A Map Editing Kernel Implementation: Application to Multiple Scale Display

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Abstract. User interfaces are a fundamental component of applications using as a support Geographic Information Systems (GIS) and geographic Database Management Systems (DBMS). We propose in this paper a model and an architecture for designing Geographic Database User Interfaces (GDUI). A GDUI kernel based on this architecture has been implemented using, at the interface programming level, X Windows, Motif and C++, and, at the database level, the GeO2 data model [DRS93b] implemented itself on top of the O2 DBMS. From the starting model, we make a first proposal for multiple scale map display.

1 Introduction

User interfaces are a fundamental component of applications using as a support Geographic Information Systems (GIS) and Geographic Database Management Systems (DBMS). Maps are the basic objects handled by such DBMS. There are two classes of functions in Geographic Database User Interfaces (GDUI): (i) the display of maps (geometry plus textual and structured description of the geographic objects displayed on the screen) and (ii) interactive queries on these maps.

[EF88, Voi91] give some user requirements for GDUI's. From a first experience with the implementation of a geographic database prototype [SV92, Voi92] with the O2 object-oriented DBMS [BDK91], it was clear that these user requirements cannot be handled by regular interfaces or interface tools for database systems. In particular, GDUI's present specific features such as the following:

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1. These queries are fully or partially graphically expressed. In particular some parameters correspond to the displayed geometry and are identified with the mouse. This identification is complex and requires computational geometry code not provided by "off the shelf" low level interface tools.

2. several maps corresponding to the same geographical area are overlaid in the same window on the screen (e.g., administrative layout and road network),

3. browsing and navigation through data is peculiar; it takes for example the form of scrolling or zooming.

4. the geometry is displayed at various scales and may have various representations (encodings) according to the scale (multiple scale representation: e.g., a town is either an icon or a polygon or a point, or...),

5. with the geometry of the map is associated a legend that includes graphical features such as line texture, color inside a polygon,..., as well as the display of alphanumeric descriptions (e.g., name of the city at the center of the polygon),

6. etc...

We propose in this paper a simple architecture for designing GDUI's. The objective is to provide high level tools, generic enough (i) to handle a large range of geographic applications (to adapt to a variety of GIS requirements) and (ii) to be independent of the database where the maps are stored. The starting point of our work was the interface model proposed in [Voi91, Voi92]. We decided to experiment its implementation, with emphasis on functionalities such as scrolling and zooming. Although we implemented simple zooming (magnifying data without resolution change) the ultimate goal we have in mind is the design and implementation of multiple scale representation. In a first step, only map display has been addressed (we left most of querying functionalities for a future work). Compared to the work in [Voi92], simplifying assumptions were made on several parameters related to the presentation of maps on the screen. In particular extremely simple legends and structures for the map display were chosen.

Our experiment [Rig93] presented below uses the GeO2 [II92] data model. GeO2 is a prototype of a simple geographic database implemented at IGN¹ with the object-oriented DBMS O2 [BDK91]. In order to fulfill the requirement of database independence, a GDUI was not developed with the O2 user interface tool O2 Look but in C++ [Sou86], X Windows [SG86] and OSF/Motif [OSF89] connected to O2 through the O2-C++ link [Tec92].

This paper is organized as follows. In Section 2, we describe a simple model and a four level architecture for implementing GDUI's. Maps are objects manipulated at the top level (in a vector form). They do not properly belong to

¹IGN stands for the French "Institut Géographique National".