An Approach to the Digital Museum
Multimedia Systems for an Ethnology Museum

Jung-Kook Hong, Junichi Takahashi, Masahiro Kusaba

IBM Research, Tokyo Research Laboratory, IBM Japan, Ltd.
1623-14, Shimotsuruma, Yamato-shi, Kanagawa-ken 242 JAPAN
e-mail: hong@trlvm.vnet.imb.com

Shigeharu Sugita

National Museum of Ethnology
10-1, Senri EXPO Park, Suita-shi, Osaka-fu 565 JAPAN

Abstract

We evaluated the usefulness of a Hypermedia Exhibit Guide System, a Hypermedia Learning System, a Multimedia Database Retrieval System, and a Remote Video Question System as museum education tools at the National Museum of Ethnology, Japan. All the systems were considered acceptable by visitors to the museums,and seemed to help them become more familiar with exhibited artifacts. Among other reasons: (1) they allowed visitors to spontaneously access all the museum's information through interactive operations of the multimedia systems; (2) they presented the results in unexpected ways; and (3) they increased the visitor's awareness of the existence of the people behind the exhibition. Several key issues needed to be addressed in order to make multimedia systems useful tools for museum education: (1) definition of a museum's contents and establishment of a model of the museum's entire information; (2) development of principles and methods for multimedia system design; (3) definition of specifications for museum multimedia education systems based on participation, freedom, profoundity,and affordability; and (4) establishment of a new multimedia based exhibition concept.

Multimedia and Museums

Multimedia can be defined as the digital convergence of different types of data such as alphanumeric data, graphics, images, motion video, and audio. It is regarded as a technology for integrating audio-visual equipment, communication networks, and computers, as well. Accordingly, it allows data of different types to be authentically managed, and offers a sophisticated user interface that stimulates all the five senses.

Museums benefit from computerization of their traditional tasks. These benefits are greatly enhanced by multimedia technology, that is, by digital convergence of museum collections (HNG95). Some of the main benefits are as follows:

(1) it can retain their museum collections' original quality for a long time;

(2) fragile and aging materials can be easily accessed;

(3) museum collections can be easily and synthetically manipulated and distributed;

(4) a single item can be accessed by multiple users at the same time;

(5) museum collections can be remotely accessed worldwide; and

(6) the collections can be browsed at high speed and in sophisticated ways.

We know that there has been much research and literature on pertinent technologies for computers, communication networks, and multimedia. Nevertheless, there has been no commensurate effort to integrate these to realize authentic digital or multimedia museums (ORN80, SGT93, WIL87).

Education services in museums have become increasingly attractive to the public because the teaching methods used are different from those used in traditional school education. At museums, people can learn by directly accessing exhibited artifacts at their own pace. Interactive multimedia technology is regarded as a new education method that enhances the exhibits (KOE93) and we can see many examples of multimedia use in museums. However, many questions must be solved before multimedia technology can provide useful museum education tools.

Multimedia Systems for Evaluation

Our report covers four multimedia systems: Hypermedia Exhibit Guide System, Hypermedia Learning System, Multimedia Database Retrieval System, and Remote Video Question System. These provide users with various levels of participation and freedom in operating the systems to get knowledge of the exhibits. The level of participation is measured according to whether the museum's visitors can operate the systems spontaneously, or simply follow a one-way presentation. The level of freedom is measured according to the accessibility of information, and also according to the system's flexibility in handling vague inquiries. In terms of the level of participation and freedom of operation, the four types of systems can be ranked in ascending order as follows: Hypermedia Exhibit Guide System, Hypermedia Learning System, Multimedia Database, and Remote Video Question System.
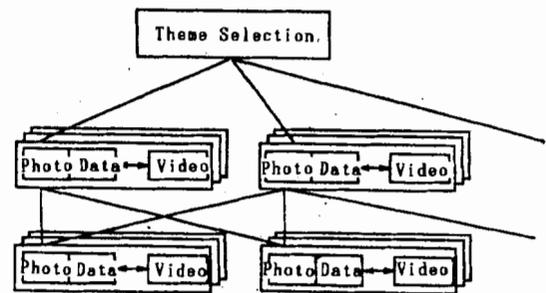
Multimedia Systems

Hypermedia Exhibit Guide System: [Figure 1] This is an electronic presentation system (SII89) which projects hyper-linked, multimedia information onto a large screen, using a transparent LCD on an OHP or video projector. It detects the positions of multimedia objects on the screen by means of a pointing bar with an optical sensor.

