Image Information System (I.I.S.): A Visual Database System for Spatial and Non-spatial Data Management

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Abstract

This paper presents the architecture and the basic operations of the I.I.S. (Image Information System), a prototype visual database system for the management of information concerning objects in images, their individual characteristics and their direction relation in space.

Keywords

spatial management, spatial constraints, non-spatial constraints, symbolic image, query, direction relations, skeleton image

1 INTRODUCTION

The I.I.S. is a prototype visual database system which gives the user the opportunity to search for objects in digital images, based on their spatial configuration and their particular characteristics, as well as to retrieve images containing objects with special spatial configuration. It integrates spatial (direction relations) and non-spatial (objects characteristics and attributes) data management.

The system is divided in four basic subsystems (see figure 1):

- Image management and data entry subsystem

It is responsible for the collection and storage of information related to image objects.

- **Query management subsystem**
It processes queries given by the users.
- **Displaying results subsystem**
It presents the results of the queries.
- **Database subsystem**
It is responsible for the storage of information concerning images, symbolic images and their objects.

Figure 1 System architecture

2 SYSTEM USAGE

A typical usage of the system includes the following steps:

2.1 Image loading

The user can load digital images stored in various formats (bmp, gif, jpeg etc.). An image may represent geographical maps, marine maps or satellite images, containing objects or symbols that represent objects. In the current implementation, the user has to manually define each object.

2.2 Object insertion

The user inserts objects in the image using the left button of the mouse. A dialog box appears where he defines the type (e.g. city) and the individual characteristics of the object (see figure 2). The object attributes are stored in the database. The object is represented on the map by a small rectangle and a letter-label.

Figure 2 Object insertion and definition

2.3 Symbolic image construction

A symbolic image is constructed in order to store the direction relations between the defined objects (see figure 3).

Figure 3 Symbolic image construction

One can see a grid on the top of the map. The dimensions of the cells of the grid specify the accuracy in the definition of direction relations. If the cells are small then the spatial information is more precise. On the contrary, if the cells are large, two objects, with the one being northwest of the other on the map, may appear to

satisfy the relation *north* in the symbolic image. The user can change the dimensions of the grid, before starting to insert objects on the map.

2.4 Query expression and processing

The query management subsystem provides the user with a query window in order to formulate the query (see figure 4).

Figure 4 Query window

2.4 Displaying results

Figure 5 depicts how the results are displayed after a typical query has been inserted by the user.

Figure 5 Query and results

The retrieved objects may also be displayed on the map (see figure 6).

Figure 6 Results on the map

In figure 7, we present a join query. The join is performed using the object variable *X* which appears in both subqueries.

Figure 7 Query containing join

The user can also search for symbolic images that contain some specific objects in specific positions (see figure 8).

Figure 8 Retrieval of symbolic images

2.5 Database modification

The database schema is dynamic. All the tables, that store attributes of different object types, are defined by the user and can be modified any time.

3 CONCLUSION

In this paper we presented the architecture and a typical usage of the I.I.S., a visual database system for managing spatial and non-spatial data. The I.I.S. gives the user the opportunity to load images, define objects in them, create symbolic images that store the direction relations between objects and pose queries for the retrieval of objects and symbolic images.

BIOGRAPHIES

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Theodore Dalamagas received his Diploma degree in Electrical and Computer Engineering in 1995 from the NTUA. During 1996, he worked as a software engineer in the KDBS Lab. In 1997 he received the M.Sc. degree from the University of Glasgow. He is currently doing his Phd in the department of ECE of

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Timos Sellis received his Diploma degree in Electrical Engineering in 1982 from the NTUA. In 1983 he received the M.Sc. degree from Harvard University and in 1986 the Ph.D. degree from the University of California at Berkeley, where he was a member of the INGRES group, both in Computer Science. In 1986, he joined the department of Computer Science of the University of Maryland, College Park as an Assistant Professor, and became an Associate Professor in 1992. Between 1992 and 1996 he was an Associate Professor at the Computer Science Division of the NTUA, where he is currently a Full Professor. His research interests include extended relational database systems, active database systems, and spatial, image and multimedia database systems. He has published over 80 articles in refereed journals and international conferences in the above areas.

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