Most modern database management systems are designed to promote controlled sharing of textual information. Individual users have their own view of the managed data and act as if they are the only users of the system.

Recently, there has been much interest in various kinds of database management systems for nontextual information. The database community has manifested this interest in proposals for multimedia databases, spatial databases, object-oriented databases, and various marriages between database and artificial intelligence techniques. In the computer vision community, interest has focused specifically on the design of image databases and efficient retrieval of iconic information by content. This iconic information will be used as a component for various query processing strategies, which in turn can directly influence efficient effector behavior, such as robot task planning.

Both the database and computer vision communities have something to offer in the way of good design proposals. The database community is in the midst of a conceptual revolution that will eventually supplant the relational paradigm. The new paradigm concerns itself with managing objects. An object is the instantiation of a particular data type, which in turn is embedded in a multiple inheritance network. As an instantiation of a data type, an object is packaged along with some operations.

Instead of managing tuples in a relation, the paradigm requires that general object managers be constructed. Virtually all proposals from the database community for the management of nontextual information use object-oriented techniques.

Except for the design of R-trees and the use of the geometry filter of Probe — both in the area of spatial databases — as well as some research in the office automation literature, database designers have not concentrated on designing efficient access methods for image databases. Nor have they considered efficient image interpretation as part of their approach. These tasks have been left largely to the computer vision community, which, while concentrating on the relational paradigm, has nevertheless developed various iconic indexing methods. These methods have not yet been integrated into unified query processing, insertion, and deletion strategies, however.

Thus, we would like to provide a forum where both database and image interpretation communities can contribute and exchange views. We believe this is necessary for image database management to grow, and we hope this special issue will encourage the necessary exchange of knowledge.

With the advent of computer vision, graphics, and CAD/CAM technologies, a wide variety of applications in various areas have evolved that require representation of the abstracted real world pertinent to the given application, both textually and graphically. Thus it has become essential to develop or extend existing data management systems to store and manage in an integrated fashion a vast amount of image data as well as textual data, some of which describes the entities appearing in the images. The type of information to be managed can be classified broadly into five categories:

- **Iconic data**: The images themselves are stored in analog and/or digitized form in an image store.
- **Image-related data**: This includes registration information, the resolution, and various format descriptors.
- **Information extracted from images**: This is the information that results from processing images through various processing methods. It includes such items as numerical/topological features as well as structural components and their relationships to each other.
- **Image-world relationships**: These describe relationships between image components and real-world entities.
- **World-related data**: This is conventional textual data describing the abstracted world pertinent to the given application.

An integrated image database management system must facilitate storage and management of all five types of information. The advantages of data independence, data integrity, data sharing, con-
trolled redundancy, and security offered by conventional DBMSs for textual data are required here for both image and textual data. Such a system should be able to perform query processing on iconic information by content so as to efficiently support retrieval of both iconic and textual information via other iconic and textual data. This, in our opinion, is what makes image DBMSs quite different from standard DBMSs.

In processing information by content, a model base is required, along with its associated model-base manager. A model base is a collection of the iconic descriptions for each of the entities/situations to be recognized/interpreted. The model-base manager is akin to a type manager in an object-oriented DBMS. Here, though, it is used in a different fashion. In a standard DBMS, the type associated with a given bit-string is known. In an image DBMS, the type (model) associated with a given bit-string (digitized image) may be unknown. Even if the model is known, we seldom have complete information regarding the entities appearing in the image. Thus, a problem arising in an image DBMS but not in a standard DBMS is to find a given object's type, which is just a rephrasing of the image interpretation task.

The articles in this special issue, authored by groups from both the database and the computer vision communities, provide a meaningful beginning for a melding of these two areas. In the first article, “Map Data Processing in Geographic Information Systems,” Rangachar Kasturi, Rodney Fernandez, Mukes L. Amlani, and Wu-Chun Feng survey a particularly interesting area of spatial data management systems, focusing on the applications of image understanding techniques to their design. The next article, “ISR: A Database for Symbolic Processing in Computer Vision,” by John Brolio, Bruce A. Draper, J. Ross Beveridge, and Allen R. Hanson, presents an excellent example of the application of new database techniques to the general task of image interpretation.


We hope this special issue encourages a further exchange of ideas in this area of growing importance.

Acknowledgments

We wish to thank Editor in Chief Bruce Shriver for his help in putting together this special issue. Also, we sincerely thank our numerous reviewers, who provided us with many insightful comments on an extremely tight schedule. Finally, we want to acknowledge the support of the Wayne State University Institute for Manufacturing Research, the Florida High Technology and Industry Council, and NASA Langley under grant 126-NAG-1-632.

References


William I. Grosky is a professor of computer science at Wayne State University, Detroit, Michigan, where he served as acting department chair for most of 1988. His current interests include model-based matching and spatial reasoning in a database environment, object-oriented databases, engineering databases, and multimedia office information systems. He is on the editorial review board of the Journal of Database Administration and the editorial board of the Macmillan Encyclopedia of Computers.

Grosky received a BS in mathematics from the Massachusetts Institute of Technology in 1965, an MS in applied mathematics from Brown University in 1966, and a PhD in engineering and applied science from Yale University in 1971. He is a member of Sigma Xi, the IEEE Computer Society, the Association for Computing Machinery, and the American Association for Artificial Intelligence.

Rajiv Mehrotra is on the Department of Computer Science and Engineering faculty at the University of South Florida in Tampa. His research interests include model-based object recognition in a database environment, low-level machine vision, VLSI architectures for image processing and computer vision, and multiple-arm robots. He is a coeditor of Multirobot Systems, to be published by the IEEE Computer Society Press.

Mehrotra received a B.Tech degree in electrical engineering from Kanpur University, India, in 1977; an M.Tech degree in electrical engineering from the Indian Institute of Technology, Kanpur, in 1979; and MA and PhD degrees in computer science from Wayne State University in 1983 and 1986, respectively. He is a member of the IEEE, the IEEE Computer Society, and the Association for Computing Machinery.

The authors can be contacted in care of William Grosky at Wayne State University, Department of Computer Science, College of Liberal Arts, Detroit, MI 48202.