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# Information Technology for 3D Relief Model Generation By Color Parameters of Pixel

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**Abstract** – Using of digital maps in simulators will dynamically change the tasks options and improve the quality of military professionals. The paper said information technology to get 3D relief model for digital maps.

Created simulator module has a user friendly interface with a large number of configuration options that allow well prepared for raster images for recognition. The generation of digital terrain automatically. The resulting digital map can edit, change display settings, zoom and move in the world coordinate system, add it necessary to vegetation and buildings.

**Keywords** – information technology, bitmap image, color pixel, algorithm, method, height map, 3D relief model.

## I. INTRODUCTION

The defensive capacity problems in Ukraine require a high-quality training of military professionals. In this regard, there is a need to improve the professional military education.

Implementation of modern information technologies into the military specialists training is unquestioned. One of these process components is the use of various interactive simulators in the training process, so their development is a topical task.

Thus, it is possible to formulate the main purpose of work - the creation of information technology for 3D relief model generation by color parameters of raster image pixel

The developed technology allows to carry out the interactive generation in the real time topographic maps in the form of 3D relief models for use in the military preparation simulators.

To achieve the goal, it is necessary to solve the following problems:

- to analyze existing methods and analogues;
- to formulate functional requirements for the module simulator;
- to develop technology of generating digital terrain;
- to develop a relief structure generating module;
- to implement a program part of the module.

## II. THE ANALYZE EXISTING METHODS AND ANALOGUES

An analysis of the existing methods for generating a digital terrain model has been considered in detail in this paper [1].

As to available data, popular and widely distributed generation software tools are almost absent among domestic developments. There are several software's that are designed to solve highly specialized issues but do not have a full value generation module and cannot be used to solve this problem:

- Populate: Terrain in 3ds Max [2];
  - TERETORY – created in SSU, military training department.
  - Three-dimensional map representation in Digitals software [3];
  - Relief generating using Unity's Terrain system [4];
- The functional requirements to which the created module simulator should correspond were formulated:
- loading and editing (rotation, movement, zoom) the most common raster image formats;
  - formation of the digital relief map (DRM) and its texturing;
  - automatic creation of additional objects (grass, trees, rocks, buildings);
  - the DRM format should be convenient for further use in the simulator development software;
  - export of the digital relief map.

Military department of Sumy state university has developed the TERETORY simulator. For achieving the set task, the existing structure were added 3 points that improve the simulator:

- Generating of a 3D model in the color image elements.
- Transfer of the generated territory 3D model;
- Loading of the received territory 3D model;

It considerably improves the process of generating 3D - surfaces.

## III. STRUCTURAL AND FUNCTIONAL ANALYSIS TECHNOLOGY

By using SADT methodology was conducted structural and functional analysis technology, presented on the Fig.1 and Fig.2 in the form of contextual diagrams and charts decomposition.

- loading
- editing;
- formation of the digital relief map;
- texturing;
- automatic creation of additional objects;
- relief map format should be convenient for further use in the simulator development software;
- export of the digital relief map.

