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3D GIS FOR SURVEYING AND PROPERTIES INVENTORY

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Abstract

This paper aims to present the use of 3D GIS for properties inventory and improvement of topographic data for Manastirea town (Calarasi County). The used sources were provided by local authorities and public institutions, and consist of plans and topographic maps, orthophotos and cadastral plans. The data was processed as follows: digitizing maps and data extraction from orthophotos by image interpretation, field data collection, GIS database design and implementation, a 3D analysis and a virtual reality model demonstration. It will be presented the three-dimensional data acquisition and the modeling and reconstruction method for objects with realistic visualization. In conclusion, I wish to demonstrate the applicability of this application in areas such as surveying and architecture, as implemented recalling directions: restitution facades in order to restore the execution of reports architectonics construction and reconstruction of historical monuments or historical monuments initial image with high degree of degradation.

Key words: *3D modeling, GIS, survey, database, orthophoto.*

INTRODUCTION

GIS is currently the most widely used tool for the analysis and presentation of spatial data from various sources. This paper aims to present the possibilities and benefits of using 3D GIS for properties inventory, and also easy retrieval of information about this. It will explain the strategy and the priorities to be applied in land using and construction, so the result will be a valuable document similar to an administrative and a technical tool of local authorities related to urban management and development of the area.A GIS approach necessarily involves treating unit into a unique database of components, mapping, topology and tabular. Although they have an important role within GIS, computer graphics elements are only one of the processes of consultation and reporting the contents of a spatial database. Database allows a wide range of other types of exploitation that special require handling capacity in processing on geographic and analytical criteria. . A GIS includes a collection of spatial operators acting on a spatial database for geographic cover a wide variety of real information. A GIS data model is complex because we have to represent and interconnect both graphical data (maps) and tabular data (attributes). In addition, even by its nature, a complex GIS is used to simulate real situations and extremely complicatedevents. This requires even more the ability of the GIS model to play perfectly events and true events. A GIS data model aims to represent Earth in a structured digital format that allows users to create, edit, update, view, analyse and represent graphical geographic data. A data model must be simple, easy to understand, flexible enough to represent data from a variety of sources, and while robust, able to model complex geographical processes and adapt to the specifics of each application. (Mihai D. 2012). The 3D GIS system is the only tool that can rationally, intelligently and efficiently solve the problems related to terrestrial resources, by facilitating the processing and the analysing of spatial data from conventional sources (maps and topographical plans) and sources that involve advanced technologies (satellite images and GPS). Thus, GIS systems, by integrating databases containing location information with decision support facilities, are a fundamental aid in the management of any complex organization. The applicability of this tool is virtually unlimited because the vast majority of human activities had as important feature the localization and spatial analysis.3D GIS is also very useful to visualize large three-dimensional data sets from many points of view, or creating a realistic perspective images in raster and vector data over a surface. Thus, I present the basics of this technology and the first steps in implementing a GIS to be a starting point for future developments that serve different purposes.

MATERIALS AND METHODS

The software used is ArcGIS for Desktop, version 10.1. To represent the study area and its integration into GIS, I have created a type of database called "file geodatabase". This can be done from the Catalog in ArcCatalog or the Catalog window in ArcMap. Inside it I created several feature classes, defined as homogeneous collections of spatial objects of same type of geometry and common set of attribute columns. These are represented as "buildings", "paths" and "green spaces". The cartographic support was an orthophoto from 2005 for Calarasi County (Figure 1), which was georeferenced in Stereo 1970 national coordinate system.Building roofs were vectorised and I have been displaced them to match the footprint, the purpose being to match the real model. Paths and green spaces have been vectorised as polygon.
To ensure spatial continuity between vectors obtained by digitizing and to prevent empty spaces, it was created a topological data structure with the "must have gaps" rule. Topology has allowed identification of all digitization errors and corrects them, so the whole set of data is currently in topologically correct.
For creating digital terrain model (Figure 2) there were vectorised 425 elevation points from the topographic plans (1:5000 scale) on Manastirea, and based on this was created by interpolation, using the Anudem interpolation method implemented in ArcGIS for Desktop program, Spatial Analyst extension at Topo to Raster tool, which is the representation of continuous elevation of the topographic surface.Geodatabase was created in ArcCatalog and for 3D visualization and editing was used ArcScene application from ArcGIS for Desktop software package.

