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USAMVB CAMPUS INVENTORY AND SURVEYING USING 3D GIS TECHNOLOGIES

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Abstract

GIS – Geographical Information System is currently the most used tool for analyzing and presenting spatial digital data of various sources. This paper aims to present the use of 3D GIS for properties inventory for the Campus of USAMVB. The used sources were provided by local authorities and public institutions, and consist of plans and topographic maps, orthophotos and cadastral plans. This article is focused on the application of GIS tools in the process of data processing for the needs of campus information. 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 modelling and reconstruction method for objects with realistic visualization. Obtained data from the output maps will be for users more friendly, more readable, more recent and accessible. Through the web interface will be easier for the users to get the required information.

Keywords: *3D modelling, GIS, database, USAMVB campus*

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 easy retrieval of information about this. It will talk about the strategy and the priorities need to be applied in land and construction using, making it a valuable document like an administrative and technical tool of local authorities related to urban management and development of the area. 3D GIS technology arose from the need to facilitate the analysis of complex operation for which the existing systems does not offer any possibility or need for increased consumption or difficult procedures (M.Doru, 2012). The 3D GIS systems is the only solution that can be solved rationally, intelligently and effectively the problems related to terrestrial resources, facilitating the processing and the analysing of spatial data from conventional sources(maps and topographical plans) and sources that involves advanced technologies(satellite images and GPS). Thus, GIS systems, integrating databases containing location information with decision support facilities are a fundamental aid in the management of any complex organization, the applicability of this application is virtually unlimited because the vast majority of human activities had as important feature the localization and spatial analysis. In this case, because exists available data, the application can be created for any geographical or administrative problem, thereby providing objectivity in presenting information. This can make predictions of a phenomenon in space and time because the level of detail the data is high and the decision-making process is increased and improved, offering advanced visualization, analysis and generating tools for surfaces (M.Doru, 2012). 3D GIS are 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 by ―buildings”, ―paths”, ―green spaces” and ―recreation areas”. The cartographic support was an orthophoto from 2009 for Bucharest (Figure 1), geo-referenced in Stereo 1970 national coordinate system.

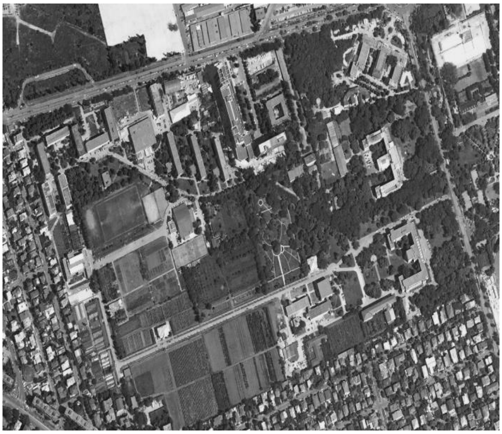


Figure 1. Study area location

Building roofs were vectorised and to match the real model there have been displaced by the footprint. Paths, green spaces and recreational areas have been vectorised polygon. To ensure spatial continuity between vectors obtained by digitizing it was created a topological data structure with the ―must have gaps” rule, to not exist empty spaces. Topology allowed identification of all digitization errors and has corrects them, so the whole set of data is currently in topologically correct. For creating digital terrain model (Figure 2) it were vectorised 257 elevation points from the topographic plans (1:2000 scale) on Bucharest, and on this basis 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.

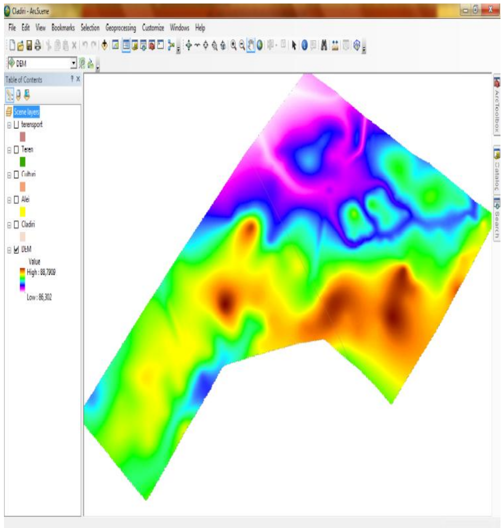


Figure 2. Digital elevation model

Geodatabase was created in ArcCatalog and for 3D visualization and editing was used ArcScene application from ArcGis for Desktop software package. 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 from the number of floors of each building. The number of floors was mapped in the field and the buildings were positioned on the digital elevation model, same with each spatial object that was positioned spatially on that model. The height of digitized spatial object (except buildings) was mapped on the ground and the extrapolated for similar items (for example: a power pole was measured and all that poles 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.

