20 DYNAMIC HYPERMEDIA FROM A MUSEUM DATABASE

The Gold of Greece Application

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Two traditions coexist in the use of information technology in museums. The first tradition, museum information systems, stems from the introduction about twenty five years ago of computers in a small number of large museums for the compilation and off-line use of inventories, indexes and lists. Microcomputer software available off-the-shelf is used by a considerable number of European museums, incorporating both documentation and collections management facilities (Dallas, 1990). The second tradition, cultural interactive multimedia, concerns mostly the disseminating function of museums, i.e., the support of exhibition, publication and educational activities. Many important cultural interactive applications have been produced so far using Interactive Videodisc. The combination of microcomputers with digital storage media such as CD-ROM in the late 1980s allowed the easier delivery of applications and the integration of data and application logic within the same medium. Combining an Interactive Videodisc with a CD-ROM, the Perseus Hypercard application allowed students of Classics and archaeology to retrieve a wide range of visual, textual and formatted data concerning Classical Greek culture (Crane, 1992).

Cultural interactive hypermedia are typically developed as stand-alone applications, with information stored within application-specific structures for a predefined delivery medium. Yet cultural data collection involves an enormous amount of effort for the organisation involved, and cannot be justified as an *ad hoc* effort related with a single hypermedia presentation (Dallas, 1992); in fact, this is a major limiting factor for museum involvement in developing cultural hypermedia. On the other hand, the latest generation of museum information systems addresses the need for complex, specialised information structuring and for the incorporation of heterogeneous media within museum databases (some institutions already store large numbers of images in electronic format), and makes it feasible that these will become integrated repositories of all relevant information about museum objects.

The Hypertext Interface for Information: Multimedia and Relational Databases (HIFI) project, supported in part by the European Commission ESPRIT grant EP 6532, addresses exactly this need. The project, a joint initiative between the Benaki Museum, Epsilon

Software SA, IPSI, GMD, Multimedia Systems Institute of Crete/FORTH, Politecnico di Milano, Siemens AG, Syntax Sistemi Software Spa and Systems & Management Spa aims to create tools and applications directly accessing data in relational and multimedia databases from a hypertext front end. In the context of this project, a hypermedia application called *The Gold of Greece* is being created. It uses the innovative Hypertext Design Modelling (HDM) methodology to design "in the large" the hypermedia application and map it to underlying relational and multimedia databases, which store the data from the museum's inventories, exhibition guide and scholarly catalogue. The reader is referred to Dallas and Garzotto (forthcoming) for a more detailed description of analysis and design issues in the *Gold of Greece* hypermedia application.

Application Requirements

Background

Founded in 1930, the Benaki Museum is the largest private museum in Greece, receiving financial support by the Greek Ministry of Culture and recognised as an institution of national status. Its mission is to present Greek art and material culture within both its geographical and evolutionary context; indeed, its collections demonstrate in a remarkable way the continuity of Greek art and culture, from the Bronze age to the present (Delivorrias, 1980). The Documentation Department of the Benaki Museum was officially created in 1991 and given the responsibility for creating and maintaining the computerised inventories, documentation standards and information systems of the Museum, including hypermedia applications. With support from the European Commission COMETT-2 programme, the Department worked with other organisations from Greece and the U.K. to create in 1992 the demonstrator version of the *Sacred Way*, the first Compact Disc-Interactive on Classical archaeology and history (Cornforth, Davidson, Dallas, Lock and Smith, forthcoming).

Subject-matter

The Benaki Museum owns one of the best collections of Greek jewellery in the world, spanning a chronological range from the Bronze age in the second millennium BC to the nineteenth century. This unique collection, fruit of the generosity of the Museum's benefactors, consists now of over 3000 jewels from all periods of Greek art. The Benaki Museum organised in 1990 the *Gold of Greece* exhibition, including a representative selection of its jewellery treasures. A published guide of the *Gold of Greece* exhibition already exists in English and German, based on the collective work of more than a dozen jewellry experts from Greece and abroad (Bromberg, 1990). The scholarly catalogue of the exhibition, including detailed art-historical discussion of the hundred and twenty exhibits, will appear shortly (Georgoula (ed.), forthcoming).

