Web-based Exploration of Geographical Information

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German Abstract

Für die Nutzung geographischer Informationen ist eine gute graphische Darstellung der Daten wichtig. Im folgenden Artikel wird ein hybrides 2D/3D-System mit selektiver Visualisierungsstrategie vorgestellt. Das System wurde als Java Applet implementiert und stützt sich auf VRML als graphisches Datenformat.

Introduction

The rapid expansion of Web 3D technology in the last decade, especially VRML (Virtual Reality Modeling Language), accelerates the development of the representation of geographical information on the Web. At the same time, the need to develop effective exploratory tools for geo-data has been widely recognized. VRML is a high level objected-oriented language for the description of scenes and the behaviors of objects. Further functionalities such as data analysis and database connection can be fulfilled by its extension to other high-level languages such as CORBA (Common Object Request Broker Architecture) and Java. The combination of VRML and Java has been widely accepted. VRML is generally adopted as a representation tool for 3D scenes and Java provides a 2D interface for manipulations on a 3D scene. Conventionally, VRML and Java components work separately and the only link between them is the one-sided influence of the Java interface on the 3D VRML scenes. This structure leads to poor interactivity between users and offered geographical information. In our work, we will develop a new hybrid system, namely the Singapore Terrain Explorer (STE), which elaborately and dynamically integrates the 2D interface components and the 3D scene.

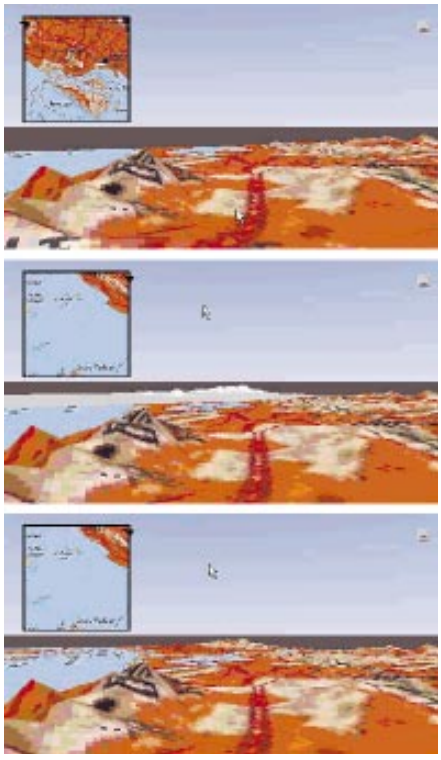


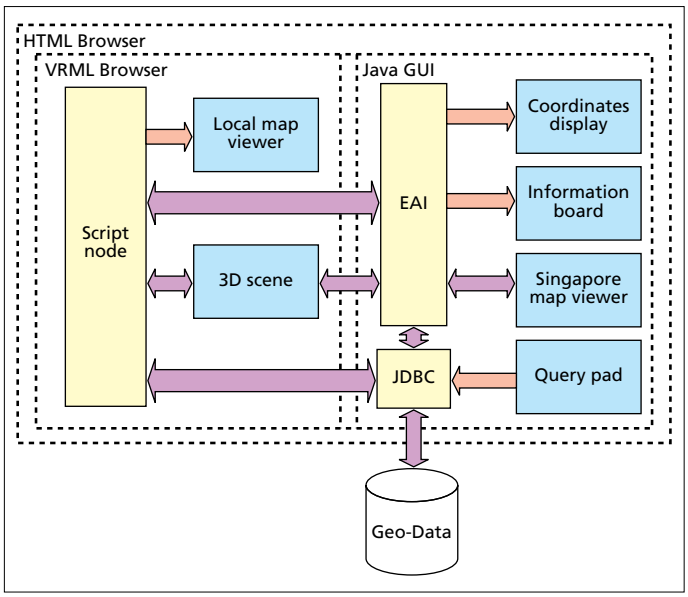
Figure 1: Progress of view dependant visualization

Selective Visualization and Implementation

Real-time visualization of large-scale surfaces has always been a challenge. Although it has its advantages in terms of availability and cost, VRML allows poorer performances in terms of visualization compared to OpenGL since it is interpreted and not compiled. To enhance the visualization performance, Level of Detail (LOD) is generally employed as an embedded node of VRML. However, for most users, when they explore geographical information of a large-scale area, information of a distant place has no significant meaning to them at all. On the other hand, many users have specific aims during exploration; for example, they want to know the places of interest around a certain area. Therefore even with the help of LOD, exploration of an entire large-scale area is time-consuming and unnecessary. We propose a method to selectively visualize terrain information on the basis of terrain tiles. A tile contains the actual terrain data of

a single square-shaped area with the elevation geometry representation as well as the texture map imagery. Visualization is carried out in a view-dependant way. Only tiles which are around the current tile (i.e. tile under current view) can be displayed. The current tile varies with the selection from users via the 2D interface and navigation of users within the 3D scene. The selective visualization mechanism is implemented by using the VRML Script node and EAI (External Authoring Interface) packages. In figure 1 you will find a series of screenshots of the VRML browser displaying the progress of view-dependant visualization with the change of the current tile.

Figure 2: Architecture of interface design



Interface Architecture and Implementation

Six components serve to construct the interface and implement the selective visualization method. The six components are 3D scene, query pad, local map viewer, Singapore map viewer, coordinates display, and information board. The 3D scene is displayed by the VMRL browser in which geographical data are interpreted to 3D geometrical model with textures. Query pad is a 2D panel listing names of places. Clicking on a name will change the current view to the corresponding place. The coordinates display shows the absolute position in global coordinates, i.e. longitude/latitude. The information board is used to display the geographical information related to the current tile. When the view changes, the contents in the information board also changes. The local map viewer and the Singapore map viewer along with the 3D scene compose the hybrid 2D-3D map system for this interface. The Singapore map viewer displays a 2D static map that covers the surface of the entire Singapore terrain with a mark representing the position of the center of the current view area. It is also used to shift the viewpoint in the 3D scene to any distant place on this map by a mere click on the map surface. The local map viewer keeps tracking the position of the current view in the current tile with a mark. When the current tile changes, the map image refreshes continuously.

Figure 3: Implementation of STE interface

Java GUI (Swing) and JDBC (Java Database Connection) packages facilitate the implementation of this interface. Figure 2 illustrates the architecture of the entire interface design. Figure 3 is a screen shot of the implemented interface.

Conclusion

STE is meant to provide an efficient and interactive environment to explore the Singapore geographical information. Moreover, STE successfully integrates the advantages of both 2D and 3D interface and achieves dynamic links between various interface components. Future work may include the improvement on the speed of retrieving geo-data from the database for the visualization of terrain tiles by means of concurrent processing. Multi-resolution visualization can also be integrated into the selective visualization. More work can be done to increase the functionalities of the interface, such as history storage and a more intelligent query engine for the query pad.

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