

# Utilizing 3D Web-based GIS for Highway simulation

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**Abstract:** This paper show that utilizing 3D web-based GIS for highway simulation without installation of expensive VR program base on the Virtual GIS. In this paper, using Viewpoint Scene Builder, Internet-based software, the transformation was conducted to give pertinent type for Web posting. In order to use the completed route at the Sence Builder, the output with ASCIIExport is required, and ASE contains the property information including the coordinate and frame of mesh vertex. Through in advance recognition of the problems regarding route design and petition due to environmental rights infringement, the time and cost due to design alteration can be reduced.

**Keywords:** 3D web-based GIS , VR, ASCIIExport, ASE.

## 1. Introduction

Nowadays, GIS should accompany the functions with the image or information media not only providing the simple geographic information with topography. In the area of design, the importance of three-dimensional drawing was not recognized because the previous design was focused on two-dimensional plane drawing. Therefore, using two-dimensional drawings, the visual effect for the design of structures could not be obtained, and in advance recognition of problems during the actual execution was difficult. Since the arisen problems during the actual occurrence are solved through the alteration of design at each situation, recently, the need of visible effect has been emphasized through the introduction of three-dimensional design from the beginning stage of design. Currently, in the advanced countries with well developed in machinery and aerospace industries, the three-dimensional design has been employed long time ago, and a consistent process, from design to production and fabrication, has achieved. However, in the field of highway design, the three-dimensional design was introduced recently, but the three-dimensional design was performed by computer graphic designer not actual coordinate design by civil engineer with only providing aesthetic function during bid or construction work. Toshimitse Mukah(1999)investigated the virtual space(consisted of virtual city and roads) on the three dimensional computer graphics platform, using the vehicle model operated through a cockpit with a steering wheel, an accelerator and a brake pedal, and proposed the concept. Verbree E. et al. (1999) proposed a multi-view approach based on three types of visualization: plan view, model view and world view. The visualization in these views ranges from a topographic map, through a partly symbolic and simplified 3D representation to a full immersive and photo-realistic 3D display. The views can be used simultaneously or intermittently, and each provides a repertoire of interaction possibilities that are apt but not necessarily limited to that view. Verbree E. et al. are currently developing a 3D GIS & VR system (Karma VI) based on existing 3D GIS and VR technology that uses the three views to support the design, development and presentation of large infrastructure plans in The Netherlands.

The previous research was enough for the visual effect using geo-spatial information system for the road design and optimization, but the previous results only made possible for unidirectional route evaluation and static view evaluation through rendering time and selection of fixed camera orbit. Therefore, they contained several problems, e.g., offering various visual points like user at the scene, expressing some limitations regarding road design, the rendering time, etc.

In order to solve the above problems, in this paper, using virtual reality technology through the three-dimensional road design, the main objectives are to search the problems real-time basis on the Web during design and construction work periods after establishing the user-based Virtual GIS, to find the problems during decision-making and design/construction work periods, and to provide an effective decision-making method between petitioner and user.

## 2. How to construct GIS Data

### 1) Study Area

The studied area for this paper was a road route which is under construction located in South Kyungsang province, S.Korea, and the area was a combined section of road and bridge with the total area of 15.1 and the route length of 2.9 km. The TM coordinates of starting and finish points in the route were N:168,036.902, E:172,811.690 and N:168,775.082, E:175,516.500, respectively. Fig. 1 presents the topographic map 1: 1,000 of area for this study.

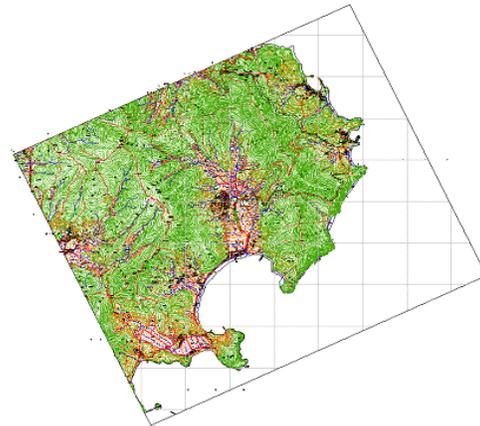


Fig. 1 Topographic map of S. Kyungsang province, Korea

### 2) Three-Dimension Drawing Highways and Facilities

After selection of the route for offering the road simulation using Virtual GIS, the classification procedure for suitable section is needed. Then, the cross-sectional drawing was completed with each section, and the route was expressed three-dimensionally with determination of cut/fill section of the route. The three-dimensional drawing was shown on the topographic map with 1:1,000 scales. All facilities were installed based on the center line of route. When 20 m gap surveying station is used, which is installed on the conventional road, the solidity of road at the curve area is diminished. Therefore, for the polygon of route, the computer automatic extraction method was used for this study, not the interval by section with the consideration of ups and downs of curve. Also, based on route center, the shape of polygon was extracted according to the width of road, the number of polygon decreases, and the shape of curve section was shown ideally. In this case, the total numbers of polygon for the route topography representation was 81,096, which is a quite big value. However, for the optimal simulation effect, the duration time of the frame and rendering time were measured using the topography of 20 m grid.