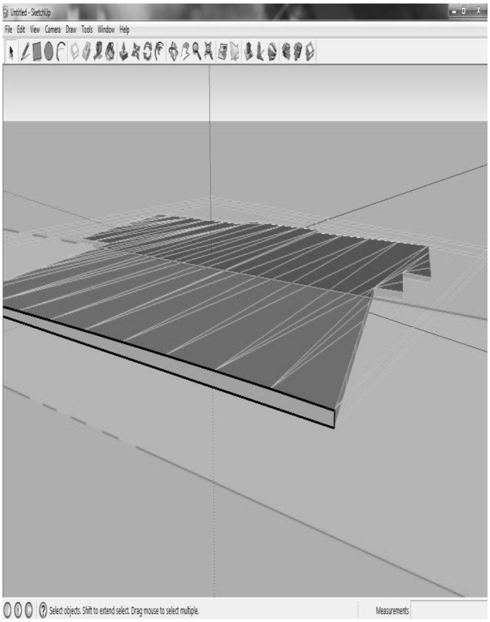


Figure 3. Edit building using Google Sketch Up

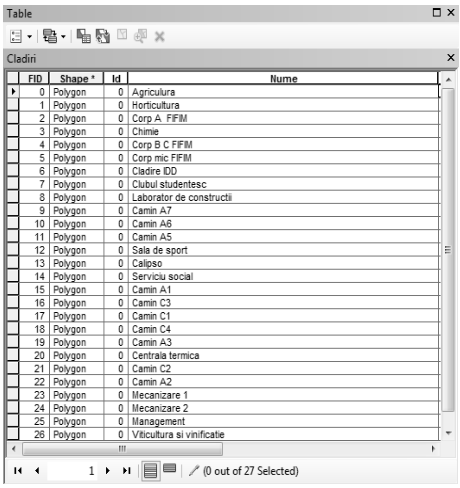
For buildings this procedure was performed for each building, but for the other elements it was performed only a few times. Trees and infrastructure elements with similar appearance were created one time only and then copied like symbol in ArcScene. FIFIM building was further processed, so the whole building was digitized in detail, it was digitized every room and access element separated and symbolized corresponding to the texture collected in the field.

RESULTS AND DISCUSSIONS

For USAMVB campus were digitized 257 elevation points of which was interpolated the digital elevation model. It was obtained a number of digitized buildings equal with 27 (Figure 5) and a number of green spaces and recreational spaces equal with 31. (Figure 4)

Figure 4. 3D view of USAMVB campus

Based on it, the user can query the 3D spatial object and find information about it. Information about 3D objects from USAMVB campus can simply be learned by 3D query of each spatial object or by making SQL queries (for example: all trees of green spaces or all the administrative buildings of the USAMVB campus).



Table

Cladiri

FID	Shape *	Id	Nume
0	Polygon	0	Agricultura
1	Polygon	0	Horticultura
2	Polygon	0	Corp A FIFIM
3	Polygon	0	Chimie
4	Polygon	0	Corp B C FIFIM
5	Polygon	0	Corp mic FIFIM
6	Polygon	0	Cladire IDD
7	Polygon	0	Clubul studentesc
8	Polygon	0	Laborator de constructii
9	Polygon	0	Camin A7
10	Polygon	0	Camin A6
11	Polygon	0	Camin A5
12	Polygon	0	Sala de sport
13	Polygon	0	Calipso
14	Polygon	0	Serviciu social
15	Polygon	0	Camin A1
16	Polygon	0	Camin C3
17	Polygon	0	Camin C1
18	Polygon	0	Camin C4
19	Polygon	0	Camin A3
20	Polygon	0	Centrala termica
21	Polygon	0	Camin C2
22	Polygon	0	Camin A2
23	Polygon	0	Mecanizare 1
24	Polygon	0	Mecanizare 2
25	Polygon	0	Management
26	Polygon	0	Viticultura si vinificatie

(0 out of 27 Selected)

Figure 5. Attribute table for buildings

The Identify tool allows you to see the attributes of your data and is an easy way to learn something about a location in a map (Figure 6). Clicking the Identify tool on a location inside a data frame will present the attributes of the data at that location. When identifying features with the Identify tool, the attributes are presented in a feature-by-feature, layer-by-layer manner in the Identify window.

