Chapter 3.8
Toward a Visual Query System for Spatio-Temporal Databases

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ABSTRACT

Visual query systems (VQS) for spatio-temporal databases, which enable formulation of queries involving both spatial and temporal dimensions, are an important research subject. Existing results treat these dimensions separately and there are only a few integrated proposals. This chapter presents a VQS called spatio-temporal visual query environment (S-TVQE), which allows the formulation of conventional, spatial, temporal, and spatio-temporal database queries in an integrated environment. With S-TVQE, the user, instead of querying the database by textual query languages will interact with the system by visual operators for the statement of the query conditions. The tool provides a visualization of the results in different formats such as maps, graphics, and tables.

INTRODUCTION

The growing significance of geographic information systems and other spatio-temporal information systems is unquestionable (Sellis, Frank, Grumbach, Guting, & Koubarakis, 2003). Decision-makers need to analyze data through thematic maps, timelines, search critical regions, and so on. Therefore, it is mandatory to provide user-friendly tools, specially designed for these decision-makers so that they can express their needs adequately and explore the full potential of the underlying information systems. The visual specification of

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database queries enables an abstraction of the database schema and textual query languages, which makes user interaction easier.

A visual interface represents an additional layer (Shneiderman, 1998), which interacts between the user and a textual query language as, for instance, structured query language (SQL) (Silberschatz, Korth, & Sudarshan, 2005) in order to access a database. For instance, spatial constraints from the visual query are converted to SQL statements, which are executed on the underlined database management system (DBMS).

That task must be executed in a transparent way, in other words, no knowledge on database schema and language syntax is required (Snodgrass, 1999), which facilitates the usability of the database mainly for sporadic users, which are not familiar with technical details of the database.

The use of visual query interfaces is more significant for spatio-temporal databases as for conventional databases for two reasons: (1) spatial data are inherently visual and (2) textual query languages for those enhanced applications are more complicated since they must provide syntax to express temporal and spatial restrictions.

For textual database query languages such as SQL (Silberschatz, Korth & Sudarshan, 2005), there are extensions to access temporal data such as TSQL2 (Snodgrass 1995), and spatial data such as spatial-SQL (Egenhofer, 1994). These extensions are adequate for experienced database programmers and automatic data extraction tools. Many end users have no expertise on computer systems. For this group, visual query systems has proven to be the most adequate interface (Catarci et al., 1997).

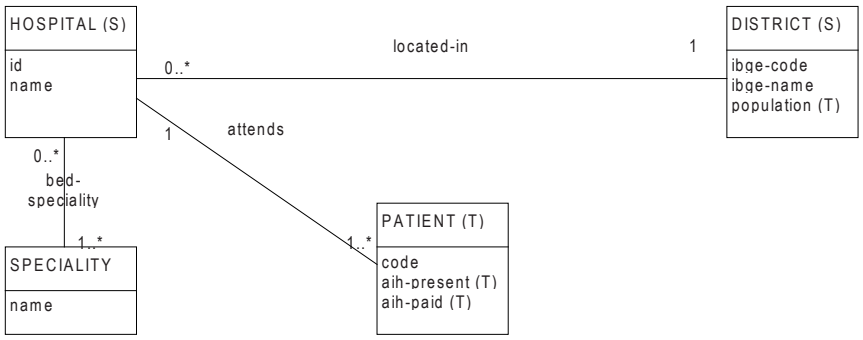
This chapter presents a generic visual environment for the access to spatio-temporal database systems especially geographic information systems. The environment can be plugged into existing databases.

For the validation of the system, we used real data from geo-referenced health information of the Brazilian Health System (SUS). SUS is an institution responsible for collecting, processing, and disseminating health information of Brazilian government.

Information related to health is generated daily in the whole country, and is stored considering valid time and spatial parameters. The volume of information already existent is very large and increases every day. Seeking to improve the quality of investments of health resources, the administrators perform statistical analyses with this data.

The health information system divides the country into regions, states, regional health nucleus (NRS), and municipal districts. Data about

Figure 1. Class schema of the health information system



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