In the course of the HIFI project, a hypermedia application is developed on the *Gold of Greece* exhibition, based on information contained in its printed documentation and on the Benaki Museum databases. For each chronological period or style a short introductory text in the exhibition guide provides the historical, cultural and technological context for the examination of the artefacts exhibited. In the catalogue, a longer text provides more detailed information for the interested specialist, pointing to bibliographic and pictorial references, as necessary. Both texts are accompanied by photographs, linked with specific subjects discussed. A chronological table and a glossary of technical and stylistic terms are also available to facilitate the effective use of information. For each of the hundred and twenty objects in the exhibition, apart from formatted data derived from the museum inventories, a short label and a longer catalogue text are used to present the object to the

general and specialist public respectively. High-quality colour photographs are used for visual documentation. The texts, glossaries and indexes of the catalogue already exist in machine-readable form, and computer scanning of exhibit photographs is already under way. Core inventory data is available in the Benaki Museum database about the 3000 objects in its jewelle ry collections.

Intended audience

The broadest category of users which will be addressed by the *Gold of Greece* application are *museum visitors*. Typically, these users will not have any previous experience with using a computer, although most will have operated handheld remote control devices of domestic appliances such as VCRs. Consultation will typically last 10 minutes.

A second category of users is constituted by *specialists* in art history, and in the study of jewellery in particular. Users in this category will be either museum curators, or specialist visitors needing to obtain visual and content information on objects from the Benaki Museum jewellry collections. The purpose of the consultation for these users is to facilitate further research on a topic, e.g. technique in post-Byzantine silverwork from Epirus, or animals in Hellenistic jewellry. Consultation of the *Gold of Greece* system for this category of users will typically last 30 minutes.

A third category, with intermediate needs between the two first categories, consists of students. Students are likely to use the application by following predefined guided tours. While their background in Greek jewellery will probably be weak, their familiarity with art history and archaeology is likely to help their familiarisation with the more demanding parts of information.

Operational traits

The *Gold of Greece* hypermedia application will perform the following functions on the underlying relational and multimedia databases:

- Organise information according to the structural relationships mapped in the database schema, but also to semantic relationships which need to be specified at hypertext level.
- Incorporate knowledge on different user profiles in structuring and accessing information.
- Support the expression and refinement of both simple and complex set-based queries.
- Allow the delivery of uninterpreted multimedia data (such as long text, image sequences, video and soundtrack) associated with entities in the relational database.
- For both set-based and navigation queries, provide a consistent user interface which will depend as much as possible on selecting links, rather than on external control functions.

With the completion of the HIFI project in June 1994, it is expected that the *Gold of Greece* application will be available from one or possibly two workstations in the Benaki Museum, equipped with large good colour screen and an appropriate pointing device, probably a touchscreen. The workstations area will be partially isolated, so that a soundtrack may be effectively used. Users will be able to acquire hard output of data and images from the application, possibly in colour. The application should also maintain basic accounting data on the usage of the printing facility, to allow the Museum to control excessive or unauthorised usage.

Technical approach

Hypertext Design Model (HDM)

The design model presented in this section initially was developed for pure hypertext applications (Garzotto, Paolini, Schwabe and Berstein, 1991/Garzotto, Paolini and Schwabe, 1991a & 1993a) and was later extended to be more suitable for hypermedia applications (Garzotto, Mainetti and Paolini, 1992), including multimedia information and formatted data.

HDM does not address all phases of hypermedia design. It focuses on "authoring-in-the-large", i.e., on the task of defining the representation structures of an application, abstracting from the development of the content (which concerns with "authoring-in-the-small") and the lay out of nodes and links (which concerns with "screen design").

In this section we will just sketch, informally, the major features of the data definition language of HDM but we will omit any description of its query language. The reader is referred to (Garzotto, Paolini and Schwabe, 1993a & Garzotto, Mainetti and Paolini, 1993b) for more extensive presentations of HDM.

Units, components, and entities

In HDM, we assume that the hypermedia application stores *simple units of information* (*units* for short), each one of homogeneous nature: a tuple of a relational data base, a simple object in an object oriented data base, a page of text, a raster image, a CAD picture, a short animated sequence, a short video clip, etc. The notion of *unit* is related to the fact that the user must consider it as an unbreakable object (as far as retrieval is concerned).