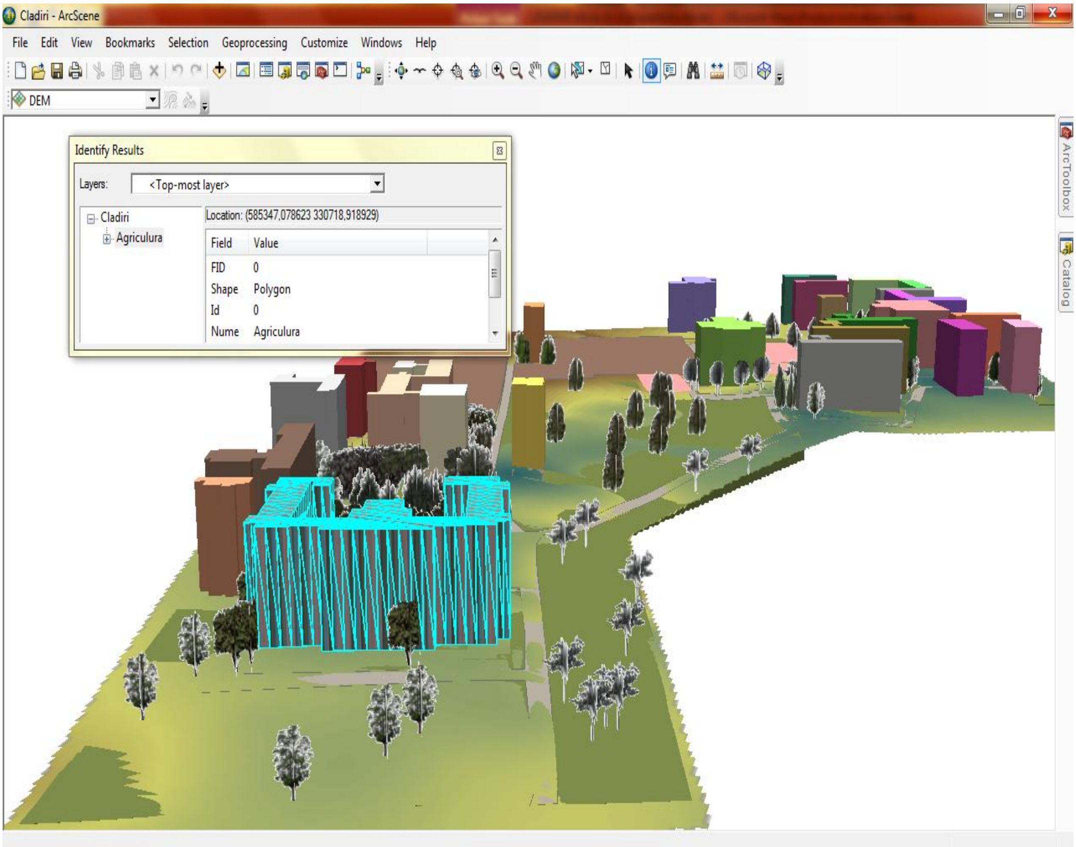


Figure 6. Query of Agriculture building

Analyze GIS data in three dimensions using geo-processing tools, and use interactive tools (such as the 3D Measure tool) in a 3D view to solve problems that can‘t be solved in 2D. The application provides several ways to measure a distance or an area of a polygon in terms of some factors such as slope and land using. The Measure tool lets you draw on the map to measure lines and areas (Figure 7). You can use this tool in several ways. For example, you can draw a line or polygon on the map and get its length or area, or you can even click directly on a feature and get measurement information. Using this function, you can create distance and direction raster and compute the least-cost or shortest path from a chosen destination to the source point. The measurement reflects the projection of the 3D data onto the 2D surface, and does not take into account the curvature of the earth. If the data frame is using a geographic coordinate system and the display units are linear, the measurements are geodesic by default.

