Application of the Georgraphic Information Systems for Creating a Digital Model of an Operational Zone

Krasimir Slavyanov and Yordan Manchev

"Vasil Levski" National Military University, 1 "Karel Shkorpiul" str. Shumen, Bulgaria

Abstract. The implementation of GIS in each area of application requires the submission of geographic data for the territory in digital form. This report presents basic theoretical aspects and specific guidelines for the practical use of geographic information systems and analyzes the means for creating a three-dimensional digital model of the operational zone based on existing topographic maps.

Keywords: thematic layer, digital model of the operational zone, 3D scene.

1. INTRODUCTION

For the necessary technical calculations and to create a digital model of the zone based on existing topographical maps, GIS ArcView perfectly fulfills the software requirements for such a specific activity because it is a powerful, easy-to-use tool that enables visual represent-tation, search for and analyze spatial data and communication intelligence operations [1,4].

The subject of the present study is the specialized activity in the field of geographic information systems for creation of a digital model of locality, studying the ways and the sequence of work in designing a digital model of the locality based on existing operational topographic maps and proving their practical endurance by designing in the working program environment [2]. The main stages in building a digital model of the site are: editing a raster image in Autodesk environment, Importing the processed image into an ArcView environment and creation of the 3D model of the operational zone.

2. EDITING A RASTER IMAGE IN AUTODESK ENVIRONMENT

Elements of the operational zone are: relief, hydrography, vegetation cover, road network and settlements. The characteristic GIS overlay technology (layers - themes) applies to the elements of the site. In this way, the relief will contain mainly linear objects (horizontal points) and point objects (mounds, separate rocks, elevations, etc.). There are linear objects (streams, rivers, canals, etc.), surface objects (seas, lakes, dams, etc.) and point objects (fountains, wells, springs, etc.) in the topic "hydrography". In the theme "plant cover" are mainly area objects, in the theme "settlements" also area objects. Object properties are specified as attributes and are recorded in attribute tables. The study is limited to one map sheet of approximately 10 in 10 km (100 km^2). The choice of the coordinate system is consistent with the baseline cartographic material. A Gaussian rectangular coordinate system is used, and abbreviated coordinates are used for convenience – Fig. 1.

Fig. 1 Topographic map in the Autodesk environment.

The creation of a digital model of the operational zone always goes through the geo-referencing procedure, which determines the location of the data source in the corresponding

coordinate system, which is designed in a plane using control points. The 1:50 000 (K-35 52-B.tif) topographic map is used as a source of information for the creation of a digital model. Rubber Sheet is the feature used. A minimum of 4 points (intersections of plan square network) are specified from different parts of the map and their full geographic geodetic coordinates (X, Y) are filled in. The necessary geodetic coordinates of the operational zone are indicated in Fig. 2.

	X	Y	Z
Point 1	53810.46764	47010.05833	0.0
Point 2	53810.81734	47059.95096	0.0
Point 3	53870.53244	47059.91474	0.0
Point 4	53870.55141	47010.05833	0.0

Fig. 2 Necessary geodetic coordinates of the map of operational zone.

For Each object a separate layer for easy data processing is created. All layers are saved in files with extension *.dxf and *.dwg.

Horizontal lines have the following features as a real relief pattern. They are continuous and thus express the continuity of relief as a phenomenon on the Earth's surface. The most important feature of the horizontal is its height, reflecting the measurability of the real object. At first, only horizontal information is converted into a digital image as a basic part of the relief information, and then, at a later stage, it is supplemented with information on relief forms (Fig. 3).
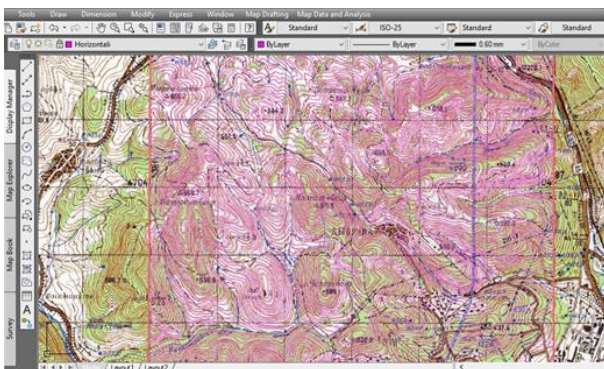
Each apea-type object forms a polygon that consists of a series of linear segments. Polygon objects (closed lines) form topologies. Topology is a mathematical procedure for clearly defining interconnections between spatial objects. Each top-level object has a topology.

