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A Study on the Construction of the Unity 3D Engine Based on the WebGIS System for the Hydrological and Water Hazard Information Display

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Abstract

As natural disasters are occurring more and more frequently, the need for a system that monitors the precipitation and hydrological information in real time and that predicts the potential occurrence of water hazard is growing. As disasters represent the natural phenomena occurring in a country's territory, they are closely linked with spatial data. In the case of the geographic information system (GIS), which utilizes an increasing amount of spatial data, the 3D WebGIS utilizing high-precision DEM and aviation images is fast becoming the norm thanks to the advancement in the related hardware and software, thereby enabling the users to perform multi-faceted and multi-dimensional analysis of diverse pieces of information fused with spatial data. The establishment of a hardware system with high specifications, however, is indispensable in terms of the operating environment because the 3D GIS is usually built upon a vast amount of collected data. To address such shortcoming, a toolkit was developed in this study using Unity 3D, which is frequently being used in mobile games and is capable of representing geographic data without any limitation. In addition, a system capable of mashing up water hazard data based on a given environment, and of providing services on the Web, was completed. As such, it has become feasible to fuse diverse hydrologic resource data based on 3D GIS information, thereby enabling real-time observation and disaster prediction.

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Keywords: 3D WebGIS; hydrological information; water hazard information; Unity 3D; water resource management;

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1. Introduction

1.1. Background

A brief look at the trend of the geographic information system (GIS) construction will show that there has been advancement in the hardware technology as well as in the spatial data acquisition technology, thereby enabling the industry to experiment with increasing incidences of 3D system construction by liberating them from the confinement of the conventional 2D system[2, 4]. The remarkable advancement in the hardware and software technology for the past couple of decades has exerted a substantial influence on the 3D graphic technology, whose palpable impact is again rippling through the related industries, including the game, film, and virtual reality (VR) industries, as well as through the aforementioned GIS sector[7]. The number of studies on the 3D GIS that was implemented in the context of the national R&D efforts has increased while diverse 3D GISs for both commercial and emergency purposes are being constructed to provide services to the general public. A brief look at vWorld [9], an open platform for GIS built by the Ministry of Land, Infrastructure, and Transport, will show that the portal provides 3D modeling of interior design templates as well as the detailed specifications of the buildings that have been built in the country. In addition, the portal provides 3D interior spatial information almost identical to that of the real world by performing accurate texture mapping of each building[1-8].

The advantage of such 3D GIS is that it allows researchers to perform spatial analysis with a degree of accuracy that is unattainable with the conventional 2D-based system. In particular, the disaster prevention and meteorological sector is benefitting the most from the 3D GIS advancement. The effectiveness of the diverse meteorological data culled from all over the national territory is maximized when they are analyzed with the 3D system, as they represent the real world. For disaster forecasting, the legacy data accumulated over the past decades would be most useful for making an accurate prediction when they are fused with the observation data of the real world, which again is driving an explosion of studies on the fusion of 3D analysis and spatial data. There are a number of available 3D GIS construction methods depending on the unique characteristic of the developer as well as on the function that one intends to offer, which will be realized by integrating high-resolution spatial data, massive meteorological observation data, and disaster data. In general, one may choose from the commercial 3D GIS engines used to construct the GIS system; an open source, which guarantees a high degree of freedom and good accessibility for the developers; or an engine developed for 3D games. The drawbacks of the open source and the commercial GIS are that they cannot meet an adequate level of development difficulty as well as desirable acquisition cost and posterior maintenance levels [2,4]. In this study, therefore, these researchers aimed to build an integrated system capable of analyzing meteorological data by employing the 3D game engine that is increasingly being adopted by game developers as well as by the engineering and other sectors, and of responding to disasters.

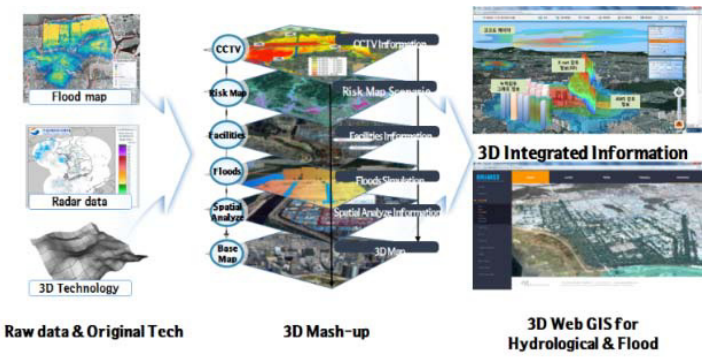

Figure 1. A 3D WebGIS for providing hydrological and water hazard information.