Hypermedia Learning System: [Figure 2] This displays titles, sub-titles, images, motion video, and text, and link information as card icons in windows (YMD95). These data are linked by hyper-links according to the scenario designed by the creator, and the user can navigate along the links to get knowledge.
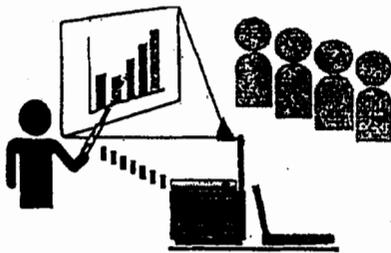
Fig. 1 Hypermedia Exhibit Guide System   *Fig.2 Hypermedia Learning System*

Multimedia Database Retrieval System: This is a multimedia database retrieval with a user-friendly graphical user interface. We modified a video scene archiving and retrieval system (HNG92) to make the initial version of the Multimedia Database Retrieval System, and then created the second and third versions [Figure 3] in line with feedback from museum visitors during the tests. In the first version, users selected keywords with a mouse from a list shown on a PC, displayed artifact images and textual information about each exhibit, and played associated motion video back. In the second version, the operation procedure was simplified, and interrelated-links were created among images of artifacts, images of related artifacts, motion videos of them, and exhibit information. Users were able to start their query by selecting artifact images and motion video frames, then display them simultaneously on a single screen. In the third and final version, various types of data were integrated on a PC in a sophisticated manner. Various forms of information of artifacts, such as images of the artifacts, images of related artifacts, specifically selected motion video scenes, exhibit information, text, narration, and voice synthesis were integrated, and manipulated simultaneously on a screen of a PC to realize a compact system.

Remote Video Question System: [Figure 4] An ISDN-based desktop video conference system (NJM93) was used in our project. It consisted of two PCs with video camera and head set, one for the use of museum visitors, and the other for the use of ethnologists. The PC for the latter had a keyboard, a tablet, a mouse, and a scanner as data input equipment.
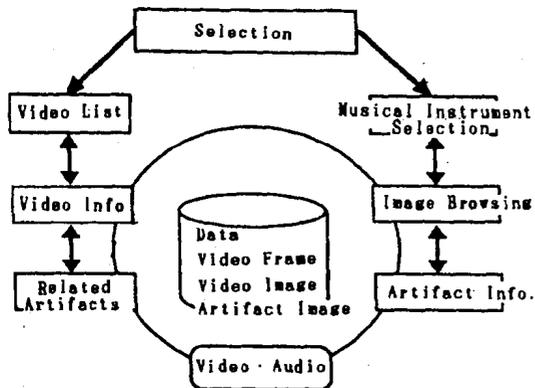

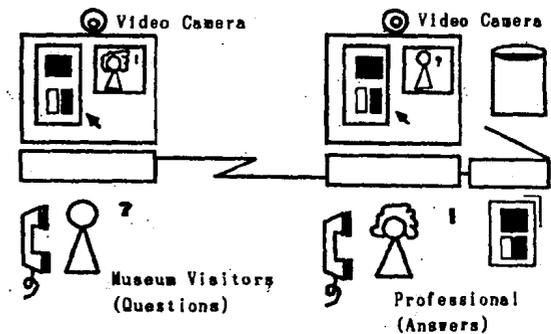*Fig. 3 Multimedia Database Retrieval System*   *Fig. 4 Remote Video Question System*

Test for Evaluating the Usefulness of Multimedia Systems

To make the Hypermedia Exhibit Guide System, we designed a hyper-link network connecting text, computer graphic images, photographic images, and motion video scenes, referring to the published exhibition guidebook of the National Museum of Ethnology. The system was set up at the entrance to the exhibition sections, since it was intended to be an electronic version of the printed guidebook. The museum visitors were shown outlines of the exhibition lasting approximately 5 minutes on a large screen. The museum staff and IBM researchers demonstrated the system in two days in July 1994.

