A Study on the Development of the Multi-Dimensional River Information System Designed for Providing Tailored Information for Each User

Kyoung-Seop KIM, Gyeong-Min KANG and Jang-Bae LEE

Abstract: Korea is currently operating diverse river space information-providing systems but they provide only 1 or 2-dimensional fragmentary information. They are also operated individually, making it difficult to acquire the information so an integrated system for the management of river information is required.

This study developed the RIVER (SuiTable 3D for River Establishing Application Management) system designed to provide the 3-dimensional information tailored to users in order to develop a system aimed at the integrated management of river facilities and spatial information. To construct 3-dimensional topographic information, a DEM (digital elevation model) was created by extracting contours and elevation points from digital topographic maps and applying the TIN interpolation method. Meshes were created based on the created DEM, so a unity-based 3-dimensional topography was constructed, and high-resolution orthographic images were mapped to construct 3-dimensionmal topographic information. Extracted is the text of the existing river facilities information, river resources information, hydrophilic information, and road traffic information, and it was extracted as images using the unity 3D. The extracted information was parsed so it was developed to acquire the information wanted by the user. It will later be linked to the river facility life cycle management technology, high-precision river facility information, and standardized 3D BIM in order to provide the information on the river facility management. The developed system is expected to improve the easiness of providing the river information required by the user and to display 3-dimensional river information so as to provide intuitive information on rivers, thus increasing the utilization of river and hydrophilic information by non-specialists.

Keywords: 3D GIS, River Information, Facility Management

1. Introduction

In this study, an integrated management system of river facilities and spatial information for efficient management of river information was developed, laying the foundation for effective application of life cycle management technology by presenting the current plans for river facilities and spatial information and the improvement of the legal system. We also improved the economy of the river space construction through development of low-cost and mobile river space measurement technology building high resolution spatial information in the process. In addition, we conducted a

Kyoung-Seop KIM, Gyeong-Min KANG and Jang-Bae LEE

Institute of Spatial Information Technology Research, GEO C&I Co., Ltd, 435 Hwarang-ro, dong-gu, Daegu, Republic of Korea

kskim@geocni.com, gmkang@geocni.com, jblee@geocni.com

study on the development and utilization of multi-dimensional river spatial information service that combines river spatial information and mixed reality (MR) technologies such as Virtual Reality and Augmented Reality.

In this paper, 3D GIS-based multi-dimensional river information provision system was developed by improving the 1D and 2D information of the existing river spatial information system in order to provide river information each customized for managers, researchers, and the public.

2. Main discussion

This study is aimed at developing a 3D-based river information system (STREAM: SuiTable 3D for River Establishing Application Management) that can provide customized information for each consumer. It is a river information service that can be linked and shared among related organizations through information presentation / visualization. Another goal of the developed system is to improve the quality of people's lives by providing river information closely related to people's lives such as hydrophilicity, disasters, and water-use leisure culture, and secure services for the people's river environment by linking 3D river information and hydrophilic environment contents. In order to achieve this goal, 3D river management system was built by fusing the existing distributed information among related agencies based on 2D, thereby laying the foundation for the use of rivers through efficient provision of the hydrophilic information. In addition, the company plans to use integrated river information by providing a customized UI through HTML 5 based responsive web.

2.1. Status of STREAM System Development

Currently in stage 4, this research is being conducted in 6 stages, and the development of STREAM prototype has been completed. In the first stage, we collected and analyzed the current status and presentation of related systems at home and abroad to investigate the basic technology trend for developing suitable 3D system, and investigated the fluid UI design and 3D display implementation technology. In order to implement customized river system algorithm, we analyzed the system structure diagram and design standardization based on the national standard framework and investigated and analyzed the information provision method that meets the requirements of consumers. In the second stage, a 3D GIS convergence river information provision algorithm was developed based on the surveyed and analyzed data. The base spatial data for system construction was collected and the basic spatial information was processed into 3D information. We implemented a 3D engine-based river spatial information presentation and GIS convergence algorithm to display processed information. We also designed the architecture of the system prototype and examined the conceptual design and standardization of the user interface. In the third phase, we developed a core module for providing river

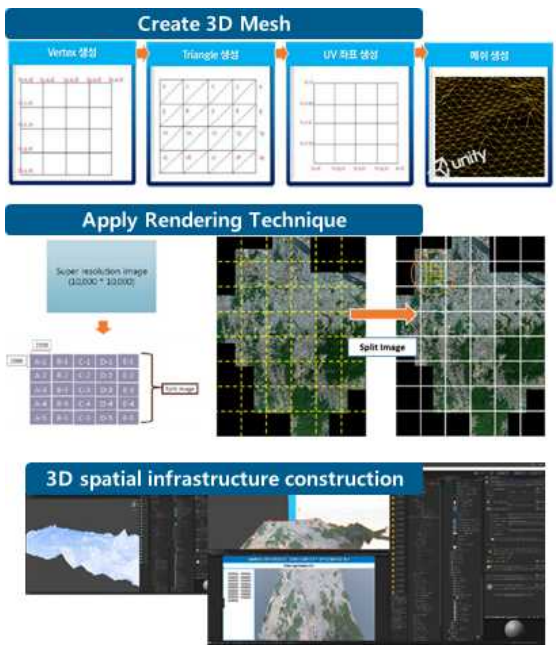

Figure 1. Spatial infrastructure for 3D Base Map

information and a prototype of the RIVER system that can provide customized river information. In the fourth stage, the spatial infrastructure was established and advanced to add more study area and 3D base map, and the river spatial data was processed and applied to the prototype.