We also assume two categories of structured segments of information: *components* and *entities*. A component consists of a set of units that denote the same piece of information under different *perspectives*. Perspectives are ways of presenting information, e.g., different media or different formats; in a museum application, for example, a text, a group of data, and a picture, each may represent the same museum object under different perspectives. Entities are organised collections (sequences or trees) of components. They denote domain objects (e.g., a museum object, a material, an art technique, etc.).

Connection categories

HDM distinguishes among various categories of connections. Perspective connections connect units of the same component. Structural connections denote structural relationships (e.g., part-of) between two components of the same entity. In HDM, structural connections among components induce the connections of the same type among their corresponding units under the same perspective. In other words, structural connections among units are *derived* from structural connections among their components.

Connections that express non-structural relationships among components - usually those of different entities - are called applicative connections. Certain techniques, for example, may be *used* for a given museum object.

Access structures

HDM includes two additional categories of connection structures: *indexes* and *guided tours*, which are typically used as access structures.

An index identifies possible items of interest for the reader. Items can be elements of a list of topics (e.g., museum objects, techniques, archeological places) or references to a specific

information unit. Moreover, a number of indexes can be interconnected in a tree fashion; the root can have secondary level indexes as items, which in turn can be connected to other indexes. Leaf items are individual information segments (i.e., units) or "guided tours". Indexes are typically used as entry points from which a navigation session starts.

A guided tour corresponds to a list of items (called "stages") and a centre. Whereas an index has the purpose of identifying possible items of interest for the reader, a guided tour has the purpose of leading the reader across a list of items in a rigid manner. In a guided tour the reader cannot select any item of interest at will: he has to make the selection according to a predefined order. The user is allowed to SUSPEND a guided tour from a given stage, and activate other connections that are available. From any point reached during the deviation from a guided tour, the user can return to the stage from which the guided tour was suspended, by RESUMING the guided tour.

Webs

As we mentioned in the previous sections, application connections, indexes, and guided tours, all share the same syntactic structure, and they only differ in their navigation semantics. To minimalise the number of primitives of the model, we have introduced the notion of web. A web is a list of objects with a centre, and a navigation category - application connection, index, and guided tour, which specify its intended navigation semantics.

Entity types, Web types, Application schema, and Application

Entities are grouped into entity types. All entities of the same entity type are characterised by the same set of perspectives for their components, and by the same organisation pattern (sequence or tree). Components and units derive their type from their owner entity.

Webs are grouped into web types. A web type defines the web category - applicative connection, index, or guided tour, the perspectives of the web centre, and the types of the elements that are allowed to be connected through webs of that type.

A schema is a collection of entity type and web type definitions.

