Global Digital Museum (4) - Hyper-link Data Model

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1. Introduction

Global Digital Museum (GDM) is a virtual museum for museum education on the Internet. It provides access modality to multimedia contents of cultural heritage stored at museums, and tools for museum education in global network environments. Focusing on K-to-12 school children and the school teachers for GDM users, we have built a prototype of the system [1]. In this paper, we describe hyper-link data model of GDM which enables contents management on WWW for unified access to distributed museum contents and for on-line editing of the contents.

2. Hyper-link data model

The hyper-link data model is a representation of contents on the Internet which is independent from specific document format such as HTML. The model is based on the following requirements on access modality on the Internet:

Globalization of museum contents: A standard access modality is required so that the user can access museum information without considering differences among individual museums.

Search quality: Contents are created not only by museum experts but also by museum educators and school children. Quality levels differ depending on museum and educational expertise of content creators. Users need to distinguish correctly such a difference to make use of the contents effectively.

Personalization and collaboration: Museum users should be able to create personal collection. For communicating with other students and teachers, personal collection should also be shared among other museum users. The access modality is required for both read- and write-access to the contents.

The GDM database is composed of two types of object: simple object and compound object. *Simple object* is a primitive object, which holds the property of the object. The simple object has generic attributes to describe application independent properties of an object, such as creator of the object, time stamp when the object is created. The simple object also has user attributes, which can be used for application-specific properties of the object, such as bibliographical attributes and index information used for search. *Compound object* is associated with a simple object. The compound object specifies link to the associated simple object and link to other compound object with the type of the link.

3. Interpretation of GDM objects

The simple object and the compound object are the granules for constructing GDM objects in an application domain. Figure 1 shows an example of the structure of GDM objects for museum application.

Scenario, page and resources:
Scenario is a sequence of *pages*, each of which is displayed to users in one Web page. The page can be composed of *resources*, including text, image, sound and video. This hierarchical structure is represented by using link field of the compound object. The scenario is defined as a compound object with *CHILD* link to the first page. The page object is defined as a compound object with *CHILD* link to the first resource, and *SUCCESSOR* link to the next page object.
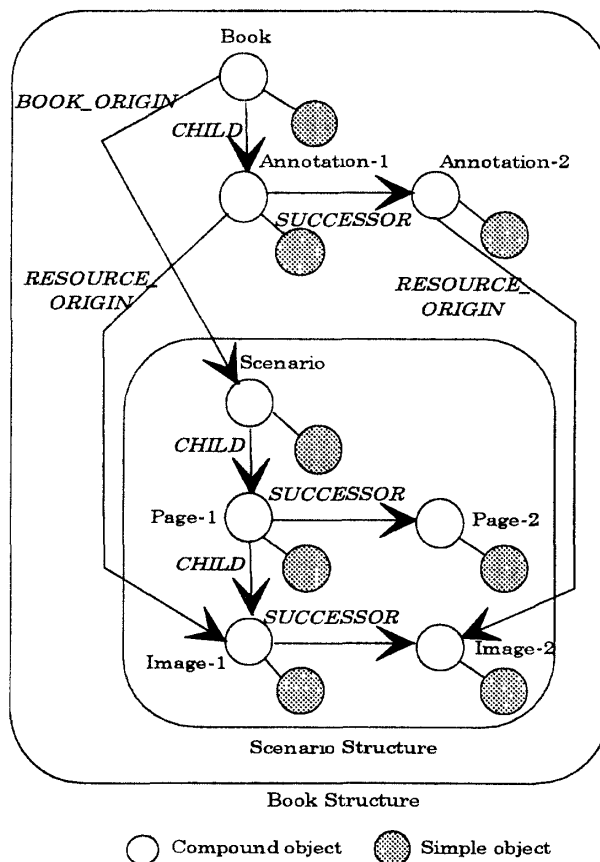

