Global Digital Museum(2) Network Architecture

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Introduction

A museum is a place which has a huge amount of a culutural heritage. Museums in the world usually have a good quality of contents that are sculputure, ancient manuscripts, cultural photographs, historical goods and so on. Their locations are geographically dispersed to the world wide. If we need to study the history and its related research using museums in the world, we have to go to museums to see museum contents. In addition of that, it is difficult to find the specific contents exactly from museums. Therefore, before going to museums, we have to know what kind of the conents those museums have. If the museum contents is digitized, is stored into databases, can be searched and retrieve them via the network, it will be easy to get the high quality of valuable data on the desktop computer.

On the other hand, the population of Internet users is rapidly increasing and the Internet is widely used for many areas. The main reason of the acceptance for the Internet was the development of the World Wide Web(WWW). The most wildely used application in the Internet is now the WWW. On the WWW client called the browser, you can navigate a large amount of the hyperlink data, and you can get information which consists of texts and images with the page layout in HTML(Hyperlink Text Markup Language). You can also search the database through the WWW. You only need to have a general WWW broswer to decode the HTML on the client side, and this is the major advantage of the WWW. You can also create contents with the homepage editor, put it to the server and show the results of your creative work to other people.

Other reason for the Internet to be widely accepted is the low cost of the installation for netowork equipments. The Internet is the simple network protocol suite and there is the good reference implementation of the protocol suite, therefore it's easy to implement the networking software to the computer, and the Internet can be constructed by inexpensive routers that can transfer datagrams without a guaranteed of QoS(Quality of Services). There is a issue to be difficult to transfer the realtime data such as video and audio because of the lack of QoS, but it's not a major problem. There is only few functions to forward datagrams between network interfaces in the router, therefore the installation and the maintenance cost of network equipments is low.

In following sections we describe the basic concept of the GDM, technical advantages of the GDM and the networking architecture of the GDM. In the networking architecture, we describe that how to query data to distributed databases in dispersed servers, how to retrieve data from them with an efficient method and how to collaborate among users.

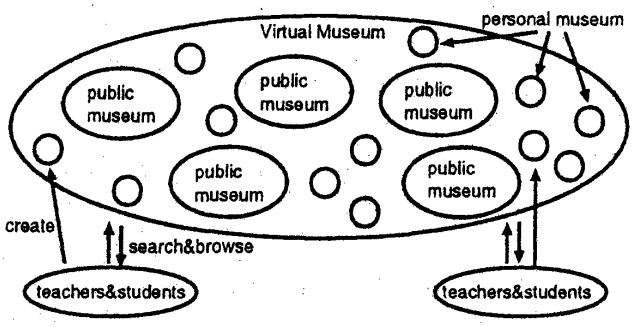

Figure 1: GDM concept

Concept

The basic concept of the GDM comes from a virtual museum that consists of the large archives which put the digitized data and the access method of them from the world wide. In general a virtual museum should consist of many dispersed museums, but there is only a single system image from user's point of view. The GDM is one of implementations for a virtual museum. At first, we created the concept of a virtual museum and designed the real system of a virtual museum, that is the GDM system. When you use the GDM, you can connect to your closed server and you can see that the GDM is the single image via the closed server. Museums contents is digitized and is stored into the archive, and they can be shared among users with the user interface. The functions such as the data search and its retrieval are important for the GDM. In addition to these functions, we also introduce the concept that users create their own museums to exhibit them on the Internet. This function is also the part of a virtual museum.

There are following two coceptual museums in a virtual museum.

- A Public Museum
- A Personal Museum

The concept of a public museum is based on real museums which are representing to visitors. They are exhibiting a qualified culutural resources that are digitized in texts and images. The museum contents is selected by experts who works for museums, and the description of museum contents is well studied. You can retrieve full texts and images of museum contents from these public museums.

On the other hand, the concept of a personal mu-

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seum is based on the personal exhibition, that museum visitors or students who want to create their own personal gallaries show them using public museums. They can search museum contents from public museums and write their own descriptions and modify images with the visual tool. Museum users can create their own personal museums. A personal museum is less qualified than a public museum. But there will be a number of personal museums in the GDM.

