)

We gave up the topographic surveys with the total station at the expense of scanning with a newer equipment appeared on the Romanian market, namely the eBee SenseFly drone. This equipment captures and combines image and point cloud data, even in locations where GNSS positioning is missing.

Figure 3.1 Tools used for data collection

Figure 3.2 Tools used for data collection

➢ **Hardware components**

An Asus Rog laptop with a very powerful processor was used to process the data, which allowed the processing of the large amount of information contained in the digital images. The main features of the laptop are: Intel® Core ™ i7-4700HQ 2.40GHz processor, Kaby Lake ™, 16GB, 1TB, nVIDIA GTX 860 4GB.

Software components used

The use of modern equipment and taking over the data from the field led, implicitly, to the use of the programs with which it was equipped, but also programs for processing. In this sense, considering the operations performed, the following programs were used:

- eMotion 2 SenseFly for flight mission scheduling
- Postflight Terra3D powered by Pix4D for processing data taken with the aircraft
- TransDatRO for data processing
- AutoCAD for making the plan

RESULTS AND DISCUSSIONS

GNSS determinations on the points marked on the route were performed by the RTK method using GNSS equipment. After completing this procedure, we have the data for the alignment of the orthophotoplan to be generated from the data taken with the help of the dorna.

To perform the measurement using the aircraft, we will perform three steps:

- In the first stage, the flight mission from the office will be established; (fig 4.1)
- The second stage will go out on the ground with the aircraft, it will be placed on the launch point preset by the surveyor (fig. 4.2)
- After completing the flight mission, the equipment is unloaded and the measurement and images taken by the camera integrated in the eBee SenseFly drone are processed. (fig. 4.3)

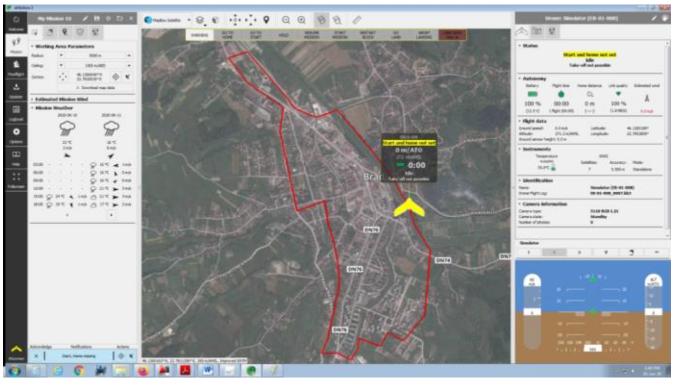

Figure 4.1 First stage

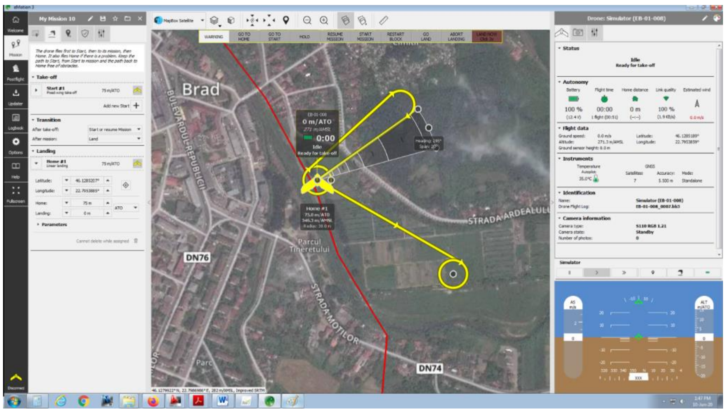

Figure 4.2 Second stage

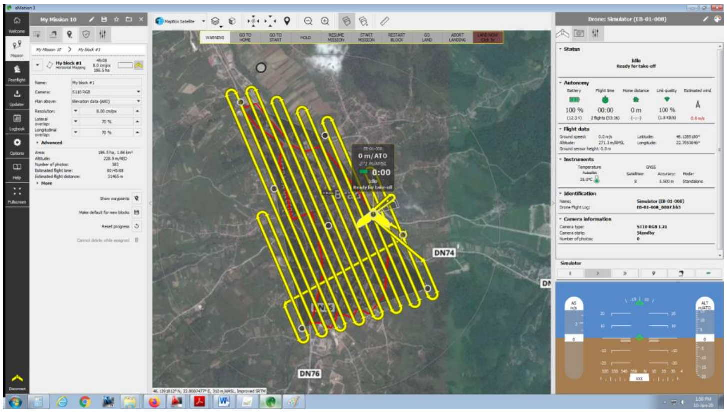
Figure 4.3 Final stage

The data obtained through the scan was processed in the Pix4D program, which is a data processing software taken with the eBee senseFly aircraft. The data taken with the drone are both images and point clouds. (fig. 5)