The Hypermedia Learning System and the Multimedia Database Retrieval System presented ethnomusicological data in various forms, including text, image, motion video, and narration.These versions of the Multimedia Database Retrieval Systems were set up at the exit of all the exhibition sections, since we intended to answer questions about the exhibited artifacts that visitors brought from the exhibition sections where they came across the real objects.The initial version was in a period of around fifteen days in July 1994, and the second and third versions for similar periods in September and November. The Hypermedia Learning System was evaluated at the same site and for the same purpose.

The Remote Video Question System was set up at the exit of the South-East Asian exhibition section to transmit questions from museum visitors to an ethnologist in a separate room. We restricted the scope of the questions to the occupation on the Taiwan archipelago, because it would have been too difficult for a single professional to answer questions on any ethnological subject. The ethnologist professional prepared some reference materials such as maps and photographic images to supplement her answer, which were digitized and stored in the PC in advance.

We distributed questionnaires on the Multimedia Database Retrieval System and the Hypermedia Learning System, and automatically recorded how the visitors used them. We also observed what their usage patterns were and interviewed them about how they felt when operating the systems and looking at the displays. These observations and interviews took place during and after demonstrations of the Hypermedia Guide System. We observed how museum visitors used the Remote Video Question System, and interviewed them after the video question-and-answer sessions.

Evaluation of Multimedia Systems

Our observations and analyses of the questionnaires on the use of multimedia systems by museum visitors are as follows:

1. Hypermedia Exhibit Guide System: Approximately one hundred visitors spent time at this two-day demonstration. Their ages and occupations ranged widely. They showed a very strong interest in the system even if they could not directly operate it. Pop-up displays of images and motion video scenes on a large screen attracted them like a treasure hunt. The larger the screen the multimedia data were displayed on, the stronger their impact. By watching the screen, especially the motion video scenes, the visitors were able to find out not only what exhibition sections there were, but also how the artifacts were manufactured and used. We found that many people spontaneously shouted out with pleasure on acquiring such knowledge, and some of them walked back to the exhibition sections to see the real artifacts. Artifacts changed from lifeless ornaments displayed in exhibition halls into windows on the life of the human beings who made them and used them.

2. Hypermedia Learning System: Details of our evaluation have already been reported. (YMD95)

3. Multimedia Database Retrieval System: According to the questionnaire results, during six days, 153 people spent time using the first version; during three days, 67 people spent time using the second version; and during five days, 107 people spent time using the third version. Sixty percent of the users were male and 40 percent were female, while about 40 percent were teenagers, 28 percent were in their twenties, and 20 percent were in their teens. Eighty-one percent of the users had some skill or experience in using PCs, word processors, or game machines. They spent an average of four minutes using the first version, nine minutes using the next version, and eleven minutes using the final version. The length of

time they spent on the system became longer in proportion to how much the user interface was improved for visualization of inquiries and also in proportion to how extensive the multimedia data was in terms of volume and interrelation. Half of the users of the final version had the specific motivation of learning about ethnological music and/or learning to use the system. Sixty percent of the users said that the system was easy to learn, and a half of the users really enjoyed using it. Seventy-two percent thought that the system could be useful for learning ethnology. Seventy-two percent also replied that they would like to use this kind of system when they were alone in quiet surroundings, and 50 percent said that system should be located close to the real artifacts in the exhibition.