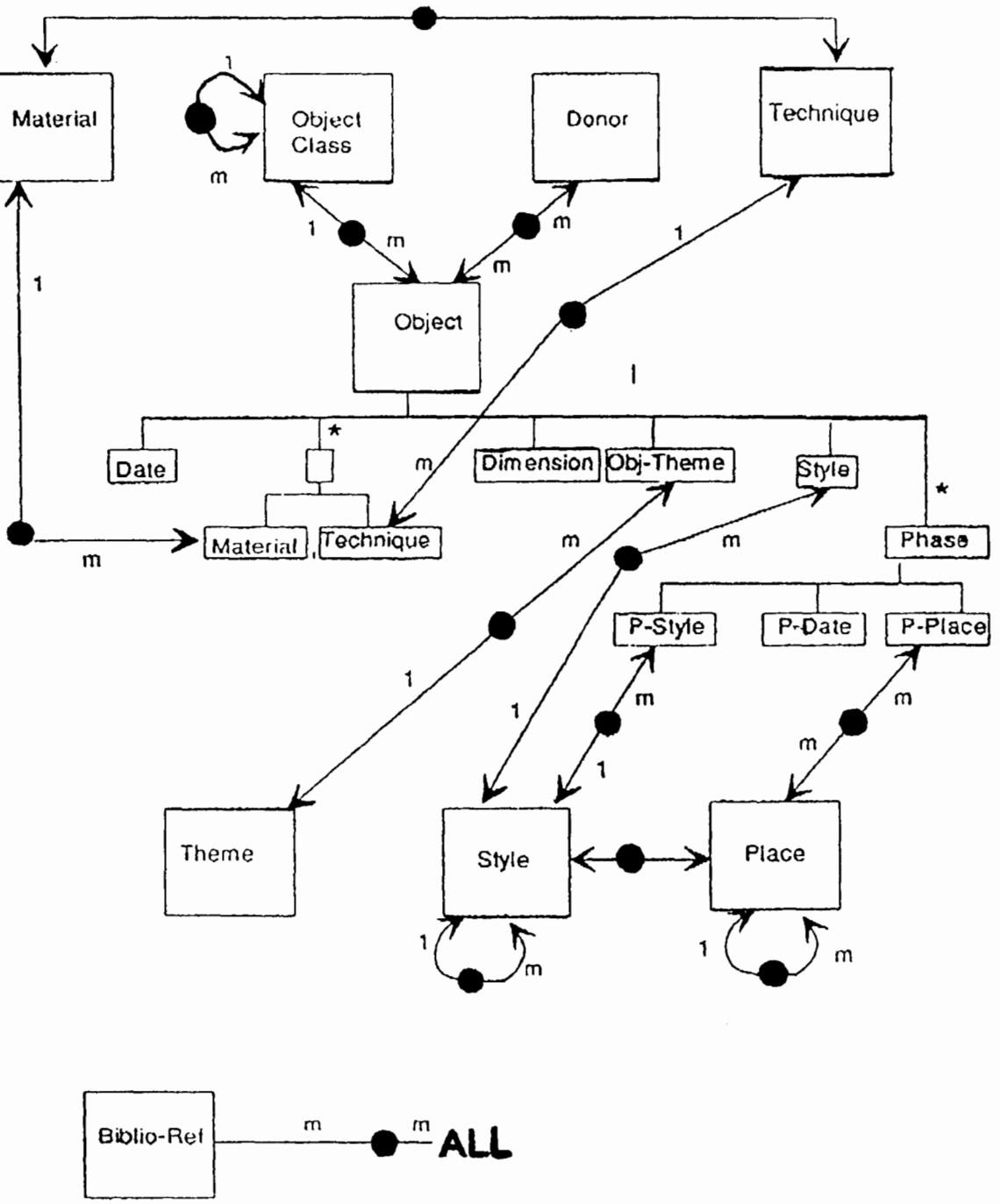
An application is an instance of a schema, i.e., a set of entities and webs that satisfy the definition of the schema.

Application schema

The HDM schema of a hypermedia application exploits the regularities presented by the conceptual structure (attributed entities and relationships) of the underlying database, but incorporates also knowledge about the application-specific high-level packaging and delivery of the information; it captures, in fact, a *hyperview* of the underlying information, a user schema defined for the specific navigation requirements of the application at hand.

The *Gold of Greece* HDM schema is shown in Fig. 1, presenting the entity types and web types used by the application; to avoid confusion, information on perspectives and on the units of some entity types is omitted from this diagram. The *Object* entity type encompasses all information associated, in the users' view, with the regular structure for the catalogue *lemma* for each jewel. The *Object Class, Material, Technique, Theme, Style, Place* and *Donor* entity types assemble encyclopaedic information about the set of domain entities which they represent. Instances of the *Biblio-Ref* entity type, on the other hand, are specific bibliographic references including information on any entity (a specific jewel, a figurative theme, a technique) of the domain at hand.