2.2. STREAM system development method

For this study, Anyang River which is rich in river and hydrophilic information and designated as a national river from the boundary between Anyang City and Seoul City to the confluence of Han River was selected. Spatial information of T / B area was defined and attribute information was classified into detailed items. In order to construct a 3D base map to express this in 3D, we collected the digital topographic maps of the target area, extracted the digital elevation data, and generated the digital elevation model (DEM) through TIN interpolation. The DEM which was created using the Unity 3D engine was turned to 3D mesh, and the 3D spatial infrastructure such as photorealistic was constructed by mapping and rendering satellite images.

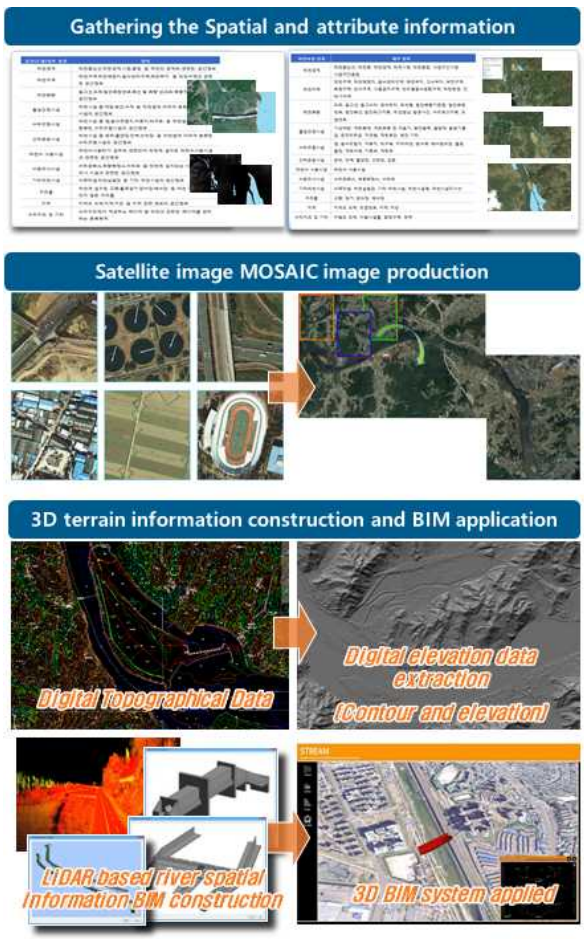

Figure 2. Development method

River space-based facilities and hydrophilic information text data were extracted to regenerate mesh data for spatial analysis, coordinate system for map matching was inputted and then called in Unity 3D in order to convert to image. In addition, the river spatial information was processed and parsed into a graphic through parsing. In addition, LiDAR-based river spatial information BIM data was collected and applied to the RIVER prototype.

The constructed STREAM prototype provides river facility data, river resource data, hydrophilic information data, road traffic data, 3D bridge data, and river cross section data. River facilities provide information on dikes, lakesides, pumps, flood gates, culverts, and other facilities, while river resources provide information on rivers, river zones, river networks, and river center lines. Hydrophilic information provides waterfront parks, and road traffic information provides overpasses, explosive lanes, underground driveways, bridges, and tunnels. IFC file, which is 3D BIM data, can be applied to display visualization and attribute information of 3D modeling data.

3. Conclusion

In this study, we developed STREAM, a multi-dimensional river information providing system that can provide customized information for each consumer. It can accommodate the needs of consumers by purpose, and it is easy to collect, express and manage river geographic information, and provide public services with its expertise in function. In addition, the difficulty of acquiring information has been alleviated through 3D display of river and hydrophilic information

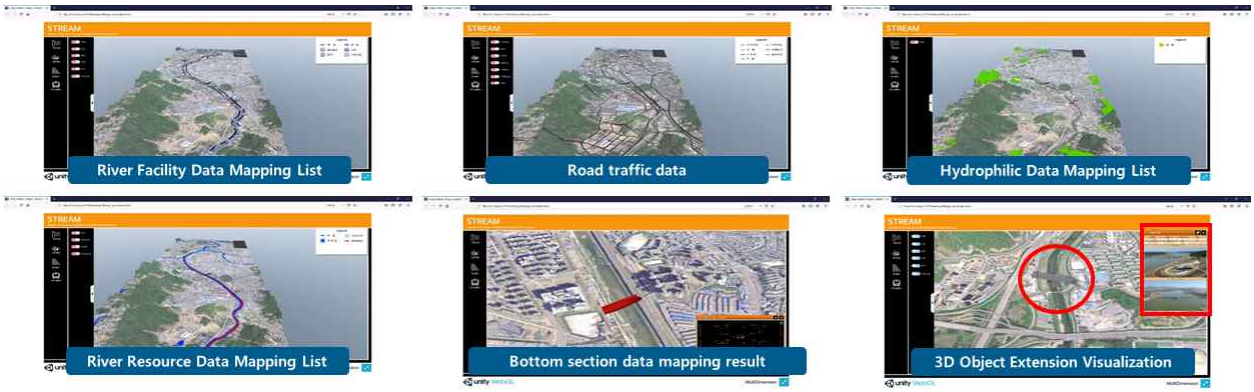

Figure 3. Functions of the STREAM Service

so that non-experts can easily acquire river information. However, only four of the six phases of system development have been completed, highlighting the necessity for continuous development and supplementation. In the future, we will apply the river facility evaluation technique considering river life cycle, river management business support, and response technology for prompt decision support. Based on this, it would be possible to construct a preventive river management system that overcomes the limitation that existing river information system can list or simply provide and process river management business support and decision support information. It would be also possible to develop an intelligent system that can support life cycle and provide basic information on river facilities and spatial information as well as current status and statistical data. In addition, it is expected to maximize the efficiency of work related to local rivers and the foundation for preparing national river comprehensive measures by efficiently managing national river-related data.

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