By watching visitors operating the systems, we learned several facts about their general attitudes toward the systems. Ease-of-operation was the most important issue. In this respect, it could be helpful to visualize the procedures by using images or icons. The visitors found a mouse easier to use than a joy pad. Data quality, which can be evaluated in terms of size, number of colors, and speed of playback, as well as interrelation of the various data types, was also a major concern. They watched all the motion videos until the end, but never replayed the same video. They read very little of the textual data on the screen, irrespective of whether it contained information on the artifacts, information on the exhibitions, or instructions.

4. Remote Video Question System: During two days of testing, approximately thirty visitors spent an average of 20 minutes operating this system, that is, exchanging questions and answers with the professional. They were all male students in groups from academic institutions ranging from junior high schools to universities. The higher their academic level, the more active they were in using the system. Female visitors, even students or those in groups, showed a very negative attitude toward using this system, because they felt very tense communicating face-to-face through a video camera with someone on the other side of the system. For this reason, three times more visitors passed by the system after just gazing at it than actually sat in front of the video camera. However, once they started to communicate with the professional, they concentrated on watching the display and listening to the professional, and started to ask various questions without being prompted.

On the other hand, the professional was under strong pressure to learn how to operate the system and to prepare supplementary materials before the tests started. It was very hard for her to learn how to simultaneously manipulate various items of equipment during the face-to-face sessions. For her, ease-of-understanding and ease-of-use were the most strongly desired characteristics of the system. She showed photographic images and maps to the visitors, which were very effective in helping them understand her answers. Easy access of the image files was another strong request of the system. These images were directly related to artifacts discussed by the ethnologist.

This face-to-face question-and-answer system helped the visitors to penetrate deeper and deeper into a particular topic. We observed that this system seemed to give the visitors the strongest sense of satisfaction.

Conclusions

1. Advantages of Multimedia Museum Systems: All the multimedia systems were considered acceptable by the visitors, who seemed to become more and more familiar with each artifact watched on the screens of the multimedia systems. Their eager acceptance of multimedia systems can be regarded as due to the advantages of multimedia. In general, multimedia systems stimulate the visitors through several senses to obtain new knowledge to satisfy their curiosity, and to make new discoveries while having fun. Manipulation and presentation of various types is an intrinsic feature of multimedia digital convergence. Access to a museum's entire collection of information, especially motion video scenes, helps visitors to become aware of the lives of the people who made and used the artifacts. This awareness of the lives of the people's existence behind the artifacts makes the artifacts much more than lifeless ornaments. This psychological aspect of multimedia supplements its ability to explain museum collections in a technical way.

2. Specification Multimedia Museum Systems: There are four key issues involved in the creation of effective multimedia museum systems.

- Participation: The visitors and the museum itself want the visitors to have access to multimedia information as well as to the exhibits. This desire can be fulfilled by allowing the museum visitors themselves to operate multimedia systems directly. When they do so spontaneously and interactively, they feel a sense of satisfaction since, in general, they prefer to visit museums at their own pace and for their own reasons. Over 70 percent of people wanted to use a multimedia system alone, as mentioned in the previous chapter.

- Freedom: Visitors want to use multimedia systems freely. The systems must be free from any restrictions on data volume and coverage. Furthermore, visitors get the greatest satisfaction from accessing the original information, or information close to the original, rather than modified information. Multimedia systems should be flexible enough to absorb any inquiries from visitors, even when the inquiries are vague and the visitors have no particular motivation to use the systems.

- Profoundity: There is a need for sophisticated mechanisms that allow visitors to penetrate deeper and deeper into the meanings of artifacts. Visitors can enjoy this intellectual adventure only if they are free from technical retractions, as well as provided with a high level of knowledge.

- Affordability: Even though multimedia systems are sophisticated and highly user friendly in terms of technology, a system is not useful if using it makes visitors tense, or if they are not motivated by it. Similarly, it is not useful if it does not show visitors who are just walking past what it can do. Attention must be paid to creating call-in and walk-up systems.

