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# PROCEDURAL GENERATION OF THE OPEN GAME WORLD MAP BASED ON REAL LOCATION USING NEURAL NETWORKS

The open world is a game level, represented by a large area where the player can move freely. The size of such levels can reach several thousand square kilometers. Sometimes when creating an open world, the real terrain is taken as a basis [1].

Creating a realistic open world is a rather complex and time-consuming process. It can involve whole groups of professional designers. Typically, developing an open world map involves determining the overall structure of the map, creating terrain, overlaying the satellite map, filling the map with ve-getation, and placing buildings, roads, and other objects. In cases where the game level is based on real terrain, the task is somewhat simplified: the ge-neral structure of the map is already known, the terrain is created based on a real elevation map, the satellite map is drawn on satellite images, and vegetation, buildings, and roads are placed according to topographic maps [4]. However, placing objects on a map still takes a considerable amount of time and requires the involvement of professional game-level designers.

It is proposed to simplify this process by creating software for procedural map generation based on terrain data. The work of the program will consist of the analysis of data and generation on their basis of a terrain and satellite map, placement of vegetation, roads, and buildings.

First, the terrain will be generated from the elevation map without significant changes. Then, a computer vision will be used to analyze a satellite image of the area in search of forests, shrubs, fields, and single trees. After that, based on the obtained data, the program will generate vegetation on the map. For forest generation, the use of ready-made algorithms is envisaged. At the next stage, the main highways will be laid based on a topographic map. The topographic map will also determine the settlements, their location, and the contours of their territories. Settlements will be divided by main streets into separate districts. The program, analyzing satellite images using a neural network, will roughly determine the type of building area: high-rise buil-dings, country houses, industrial objects, etc. Next, based on the collected data, the program will generate streets and buildings. In this case, the resul-ting settlement will correspond to its prototype only in the contours of the territory, the location of the central streets, and the type of building. When placing objects and roads, the program will adapt the terrain and satellite map.

Satellite images and topographic maps are offered for download from Google Maps. It is recommended to use the SRTM database [3] to obtain elevation maps. SpeedTree software is expected to be used as an algorithm for forest generation.

In conclusion, the map of the open game world describes a certain large area. Therefore, its creation is a rather long process. In cases where such a map is based on real terrain, the use of procedural generation is proposed to simplify its development. The software should analyze terrain data and ge-nerate an open world based on it. The use of neural networks is proposed for data analysis and map generation.

## References

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