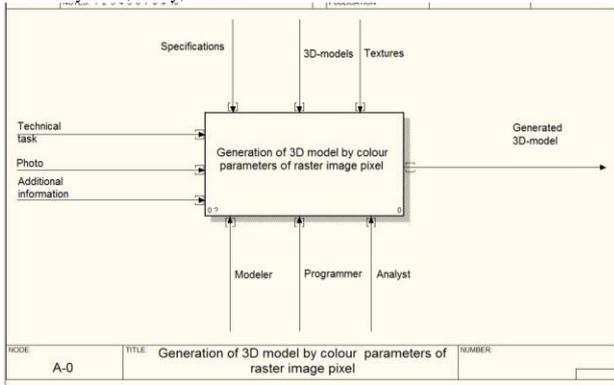


Figure 1. Contextual diagrams of technology

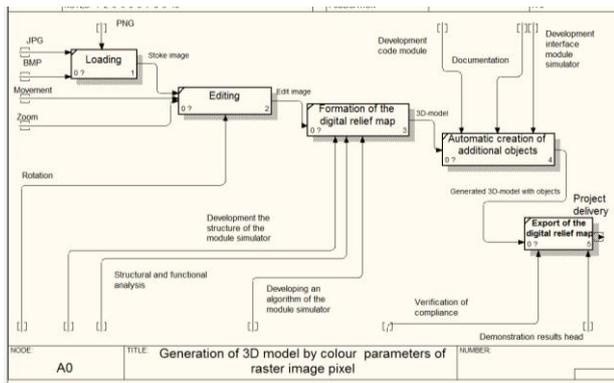


Figure 2. Diagrams of charts decomposition

#### IV. TECHNOLOGY OF COLOR MAPPING

For practical implementation of the task as the base was used plugin game engine Unity [5], which was integrated module designed simulator. The connection between the base and plug-in module is shown on the Fig. 3.

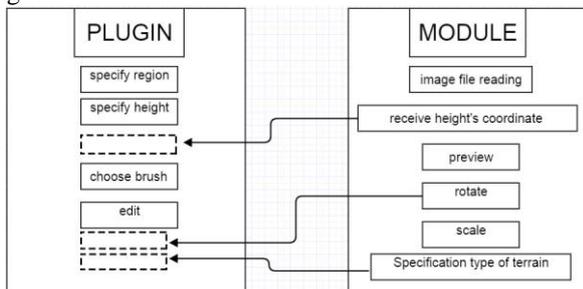


Figure 3. Communication between Unity 3D and the module

Usually in forming the relief is used [6]:

- the first – to use of a regular height grid (or its another name - HeightMap).
- the second – to use of an irregular height grid and communications that connect them (i.e. storage of a simple triangulated map ).
- the third - a landscape map storage, but in this case no specific height is stored, but the

information about used blocks. In this case a certain amount of pre-built segments is created, and only indexes of these segments are indicated on the map.

In this research only landscapes with a regular grid will be considered. It will allow to use rather simple algorithms for their generation. When using a regular grid (elevation map) data presented as a two-dimensional array (Fig. 4). Specified two coordinates (x, y - height and width array), and the third coordinate given value in a particular cell is the height.

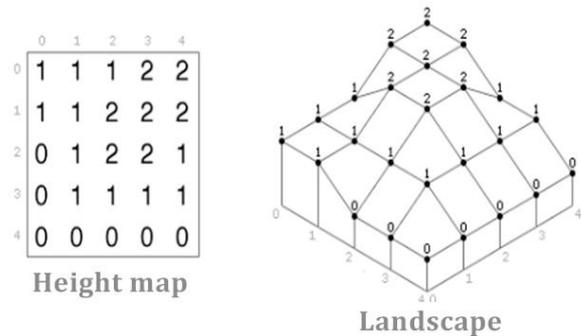


Figure 4. Converting a two-dimensional array in relief

Typically elevation map stored in image files (Fig. 5). This makes it easy to change and more or less clearly view the data. Then two coordinates to position a particular pixel in the image, and the third coordinate will be represented by color (direct dependency on brightness color components of the pixel, the higher the brightness - especially height values for this point). Typically, these images are in black and white version, but you can use all the colors. The second option gives us more height gradations than 256 gradations predictable if monochrome presentation.

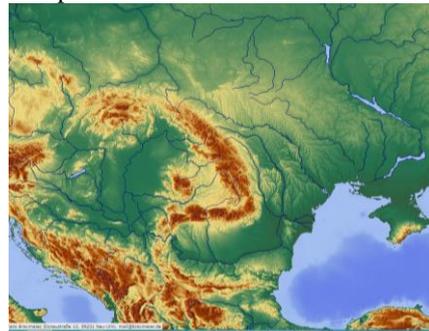


Figure 5. Image file of map

To form the two elevation map coordinates x, y choose the size of bitmap (pixel current position horizontal and vertical of image). The third coordinate (height) will be determined by the color map, which displays color scalar data. Scalar values serve as indices in the reference color (Fig. 6) lookup table [7].