The four multimedia systems that we tested for this report are mapped in Figure 5 to four evaluation axes. The Hypermedia Exhibit Guide System occupies the lowest positions in the participation, freedom and profoundity axes, because of its fixed hyper-linkage and one-way presentation. However, it occupies the highest position in the affordability axis because visitors feel little pressure in approaching it. The Remote Video Question System, which is the most sophisticated, ranks top in profoundity axis, since the users can directly communicate with professionals. For the same reason, though, the technology imposes the strongest mental pressure on visitors, who are often novices in using multimedia systems.
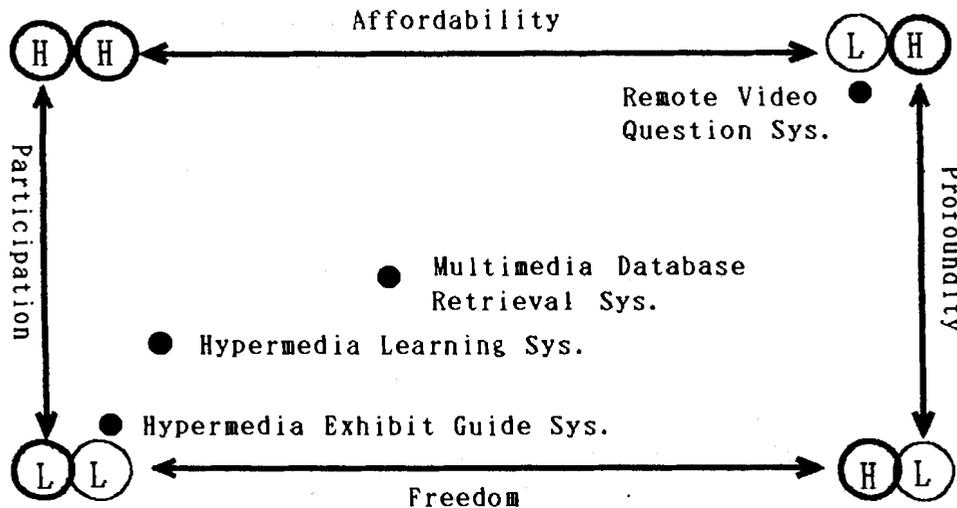

Fig. 5 Specifications of Multimedia Museum Systems

3. Museum Contents and Museum Information Model: An ethnology museum's information consists of artifacts and associated information of various data types about each artifact. Furthermore, the information of an artifact is intimately related to information of other artifacts. When this information is integrated, it can offer deep insight into cultural meaning of the artifacts. To satisfy visitors, both the amount of information and its coverage must be large enough, and the quality of the information must be high enough for it to be digitized. Visitors feel a sense of satisfaction in accessing original information, and in seeing various versions of the data processed by means of digital technology, which allows the museum's entire collection of information to be handled flexibly. Establishment of an information model for the museum is of vital importance if the information is to be used effectively.

4. System Design and Implementation Tools: There are various types of multimedia systems, apart from those described in this report, and all have various unique features. The key issue is how to position appropriate multimedia systems in a complete system; for this purpose, we must address the principle of design and design methods. Since off-the-shelf multimedia-implementing tools have been developed for general purposes, rather than specifically use in museums, we also need to define and develop tools specifically for museums uses.

5. Multimedia-Based Exhibition Concept: Since multimedia representations can be regarded as intrinsic aspects of real artifacts, they can provide visitors with complementary information, thus allowing them to access a museum's entire collection of information of each artifact. Real artifacts and multimedia must be handled on equal terms as museum information source and in terms of their information value. Multimedia information should never be used as supplementary, like the name tags of artifacts. Traditional concepts of an exhibition centered on real artifacts must be reconsidered to involve multimedia as an equal partner in the museum environment. In other words, multimedia's position in a museum environment should be established by paying attention to factors such as size, color and shape, screen design, and information content.

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