Figure 1. Study area location

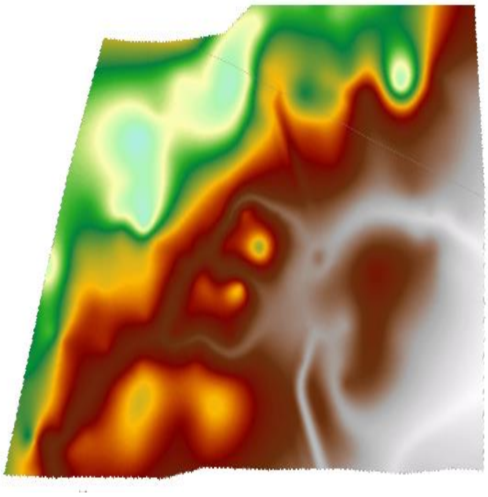

Figure 2. Digital elevation model

This collection of data was overlapped to the terrain model and for 3D visualization it was changed the vertical exaggeration value from 0 to 5. Changing vertical exagere factor is required where elevation differences are too small to be perceived by the human eye. Polygons that represent buildings were extended vertically by an amount equal to their height, and the building height was estimated approximately equal for each common building. The height was mapped in the field and the buildings were positioned on the digital elevation model, similar to each spatial object that was positioned spatially on that model. The height of digitized spatial object (excepting buildings) was mapped on the ground and then extrapolated for similar items (e.g.: a tree was measured and all that trees gained the same amount of height). To create textures I used Google Sketch-Up program that allows shooting in the field of spatial objects and the reproduce them in 3D (Figure 3). The footprint of each object was exported from ArcGIS and imported in Sketch-Up; here was processed and it was generated a 3D model which in turn was imported into ArcScene.

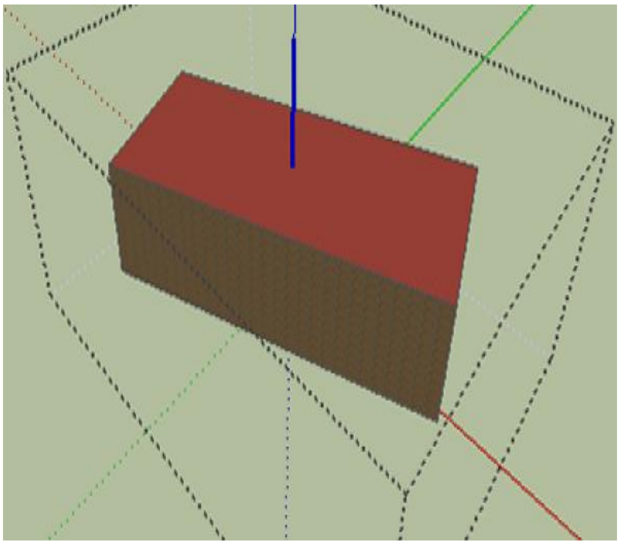

Figure 3. Edit building using Google Sketch Up

For buildings this procedure was performed for each one, but for the other elements it was performed only a few times. Trees and infrastructure elements with similar appearance were created one time only and then copied like symbology in ArcScene (Figure 4).

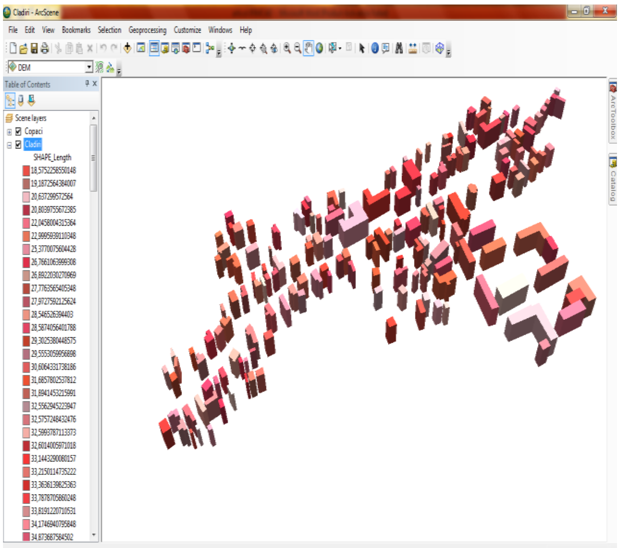

Figure 4. Buildings after exporting to ArcScene

RESULTS AND DISCUSSIONS

For Manastirea town 387 elevation points were digitized, of which the digital elevation model was interpolated. It was obtained a number of digitized buildings equal with 560 (Figure 5) and a number of green spaces equal with 611. Based on it, the user can query the 3D spatial object and then find information about it. Information about 3D objects from Manastirea town can simply be learned by 3D query of each spatial object or by making SQL queries.