3. IMPORTING THE PROCESSED IMAGE INTO AN ARCVIEW ENVIRONMENT

Autodesk Map supports Import / Export to almost all known formats from other CAD and GIS systems. To create a 3D model of the site in the form of a scene, the functional capabilities of the ArcView GIS software product were used. For this purpose, Autodesk Map objects are exported to ArcView environments. When exporting geographic data from Autodesk Map to a Shape file, objects become ArcView GIS objects without loss of information or features. The files are imported afterwards in a ArcView GIS project – Fig. 4.
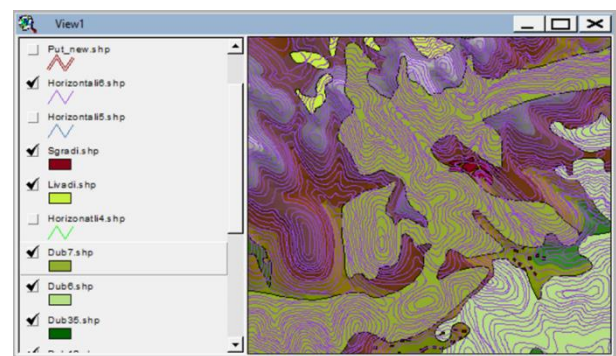

Fig. 4 Visible objects in an ArcView project.

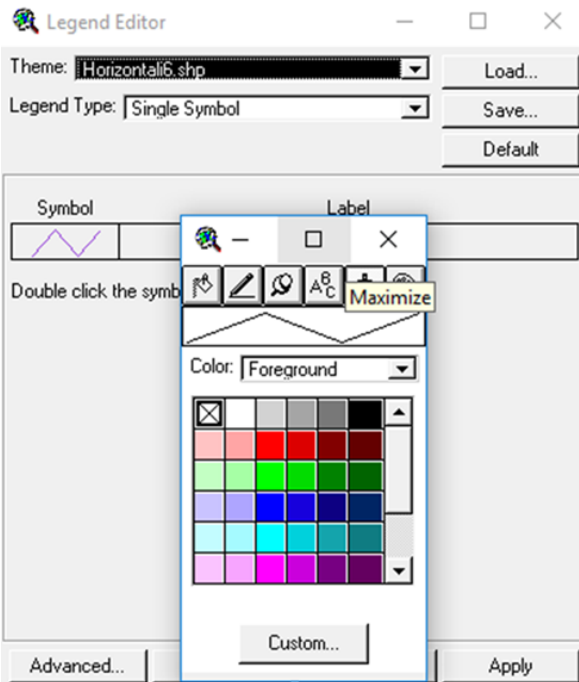Changing digital map properties for better readability are outlined in Fig. 5 [3].

Fig. 3 Horizontal information.

Fig. 5 Specifying object properties (color, line thickness, etc.).

4. CREATION OF THE 3D MODEL OF THE OPERATIONAL ZONE

Triangular Irregular Networks, a non-parallel triangle system, and used as a data model for the construction of a digital model of relief representing its set of height abrasions at network nodes and replacing it elsewhere. The creation of the TIN model is shown on Fig. 6. For better readability and clarity, it is necessary to edit the properties of the 3D model. For this purpose, Theme is also selected from the drop-down menu - 3D Properties. As a result, the 3D Theme Properties dialog box is used.
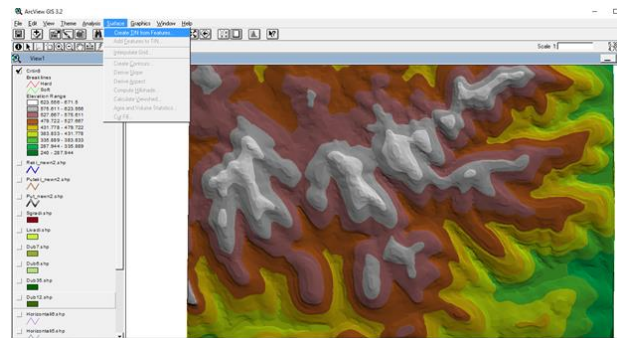

Fig. 6 Creating the Triangular Irregular Networks (TIN).