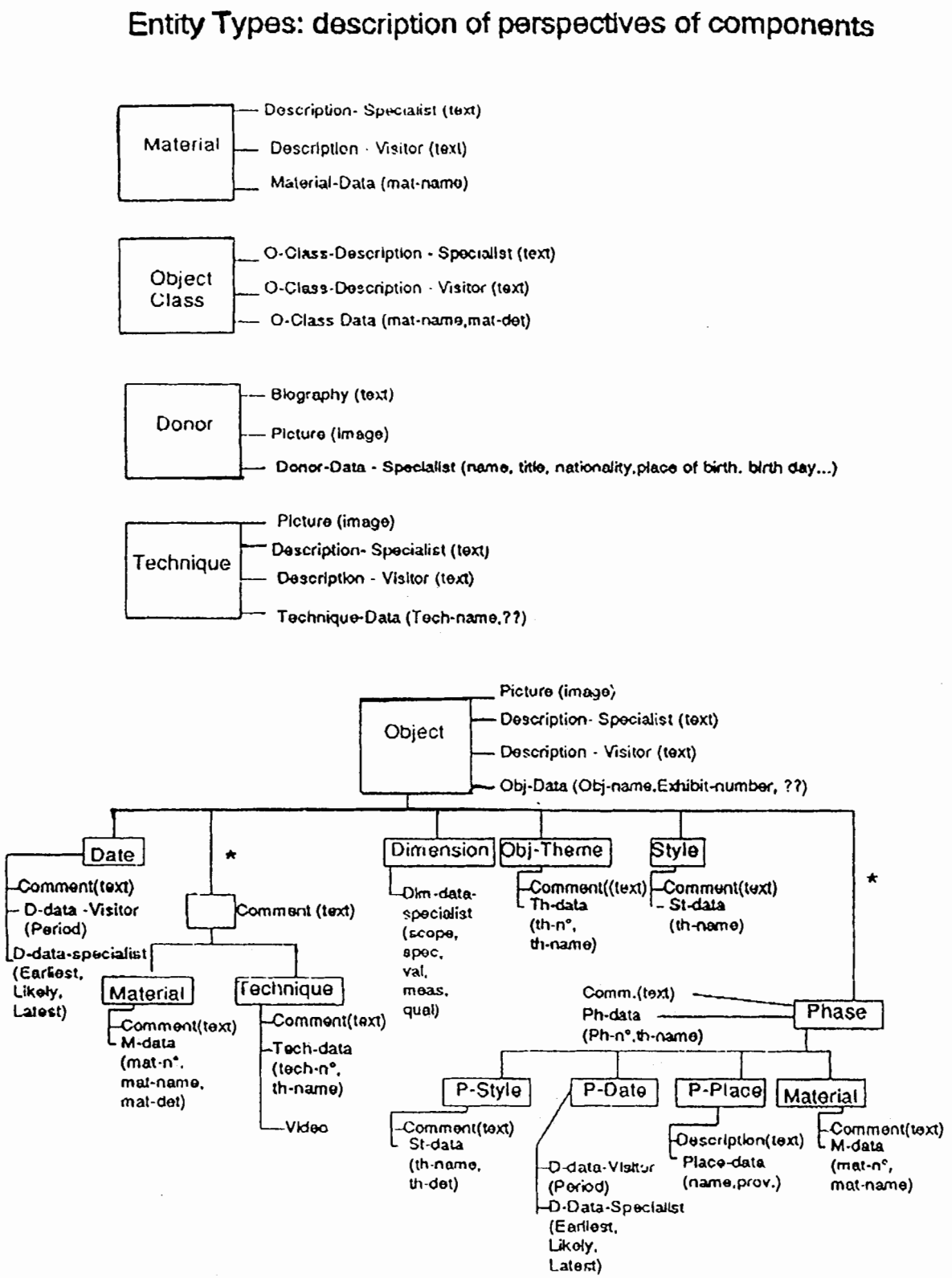
Fig. 1 *Gold of Greece* application schema



This expression means that bibliographical references are related to each entity or component of instances of the above schema

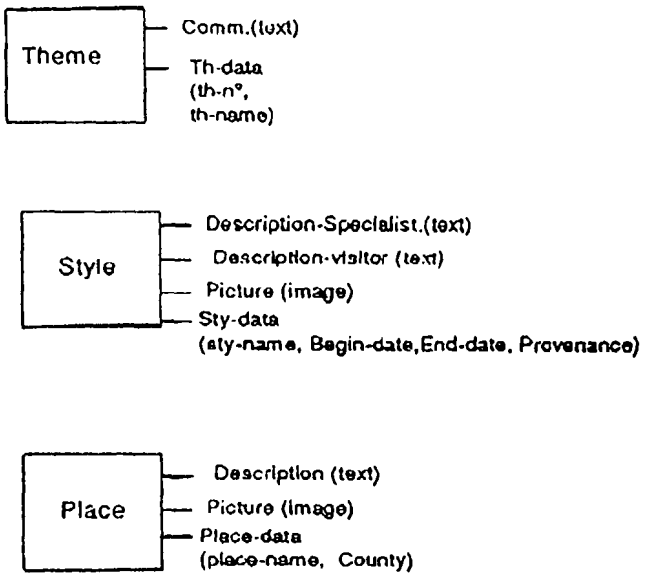
The marks 1 and m assigned to the web selectors denote the cardinality of the relationship (one-one, one-many, many-many)