Figure 1: Structure of GDM objects

Book and Annotations:

Book is a personal collection of scenario for individual users. The book is distinguished from scenario in that the object can be updated by the user. The book is created by referring to the scenario. *Annotation* is a text object which is associated to a resource object contained in a book. For the image resource, user can make an annotation to a rectangle area of the image. The book may have multiple annotations to different area of an image, as well as annotations to different resources. The book object has *BOOK_ORIGN* link to the original scenario, and *CHILD* link to the first annotation. The annotation object has *RESOURCE_ORIGN* link to the resource object to which the annotation is assigned, and *SUCCESSOR* link to the next annotation object. Annotation text and annotated area of image resource is stored in the user attribute of the simple object for the annotation.

4. Implementation

GDM objects, which are composed of the simple objects and compound objects, are stored as a set of records in relational database. The following list shows attributes of tables for the simple object and the compound object in the current implementation.

Fields of simple object:

object_id	Object ID
resource_type	Type of resource
url	URL of resource
creator	Creator of object
created	Timestamp of creation
last_update	Timestamp of last update
read_users	List of read-access users
write_users	List of write-access users
type_of_action	Method of the object
title	Title of object
description	Description of object
created_date	Created date and time
analyst	Creator of index information
object_code	Application-specific data

Fields of compound object:

object_id	Object ID
simple_object_id	Associated simple object
type_of_object	Type of object
type_of_link_1	Type of first link
next_object_id_1	First link destination
type_of_link_2	Type of second link
next_object_id_2	Second link destination

All the objects are uniquely identified with an object ID on the GDM system. The object ID is specified with host name and the local object identifier. Semantics of a simple object are determined by the type of object. The following set of values are defined for *resource_type* field of the simple object:

{GDM_SCENARIO, GDM_PAGE, GDM_TEXT, GDM_IMAGE, GDM_SOUND, GDM_VIDEO}

The field *url* denotes the location of the resource for the object. The resource may located at the different site from the location where the simple object is resident. Index information of is stored in the user attributes of the simple object. Up to nine fields, *object_code1* to *object_code9*, are available for the

simple object.

Commands for the protocol are used for the manipulation of GDM objects. A session is started by *OPEN* command, and is closed by *CLOSE* command. The new GDM object is created by *CREATE* command. The *CREATE* command takes arguments of object type and host name where the object is stored. The object type is denoted by *S_OBJECT* and *C_OBJECT* for the simple object and the compound object, respectively. When the *CREATE* command is successfully completed, object ID is returned for the new object. The *PURGE* command removes the object which is identified with the object ID. *GET* command and *PUT* command are to read and to write the object specified by the object ID, respectively. *SEARCH* command is to look for GDM objects with conditions on attributes of simple objects. The search conditions are specified by the list of field name and the value pair. The *SEARCH* command returns the number of results and a set of compound objects, each of which has the link to matched simple object. On manipulating GDM objects, the link consistency among the simple object and the compound object is kept. For example, the compound object does not exist if the simple object is not created, and simple object is not purged if compound object is associated to the simple object.

5. Concluding Remarks

In GDM prototype, hyper-link data manager has been implemented on top of RDB. Formatting of GDM object is done by the client of the hyper-link data manager according to the interpretation of the field values of the GDM objects. We defined a primitive set of objects and its interpretation for museum application. The construct of the hyper-link model is general to accommodate the contents of other application domains by using different interpretation of the field values, such as type of resource and type of link. Future extension of the model includes:

- Enriching the semantics of the scenario and the book, such as creating the book from the scratch, and editing components of the book from multiple scenarios
- Incorporating formatting information, such as the place where the resource is displayed, as the GDM object
- Defining manipulation and protocol in composite object level
- Mechanism for public and private use of book and annotation

Acknowledgment

References

Takahashi, et al, "Global Digital Museum (1) - Concept," 53rd IPSJ Annual Convention, Sept. 1997.