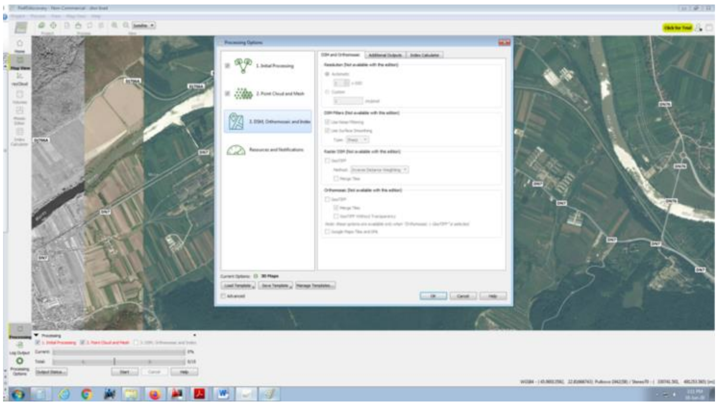
Figure 5. Data processing using the Pix 4D program

From this menu, select the flight to be downloaded, the flight log to be used, download and coordinate the pictures taken and create the project. (fig. 6).

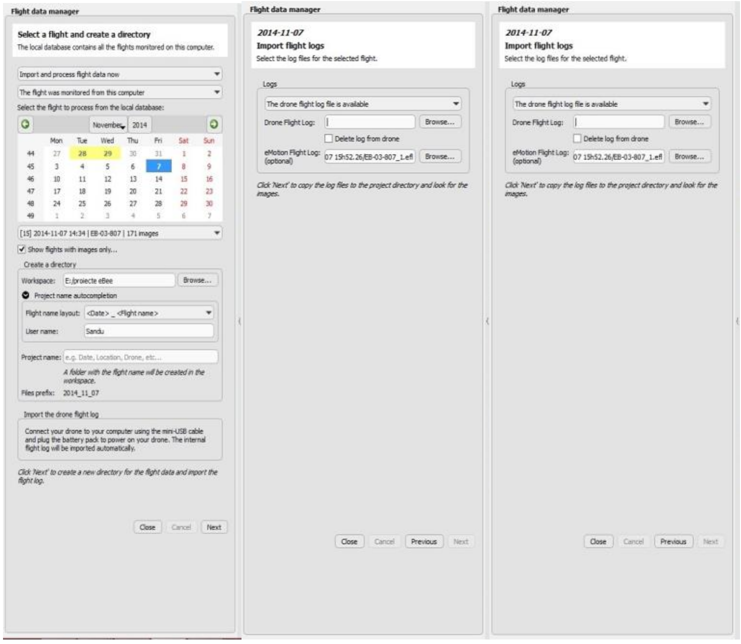

Figure 6. Flight unloading

The project can be imported either directly from the eMotion interface or by creating a new project and manually importing pictures taken with the drone. (fig. 7)

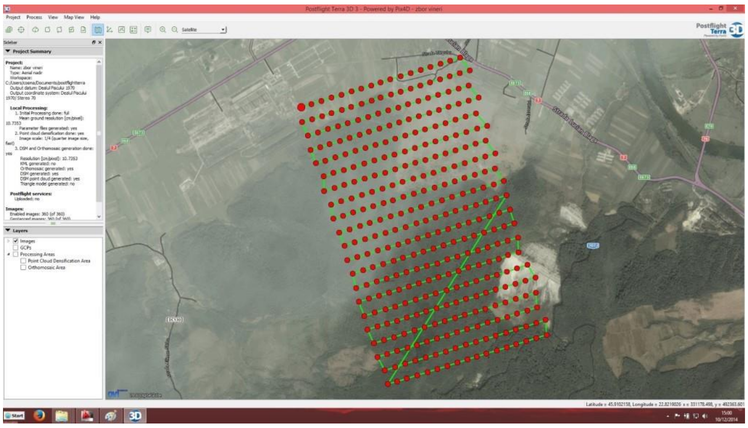

Figure 7. Viewing images taken by the drone

CONCLUSIONS

The advantages of using geographic information systems and their applicability in many fields have led to the spread of this concept. Most institutions, companies working with spatial data have initiated a GIS project.

