건축 공사를 위한 지형 편집 및 처리 시스템 설계

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Terrain editing and processing system design for construction work

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요 약

In this paper, we propose a terrain processing system that can display real and large terrains. The system integrates real terrain display and interaction, which makes up for the lack of interactive functions in mainstream terrain visualization software. In addition, the system provides functions such as line marking, volume calculation, and contour display.

1. Introduction

Terrain processing is an important process for group planning, terrain surveying, resource mining, and other tasks that rely on terrain analysis.

Computer-aided design (CAD) is a ubiquitous tool for industrial designing, and it has penetrated the advertisement and entertainment industries recently.[1] It has been used to design circuits, buildings,[2] mechanical structures, and apparels. However, there are hardly any CAD applications that are designed for terrain processing. This is because the functions provided by most CAD applications are not suitable for terrain detection and manipulation. Traditional CAD applications cannot be flexibly applied to terrain reconstruction problems in geological surveys, resource exploitation, earthquake relief, and so on. Another problem is that most CAD software packages require PCs. This limits their utility in projects that require field trips.

Many studies have been performed for terrain visualization and editing. Eric Bruneton and Fabrice Neyret[3] proposed a method for real-time rendering and editing of vector-based terrains. Although this method can provide feature descriptions of very large terrains and allows interactive editing, it falters when users need more detailed terrain data such as data on terrain contours and potholes. Mainstream 3D terrain visualization software packages[4] have powerful large-terrain visualization capabilities; however, only a few of them provide terrain marking and calculation capabilities.

To solve the aforementioned problems, in this paper, we propose a system for terrain detection, display, and calculation.

2. Terrain Processing System

The terrain processing system we propose can generates terrains captured by drones and provide display and basic calculation modules. The framework of the system is illustrated in Fig. 1. We use several drones to capture the terrain point cloud data and transfer it to the data capture module. All the point cloud data is enhanced and merged in the 3D point cloud process function through GPS (Global Positioning System) and ICP (Iterative Closest Point) algorithm. Subsequently, we generate the terrain display module using the processed point cloud data. The terrain under study is loaded in small parts and updated at a fixed time.

The terrain display module provides the basic functions of rotation, scaling, and transformation, through which the terrain can be displayed on devices such as PCs, phones, and tablets. The three main functions of the terrain calculation module are edge, volume, and contour calculation. The edge calculation function allows the user to draw curved lines or circles on the terrain, which makes it possible to identify or mark specific parts of the terrain such as lanes, holes, and edges of cliffs. The volume calculation function determines the volume of an identified hole. The contour calculation function provides the profile of an identified portion of the terrain.

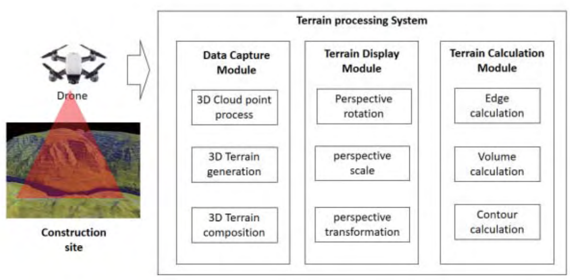

Fig. 1. Terrain processing system

3. Experiments and Analysis

For implementation, we used Unity 3D as the developer platform. We preprocess the data acquired by the drone and import it into Unity 3D to generate the data capture module. A user can interact with the terrain processing system on PCs, phones, and tablets through the user interface provided. Using input devices, the user can observe the terrain in any direction and angle, and draw on the terrain to identify lanes, potholes, and cliff edges. In addition to calculating the volumes of holes, the system can display terrain contours for a given location. The results of the experiment are shown in Fig. 2.

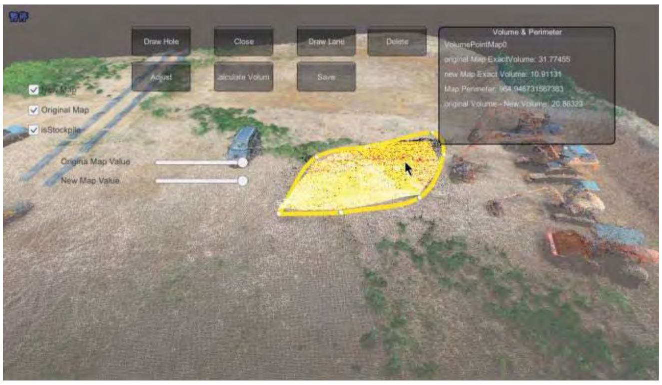

Fig. 2. Results of the experiment

4. Conclusion

In this paper, we propose the design of a terrain processing system, with interactive functions such as volume calculation, for displaying, large terrains. In an experiment, we edit actual terrain data in Unity 3D and add interactive functions. The experiment shows that our system performs well at displaying and interacting with large terrains.

Acknowledgements

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