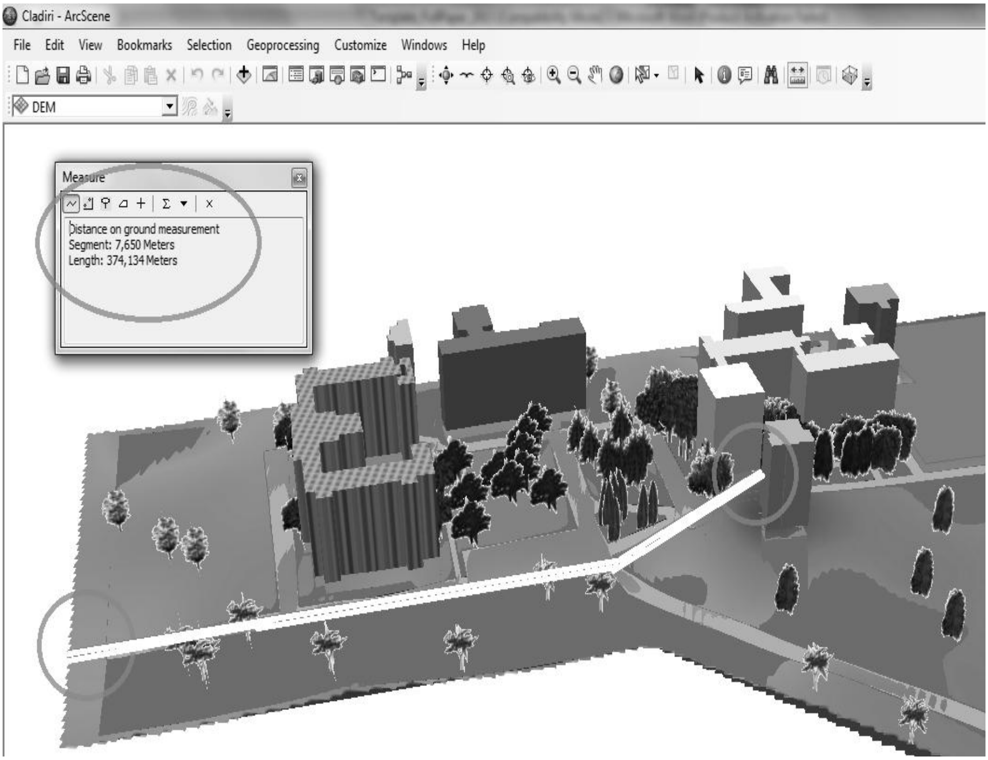


Figure 7. Measure a distance in the scene

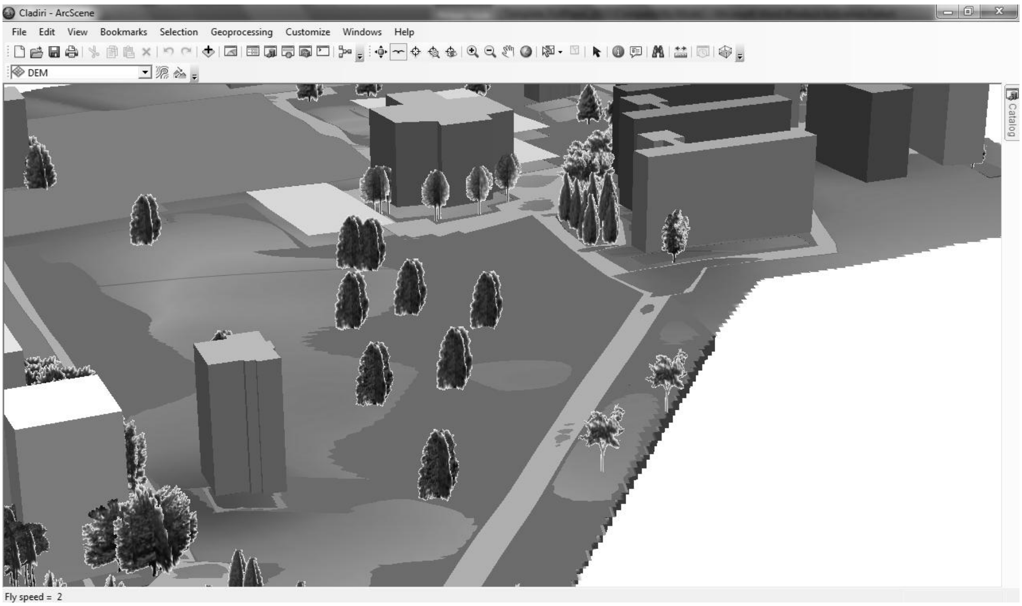


Figure 8. Flying through a scene

The Fly tool is used in ArcScene to fly through a scene (Figure 8). The speed is relative and goes from negative numbers (backward) to positive numbers (forward). Sometimes these speeds need further tuning.

CONCLUSIONS

Using virtual reality provides a better understanding of surrounding space and better support for decision-making. 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. Making decision requires information as well as exploration. With analysis and design tools, information can be used to make decisions.

Exploration will support both the process of finding (user looks for specific information) and discovering information (user doesn't know what is looking for).

Analysis aims at enriching the available information by computing specific measurements (e.g. the area of a parcel) or solving specific problems (e.g. compute the shortest route from point A to point B).

Finally, the design process starts from an exploration and analysis process

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ArcGIS for Desktop Help

Google Sketch Up Help

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