Other advantages of using GNSS and aerial photography technology are:

- Speed of measurements (for detailed topographic surveys or other types of projects);

- Obtaining point clouds, therefore a detailed image, in coordinates of the area of interest;
- The precision and accuracy of the data obtained;
- The high degree of detail, gives the possibility to use the images obtained in projects such as arrangements in the field of constructions, design, road infrastructure, geodesy and general cadastre, architecture, cartography, etc.
- The possibility of using the data obtained in the GIS environment which allows "combining" with other geospatial data or creating non-graphical databases.

BIBLIOGRAPHY

CHATZISTAMATIS, S., KALAITZIS, P., CHAIDAS, K., CHATZITHEODOROU, C., PAPADOPOULOU, E.E., TATARIS, G., SOULAKELLIS, N., 2018. Fusion of tls and uav photogrammetry data for post-earthquake 3d modeling of a cultural heritage church, the international archives of the photogrammetry, remote sensing and spatial information sciences, volume xlii-3/w4, 2018 geoinformation for disaster management (gi4dm), 18–21 march 2018, istanbul, turkey

HERBEI M.V., SALA F. 2014. Using gis technology in processing and analyzing satellite images case study cheile nerei beusnița national park, romania. journal of horticulture, forestry and biotechnology. 18(4): 113-119.

HERBEI, M. V., POPESCU, C. A., BERTICI, R., SMULEAC, A., & POPESCU, G. (2016). Processing and use of satellite images in order to extract useful information in precision agriculture. Bulletin of University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca. Agriculture, 73(2), 238-246.

HERBEI, M. V., ULAR, R., & DRAGOMIR, L. (2011). Map overlay in GIS. TRANSACTIONS on HYDROTECHNICS, Politehnica University Timisoara, (56), 70.

HERBEI M.V., SMULEAC A., POPESCU C.A. 2018. Cartografie digitala & mobila GIS. Ed. Mirton, Timisoara 2018

HERBEI M., GIS si Modelare cartografica, Ed. Universitas, Petrosani, 2015

SIMON, M., POPESCU, C.A., COPĂCEAN, L., COJOCARIU, L., 2018 - Topo-Cadastral and geospatial analysis of the structure of the functional fund and procedures for change of the land use category, International Multidisciplinary Scientific Geoconference : SGEM; Sofia, vol. 18, ISS. 2.3, (2018). doi:10.5593/sgem2018/2.3/s11.087

SIMON,M., POPESCU, C.A., BORDEAN, M.D., COPACEAN, L., COJOCARIU, L., 2017 - Geomatic models applied in the planning of agricultural space in the western area of Romania, SGEM2017 Vienna Green Conference Proceedings, ISBN 978-619-7408-27-0 / ISSN 1314-2704, 2017, vol. 17, issue 33, 561-568 pp; doi: 10.5593/sgem2017h/33/s14.070

SIMON, M., POPESCU, C.A., COPĂCEAN, L., COJOCARIU, L., 2017 - CAD and GIS techniques in georeferencing maps for the identification and mapping of meadows in Arad county, Research Journal of Agricultural Science, vol 49(4), ISSN 2066-1843, pp. 276-283, 2017

TUCCI, G., BONORA, V., CONTI, A., FIORINI, I., 2017 - Digital workflow for the acquisition and elaboration of 3D data in a monumental complex: the fortress of Saint John the Baptist in Florence, The International archives of the photogrammetry, Remote sensing and spatial information sciences, volume XLII-2/w5, 2017, 26th International CIPA Symposium 2017, 28 august–01 september 2017, Ottawa, Canada

https://arad-city.map2web.eu

https://leica-geosystems.com/products/detection-systems/cable-locators/leica-ultra

https://leica-geosystems.com/products/mobile-sensor-platforms/capture-platforms/leica-pegasus-backpack

https://blog.hexagongeosystems.com/how-to-choose-the-utility-detection-instrument-that-best-suits-my-tasks/