A Web-Based GIS for Analyzing Commercial Motor Vehicle Crashes

Sanjay Bapna, Morgan State University, USA
Aryya Gangopadhyay, University of Maryland, Baltimore County, USA

ABSTRACT

The purpose of this paper is to describe the design and implementation of a Web-based geographic information system (GIS) for providing online crash information and statistical information for commercial vehicle crashes. The system is capable of displaying crash data such as specific geographic location, period and time of crashes, severity, contributing factors, and cost. The system supports interagency communication with the purpose of reducing the number of crashes. Through the description of the design and implementation of the system, we demonstrate the feasibility of addressing spatial problems in a collaborative OLAP environment. It provides a guide for the design and development of similar systems and identifies a series or related, but yet unsolved, research problems.

Keywords: collaborative decision making; commercial motor vehicle crashes; GIS; OLAP; spatial database

INTRODUCTION

Computer networks provide opportunities to extract information from multiple sources in real time. The Internet in general and the Web in particular offer tools for more interactivity and connectivity among diverse groups. The integration of conventional planning method and innovative Web-based tools can offer a robust system to solicit community perspectives. Carver et al. (1999) have identified several advantages of a Web-based spatial decision support system (SDSS). In this framework, access to data and model is considered the key element of social and political empowerment through the experimentation of what-if? modeling. Bosworth et al. (2002) describe an encouraging experience based on public engagement in growth management and transportation planning, “A public workshop is considered a success if 60 people attend, while a Web site on the topic can reach 6000 people a week.” Before a Web-based spatial decision support becomes reality, studies are necessary to explore the feasibility of solving spatial decision-making (e.g., transportation planning, hazardous facility location,
urban land use/resource development negotiations, multiple use of natural resources, etc.) in a collaborative environment.

In this paper, we present the design and implementation of a prototype of a geographic information system (GIS) for the state of Maryland that has the capability of providing online crash information and statistical information for commercial vehicle crashes. The system is capable of displaying crash data such as specific geographic locations, period and time of crash, crash severity including the number of fatalities, contributing factors, and the cost per crash, just to name a few. The system supports interagency communication with the objective of reducing the number of crashes.

The rest of the paper is organized as follows: in the next section we discuss some of the related work, followed by the methodology for design and implementation of a prototype system, followed by the conclusion.

PREVIOUS WORK

The relevant literature related to the current work can be divided into three categories: work on geographic information system for tracking commercial vehicle crashes, spatial decision-making, and spatial online analytical processing.

GIS for Analyzing Commercial Vehicle Crashes

The literature in this field consists of work on cost analysis of motor vehicle crashes (Blincoe, 1994; NHTSA, 2000), traffic planning (Azar et al., 1995; Bayapureddy, 1996; Hans et al., 1995; Lang, 1999; List et al., 1995; Nielson, 1995), and GIS for crash analysis. We will describe two systems that are closely related to ours.

Souleyrette et al. (1999) implemented a system for the state of Iowa based on a map interface for crash location analysis. Initially, benefits from speed and ease of use were the developers' sole objectives. Development and implementation, however, revealed that data could be displayed in themes to differentiate types of crashes in various areas. These themes can be laid over other themes to reveal a unique type of data display and analysis. In addition, physical features of highways, such as sharp grades or curves, are displayed alongside these overlays. This adds an additional layer of information for interpretation. This newly found power of the Iowa system led the developers to examine applications specifically in terms of rural areas. Data considering the age of involved drivers, types of vehicles involved, and the type of road (i.e., gravel, paved, etc.) upon which the crash occurred were all included in the GIS database and allowed for a far more complete view of data trends across geographic areas. This particular project is concerned primarily with crashes involving vehicles, but, obviously, GISs are powerful enough to accommodate a wide variety of data.

Richards et al. (2000) describes a system developed for North Carolina that analyzes data related to crashes involving trucks in an effort to reduce such crashes. Tracking data for commercial vehicle crashes, this system includes data related to crashes as well as supplementary information such as the relative proximity of trauma centers to different crash concentrations. Population data also allow their system to track changes in crash density across regions as populations change over time. The ability to pinpoint such trends allows enforcement officials to anticipate future problem areas and modify enforcement activities accordingly.
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