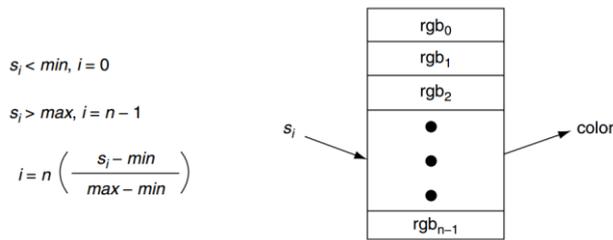


Figure 6. Displaying a scalar colors through a table

The table contains an array of colors (red, green, blue (RGB) components or other similar views). The indexes are defined as follows. Scalar values greater than the maximum value range, color shifts to the maximum scalar value and lower minimum range - shifting to a minimum of color value.

The resulting data is transmitted in Unity for future generation of relief using embedded objects Lines, Polygons, Mesh and displayed on the screen.

## V. PRACTICAL RELEASE

Before working in Unity, a new project is created and a module area is marked. At the same time the standard built-in tools of the program are used.

Module import to the project happens with Drag & Drop method. Then the developed module is loaded by means of the appropriate command in the Window menu or a specially tuned combination of the "hot" keys Ctrl + G. Work module begins with loading the saved file raster maps. Further verification comes loaded maps correctness, defining attributes of colors and sizes maps. Then apply existing texture image generation performed main texture filter checks for and receiving component filter surface. Next generation topography performed with a given dimension (width, height, depth, resolution) and the result is a surface. The simulator created module has the convenient interface with configuration setups that allow to prepare qualitatively raster images for further recognition. Generation of a digital relief is carried out automatically. Terrain map can be displayed in color as form and in tinted form and a polygonal mesh, which allows you to check the correctness of topology construction (Fig. 7). The received vector map can be edited; display parameters, scaling and relocation in a world coordinate system can be changed, with adding to it all the necessary objects of flora and buildings.

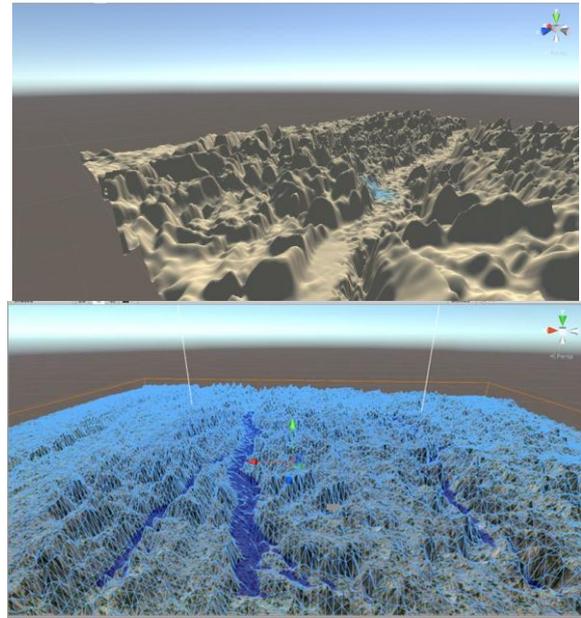


Figure 7. Options terrain map display

## VI. CONCLUSIONS

As a result of work these problems have been resolved:

- analyzed existing algorithms for obtaining digital maps and software for generation of terrain;
- formulated functional requirements generated by the module simulator;
- developed the technology of the module simulator based on selected methods and tools for generation of terrain;
- developed structure and algorithm module simulator that allows dynamically generate digital map real relief;
- realized module simulator among the game engine for future use when creating a simulator as a whole.

Developed module allows you to generate real options challenges and improve quality of training the military.

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