Table

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OBJECTID *	SHAPE *	SHAPE_Length	SHAPE_Area
1	Polygon	65,675958	243,15988
2	Polygon	53,641875	179,780493
3	Polygon	61,889647	134,01482
4	Polygon	69,896095	167,546679
5	Polygon	66,424016	229,019801
6	Polygon	44,0779	120,662145
7	Polygon	116,208739	770,917282
8	Polygon	29,555306	54,288293
9	Polygon	48,407119	79,688952
10	Polygon	32,556295	65,62544
11	Polygon	39,021819	76,007436
12	Polygon	28,546526	49,470437
13	Polygon	38,976384	92,703987
14	Polygon	38,957478	94,728538
15	Polygon	72,048607	212,412552
16	Polygon	127,238817	593,008192
17	Polygon	72,898482	257,498092
18	Polygon	34,174694	72,087479
19	Polygon	39,242826	85,876922
20	Polygon	41,851493	95,531379
21	Polygon	44,713865	114,745094
22	Polygon	69,458111	229,169088
23	Polygon	22,999594	32,158373
24	Polygon	59,343943	214,739928
25	Polygon	51,022701	161,972271
26	Polygon	20,803976	26,104857
27	Polygon	85,844813	434,489372
28	Polygon	37,763685	84,224439
29	Polygon	31,894145	63,483625
30	Polygon	152,150494	703,328215
31	Polygon	191,48323	1376,325995
32	Polygon	92,492138	398,478664
33	Polygon	48,029271	135,237827

1 (0 out of 177 Selected)

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Figure 5. Attribute table for buildings

CONCLUSIONS

Using virtual reality provides a better understanding of surrounding space and better support for decision-making (Figure 6). The time required to achieve 3D models is significantly higher than for achieving 2D models, but the amount of obtained information is considerably higher. These results can contribute in the design of a 3D city modelling software and can indicate the benefits of integrating 3D city models in working processes of communities.

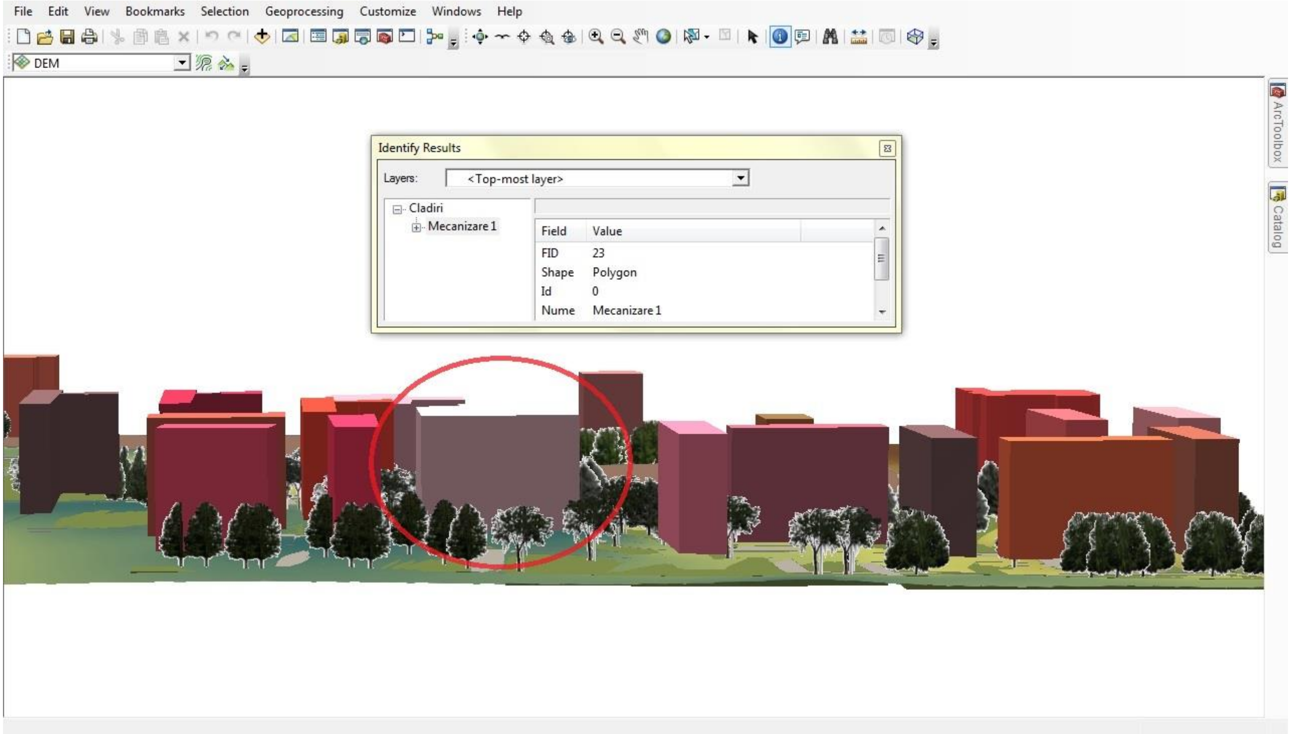

Figure 6. Query of a building

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ArcGIS for Desktop Help

Google Sketch Up Help

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