Chapter XI

A Collaborative Virtual Geographic Environment:
Design and Development

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Abstract

A collaborative virtual geographic environment (CVGE) is a 3-D, distributed, and graphical world representing and simulating geographic phenomena and processes to enable geographically distributed users to explore geoproblems and theories and generate hypotheses, and to support geomodel building and validation and collaborative ecological planning. This chapter reports an approach to establishing a CVGE across the Internet, and its application to the collaborative planning of silt dam systems in watersheds through the integration of distributed virtual environments, geographical information systems (GIS), planning models of dam systems, and geocollaboration. The chapter addresses the conceptual and system frameworks of the distributed CVGE, and the 3-D modeling of virtual geographic environments and virtual collaborative studios in addition to

the mediated tools for collaboration, such as streaming media based communication, shared whiteboards for text input and graphics drawing, and text-based dialogue. In a case study of the Qiu-Yuan-Gou watershed, Suide County, Shanxi Province, China, a prototype system is designed and developed with Java, Java3D, and VRML. The complete dam systems in the Qiu-Yuan-Gou watershed represent a typical example model of a massive silt dam construction project on the Loess Plateau. The study employs the example model of the watershed to explore the methodologies of collaborative spatial planning of silt dam systems. Using the prototype system, participants can implement communication with each other via media tools, mainly in the virtual collaborative studio, and 3-D editing of shared dams, calculation of topographic properties, and ideal spatial distribution of dam systems in virtual geographic environment.

Introduction

Geographic environments are open, huge complex systems in which most complicated geoproblems, such as ecologic planning, sustainable urban development, evaluation of large geographic projects, disaster forecasting and early warning, emergency response and process, and ecologic security need to be collaboratively explored and solved by a group of people. Meanwhile, the rapid development of information and communication technologies facilitates the potential to invent many tools to support collaboration, with computer-supported cooperative work (CSCW) becoming an important research field (MacEachren, 2001; Mandviwalla & Khan, 1999). In the GIScience community, the limitations of current geographic information systems only designed for individuals, and the resultant increase in interest in geocollaboration is evidenced by the growing body of work on group decision support systems, public participation GIS, collaborative GIS, and collaborative geovisualization (Batty, Didge, Doyle, & Smith, 1998; Benko, Ishak, & Feiner, 2003; Cheng, Hu, & Ma, 2003; Craig, Harris, & Weiner, 2002; Densham, Armstrong, & Kemp, 1995; Jankowski & Nyerges, 2001; MacEachren & Brewer, 2004). This chapter will focus on the design and implementation of technologies for geocollaboration from the perspective of distributed virtual geographic environments.

The rest of the chapter is organized as follows. In section 2, work related to geocollaboration, with a special emphasis on distributed-virtual environments, is presented through a discussion of relationships with the online community, networked visualization, and Internet/virtual GIS. Section 3 elaborates the design of the conceptual and system framework of collaborative virtual geographic environments. Section 4 presents a prototype system of CVGE, and a case study

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