The 3D model is a good visual tool and a practical tool for better understanding of each geographic area. The visualization of the 3D model of the area of the operative zone is shown in Fig. 7. The model includes all major and significant objects of the area around the operative zone: relief model, three-dimensional building images, road construction depictions, forest types, hydrographic information, each object in a different color. The model can be viewed from different angles, rotated, analyzed from top to bottom, there is the possibility of constant updating, inclusion of new objects.

The created 3D model provides accurate reflection of the real world and provides modeling and analysis capabilities in the area of spatial planning and management of an operation. In addition,
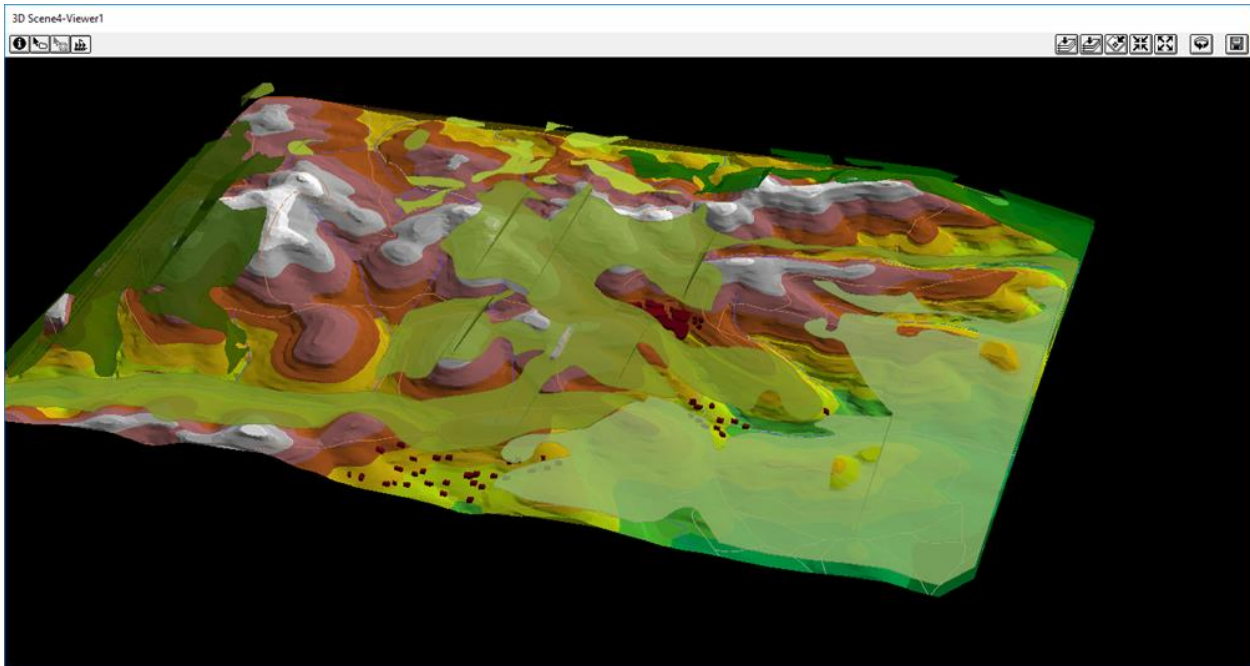
Fig. 7 3D model of the operational zone.

5. CONCLUSION

This 3D model allows for solving tasks related to the planning of communication networks in the village and in intersections where information on relief is of paramount importance. The model can be used anywhere where spatial data is available: environmental protecttion; management of land and forest resources; zoning, land use; agriculture and forestry; ecology; tourism.

REFERENCES

1. Harlahan P., 1982. *Creating volume models from edge-vertex graphs*, Computer graphics.

2. Carlbom I. et al, 1986. *A hierarchical data structure for representation the spatial decomposition of 3D objects*, Computer Graphics Forum, 5, pp. 2-12.

3. Andreev A. and Markov M., 2009. *Guidance for exercises on Geographic Information Systems*.

4. Nikolov L. and Slavyanov K., 2014. *Benefits and features of a COMINT software*, Proceedings of conference "New paradigm for security in the cyberspace", Shumen, 2014, pp. 283-290.