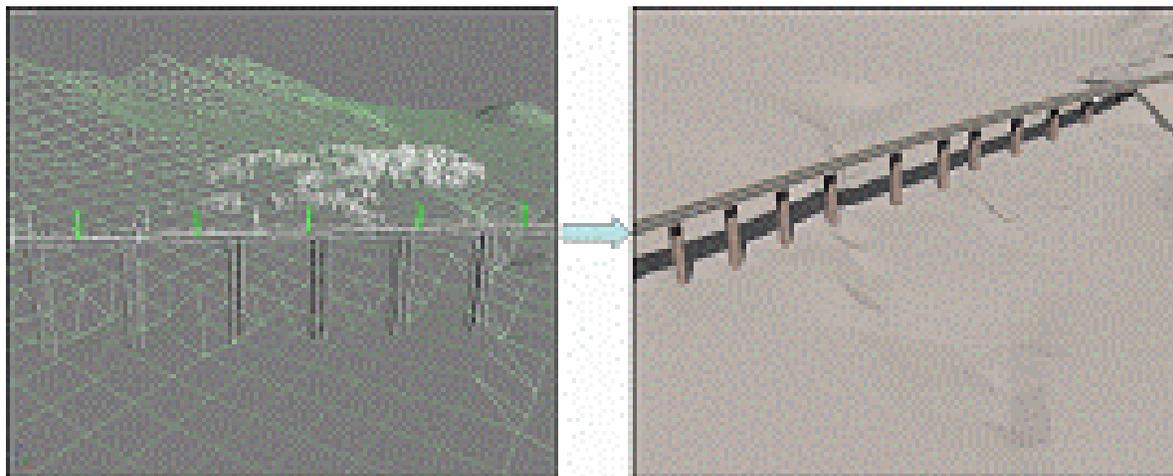
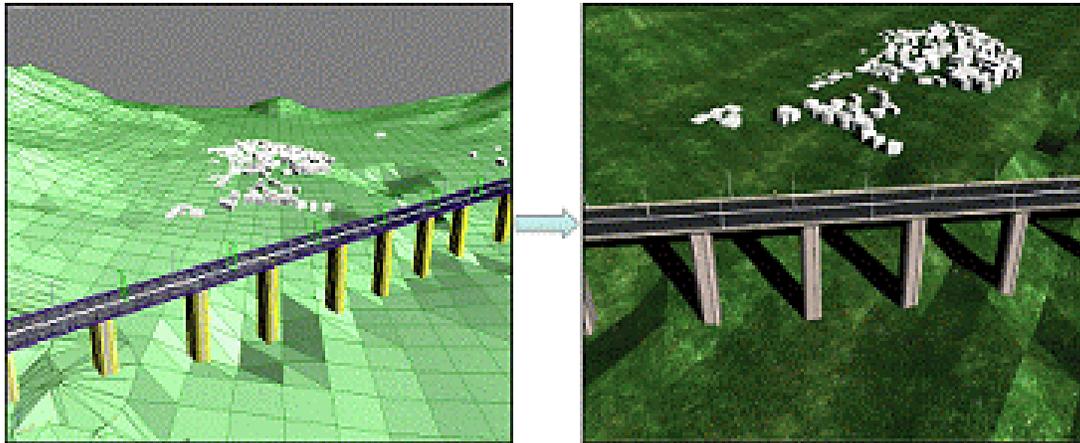


Fig. 3. A view of the simplified 3D model of study area

Fig. 2 shows the rendering image prior to providing texture of DEM for the studied area. For subsidiary facilities, road signs, street lights, protection facilities, etc. were set up according to 'Guideline for the installation and management of road safety facility in Korean criterion (2002)'. The structures installed for the establishment of road design simulation of Virtual GIS were provided texture through the texture mapping. For the conventional three-dimensional design, since the road was expressed with only polyline, it was difficult to provide the visualization of evaluation or road driving. However, in this study, the visual effect was induced through providing texture to the objects using the Autodesk VIZ. Especially, for VIZ, the ASCII Scene Export type file can be produced, and provides the interim stage of future Scene Builder structure file generation source, later on. Since the investigated area was consisted in the combination of roads and bridges between hills, grass and soil map was used for mountains, and the topographic map was used for road with concrete and asphalt materials. Fig. 3 presents the rendering scene of three-dimensional road structures prior to providing pertinent materials and exhibits the rendering scene after texture mapping.

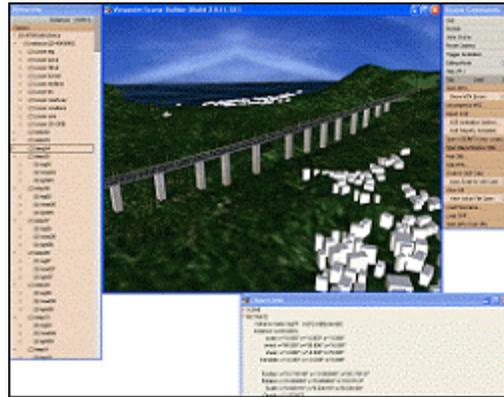


**Fig. 4. The rendering scene after texture mapping**

### 3) Transformation ASE

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Format-8. Since the results in this study was required 1.5 MB through the comfile of scene file, the speed problem due to initial activation was solved.



**Fig. 5. Windows of the scene builder at the wep posting step**

### 3. Conclusions

The current research on the Internet offering based on the establishment of three-dimensional road simulation using Virtual GIS leads the following conclusions. Without installation of expensive VR program, the sharing information is possible through posting three-dimensional road structures on the Web, and avoiding the conventional top-down decision making method, fast bottom-up communication is possible. Through in advance recognition of the problems regarding route design and petition due to environmental rights infringement, the time and cost due to design alteration can be reduced. From the route plan and design to simulation evaluation, visual and three-dimensional plan is possible through the computerization of all processes, and the suitability of design alteration can be displayed. If the completed state, by three-dimensional road driving and view evaluation, could be established on the Web-based, the objective review could be possible in terms of the suitability evaluation of environmental analysis. The file capacity decreased eminently as compared with conventional three-dimensional Web posting program, and it is easy to use through the easiness of modification and renewal of data. Moreover, since XML command can be used, it is possible to provide user convenience through the convenient understanding of data structure and data connection.

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