Fig. 2 Perspective description of *Gold of Greece* entity type

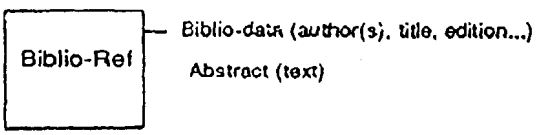


Nota: all the above entity types, in each of their components, have a data perspective "References" (for specialist only), which is a list of bibliography data of the form: author(s), title, edition...; this perspective has been omitted for simplicity. Entities of type Biblio-Ref (described below) provide details about each reference

Fig. 2 cont'd.



Note: all the above entity types, in each of their components, have a data perspective "References" (for specialist only), which is a list of bibliography data of the form: author(s), title, edition...; this perspective has been omitted for simplicity. Entities of type Biblio-Ref, provides details aboit each reference



Perspectives used in the *Gold of Greece* application are listed in Fig.2. The *specialist* perspective is intended for use by jewellery specialists and by students; texts are derived from the scholarly catalogue of the exhibition, and, at the presentation level, they are intended to be shown on screen in a scrolling text window. The *visitor* perspective, on the other hand, is designed for the museum public; texts are shorter captions derived from the exhibition guide and may be delivered as a voice commentary, rather than listed on the screen. The same image appears in both perspectives.

Examples of use

A typical use of the application involving a visitor of the Benaki Museum follows. From a list of general options, the user selects the Styles option and is presented with an index of period styles in Greek jewellery. From these, the user selects the Post-Byzantine period. A guided tour is presented, consisting of a sequence of the following entities:

- The Post-Byzantine period entity of the Style entity type.

- Places which were known centres of Post-Byzantine jewellry.
- A thumbnail view of post-Byzantine jewels in the Gold of Greece exhibition (voice "The Benaki museum owns an exquisite collection of Post-Byzantine jewels, which come from different parts of the Greek world . . .").
- The root of the object entity for the Caravel earrings, Benaki Museum inv.no. 7670; in the visitor perspective, the root consists merely of the object's picture, inventory number, object name and credit line (indicating that it belongs to the Holon Stathatos bequest) accompanied by a voice commentary, as follows:

This pair of earrings is notable for the highly colouristic effects achieved by the contrast of filigree enamel, pearls and gold. The pendants are in the form of three-masted carvels, while the hooks have fan-shaped attachments with crowns on top and bows at the bottom. Earrings with ship pendants belong to a larger group of ornaments called *Venetika* (Venetian) in the 17th century Greece. However, it is likely that this type of jewellery was made on one of the Greek Islands, at a centre open to Western Europe influences . . .

The user interrupts the guided tour, and moves to the materials and techniques "leaf" of the BM7670 entity. From the materials listed for the current object, he selects *pearl*. Following the *Object Material* to *Material* application web, photographed details of the earrings are shown with the following voice commentary:

> From the keels of the caravels are suspended three pendants, each with two pearls of unequal size. One pendant with two pearls of unequal size is also suspended from each bow.

Then, the root of the *pearl* entity of the *Material* entity type is selected, giving encyclopaedic information on pearls. The user selects the *Resume* button, and returns to the point where the Byzantine period guided tour was interrupted. The root level of the next jewel in the guided tour, Benaki Museum inv. no. 1990, is then displayed. After following the guided tour to its completion, the user leaves.

Although some recent cultural multimedia applications attempt to separate information structure from information content, they depend on bespoke data structures stored locally, and are implemented in a hard-wired fashion using as the result of very costly programming efforts. On the contrary, the approach followed in the *Gold of Greece* application within the context of the HIFI project is, firstly, to provide full support for the formal "authoring in the large" of hypermedia applications using both formatted and multimedia data, and, secondly, to allow the direct use of data from such databases for live hypermedia applications.

The main attraction of the HIFI approach for the museum domain is, however, application reusability. Since a generalising approach is used to map structural regularities within museum data bases in the hypertext front end, without modifying the structure of the native data, the effort of accessing other collections of the museum using the core of the *Gold of Greece* application will be minimised. Large parts of the design work for this application will thus be of direct use for further point-of-information applications.