In general the GDM is mainly applied to the museum education. Before students come to the museum, they can study the museum contents with the GDM. After they go to the museum, they can study their homeworks with the museum contents in the GDM. If they upload their contents to the GDM, they can share their personal museums among students in the world. This work will be highly motivated by students.

There are many digital museums that are located at many countries and they show their museum contents with the WWW, but there is no relation among them. You have to get data from them with the normal WWW access. The issue should be solved by a single system image from the user's view. The museum contents are placed in many places, therefore the GDM needs to use distributed databases for search and to have the management function of the museum contents. The system adopts the WWW client and the WWW server. We have the technical advantage of following items in the GDM in addtion to the normal WWW client-server structure.

- Hyperlink database to manage museum contents efficiently.
- Distributed search to dispersed GDM servers on the Internet.
- Visual tool to create their own museum contents that can be shared among users.

History

We planed to divide the GDM project into two phases. The GDM Version 1 is the first prototype system to show a virtual museum at early stage to evaluate by users. The GDM Version 2 will be the complete system for the real environment. The first GDM system called the GDM Version 1 was aimed at the early installation, therefore the prototype system was evaluated by many users and will improve with their evaluations in the future release. At the GDM Version 1 for early installation, we used off-the-self programs such as the NCSA httpd that is the WWW server, the Netscape Navigator that is the WWW client, the Dienst distributed database by Cornell University and DB2 that is the database engine. At the client side, we developed the GDM book that is the visual tool to create the museum contents for a personal museum. The GDM book has the function to support multi-layer and multi-page of the museum contents. You can create your own museums using the museum contents by the GDM book.

Basic Design of the system

There are three basic functions for the GDM Version 2 system based on the GDM Version 1.

- create and edit the museum contents
- search and navigate the museum contents
- Internet between clients and servers

The item one is the client side function which can be manipulated for the database on the server side. You can create and edit the museum contents in personal

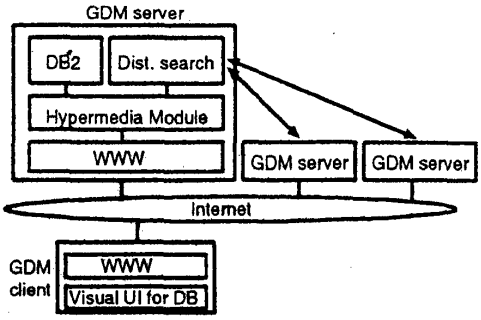

Figure 2: system configuration

museums. There is a large collection of museum contents that users created.

The item two is the data repository which is installed in the server. The relational database is used to manage the data repository. At the results of using the database, these data are searchable and we can look for the exact data from the database.

The item three is the networking architecture between the client and theserver. As the Internet isn't reliable and doesn't have any performance guarantee mechanism between them, you need to have the caching mechanism system. for the networking architecture. The caching should be searchable even if it's in the caching. The 2 show the system configuration of the GDM Version 2.

Networking Architecture

The Internet is an important role in the GDM. The GDM uses the Internet as a communication media to transfer data. Although the Internet is widely installed, the Internet doesn't have a good reliability for the data transfer. Because there are data loss, disorders of data and data errors on the Internet. The connection is often down and the data transfer takes times because of the packet loss. The TCP that provides the stream connection between the GDM servers has a responsibility of the reliablility, but the connect is often lost. From the point of view at the database, a unreliable network is a issue for the data search. It takes much time to search data and if the network is unreliable, and it often fails when the data is searched. Therefore the distrubuted database should be robust on the Internet. One solution of the issue is to use the caching mechanism in the server to keep data locally when the search is done. If the caching data exists and another query is done, the server can retrieve data from the local cache without querying to the remote server. There is no actual data transfer on the Internet, therefore you can get data soon. This is an efficient method in the low transfer rate or the low reliable network.

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References

1. Takahashi, J. Global Digital Museum(1) Concept. the IPSJ 53th conference, 1996.
2. Kusaba, M. Global Digital Museum(3) Application for museum education. the IPSJ 53th conference, 1996.