Meta-Museum: A Supportive Augmented-Reality Environment for Knowledge Sharing

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Abstract

The Meta-Museum is a newly coined concept which seeks to enhance people's knowledge exploration experience in museums. The Meta-Museum blends virtual reality and artificial intelligence technologies with conventional museums to maximize the utilization of a museum's archives and knowledge base and to provide an interactive, exciting and educational experience for visitors.
The Meta-Museum concept is presented along with the current progress of our research on personalized investigation. As an example, an archaeological environment is being developed. A user can walk through the virtual acient Japanese village and access to the hyper-linked information. The visualization of village's evolutionary sequence can provide both the non-expert and expert users with a spatial sensation of house building plans.

1 Introduction

Museums are society's great archives of wonderful natural phenomena, historical artifacts and artistic masterpieces which are on display for visitors to come and see.

Not only do they contain these concrete sources of information, but they embody the *knowledge* from the creators of the artifacts and the exhibitors and scientists who investigate, relate and reason about the artifacts or natural phenomena.

However, the reality is that the visitors are often not able to cherish the fruit of a researcher's work. For example, conventional museums provide exhibitions to general audiences, thus they cannot totally satisfy every visitor. Moreover, because of the limitation of space and physical constraints of a dynamic exhibition, a visitor cannot explore the detail behind a particular exhibit. This presents a communication gap between the experts and non-experts which often occurs at several levels. Our goal is to provide a supporting tool for these kinds of communication objectives, e.g. knowledge sharing, mutual/self understanding, creative collaborations, etc. Knowledge sharing is one of the most basic functions of communication.

The Meta-Museum is a newly coined concept which seeks to enhance people's knowledge exploration experience in museums. The Meta-Museum blends virtual reality and artificial intelligence technologies with conventional museums to maximize the utilization of the museum's knowledge base and to provide an interactive, exciting and educational experience for visitors. The Meta-Museum environment provides visitors and exhibitors with aids to explore and/or share in the collection of knowledge, history, arts, life and other artifacts. The Meta-Museum offers rich and effective interaction with a museum's archives and the people behind them. A story-telling like scenario of a futuristic museum on a natural historical museum can be found in W. Kellogg et al.[5], which is a good illustration of a Meta-Museum. They stress museums are the best place of the augmented reality applications. The objective of the Meta-Museum research is to realize such a scenario and provide a communication environment on the edge between the real-world and cyberspace.

The curiosity to obtain knowledge and its satisfaction has been the largest entertainment of mankind and the Meta-Museum can provide such an entertaining environment as well as the learning facility like a huge textbook.

In this paper, we present the concept of the Meta-Museum and the current status of our research on personalized investigation. An interactive visualization and simulation tool for archaeological study has been developed. The tool is the archaeological approach for realizing the Meta-Museum environment.

2 Meta-Museum

Meta-Museum is an environment of communication between visitors and people behind the exhibits. Its

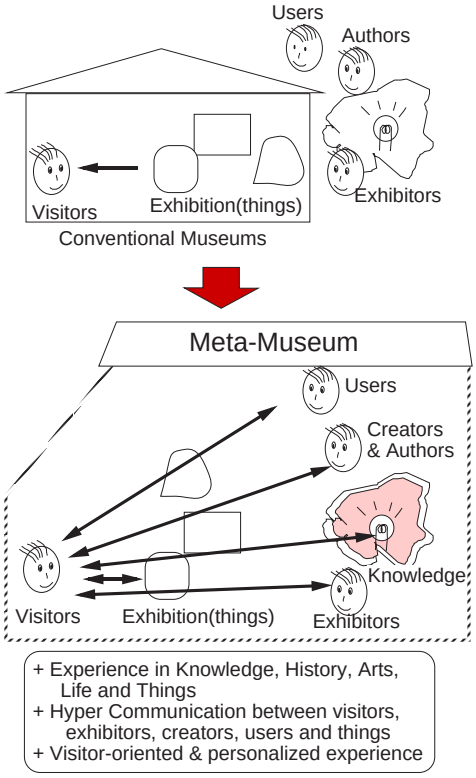

Figure 1: Concept of MetaMuseum

purpose is to support entertaining knowledge discovery by providing a space of experience in knowledge, history, arts, life and things. As personal experience is a key to acquire feelings and sensations, visitor-oriented exhibits will facilitate the communication (see Figure 1). Accordingly, the Meta-Museum incorporates:

1. real, sensitivity-rich objects *augmented* by virtual objects with hyper-links for accessessing abstract knowledge spaces,
2. personal artificial guidance agents for the visitor,
3. visitor oriented and personalized access, experience, and learning of exhibitions, and
4. ease of communication between experts (people behind the exhibition) and non-experts (visitors).

We have identified the following three primary technologies to realize the Meta-museum.

1. A visualized guide system based on augmented reality: this guide system could be a multi-media version of conventional recorded guides such as a 3-D graphical model overlaying a fragment of a real artifact or a life-like believable agent [7] as a tour guide in the real museum.
2. Visitor understanding system: a visitor's situation and interaction are recorded and interpreted[8] by an agent system to know the visitor's interest and to learn how to provide the most valuable information to them at the moment.
3. Support of two-way flow of communication: mechanisms for integrating personal experiences and merging conceptual spaces of visitors and experts will minimize the mismatch between them.

Figure 2: A computer generated agent character that looks like it is drawing attention to the ground

2.1 $Virtual + Real = Meta?$

The Meta-Museum is not just another virtual (or digital) museum[6]. We'd like to put emphasis on physical exhibit at conventional museums. There is a big difference between the real/physical artifacts and the digitized ones shown on computer display in terms of reality and sensitivity. The richness of sensitivity which is provided by original artifacts becomes a window to the curiosity, therefore it can lead us to different dimensions of thoughts, imaginations, sensations, etc. We want to use this property of original/physical artifacts as a window or a key to the huge collection of knowledge in the virtual space.

Meta means, in other words, not only the integration of the virtual world and the real world but also the hyper communication facilitation between visitors and people behind the exhibits. If the hyper-links thorough exhibits extend over individual museums, the whole network becomes an entity. Upon this networked exhibition, "meta" level exhibition can be created by exhibitors or interdesiplinary researchers. In this way, the Meta-Museum will become namely a *"meta"*-museum.

2.1.1 Use of HMD as a guide receiver

A simple idea to realize such a combination of real and virtual integration is to use a see-through head mounted display (HMD). There are two ways of suppling virtual/digital information onto HMD screens; the location sensitive mode and the location independent mode. When exhibiting an excavated piece of an ancient pot, the viewer in location sensitive mode may be expected, for example, to supplement the idea of the placement of the piece with an original whole shape overlay. On the other hand, in location independent mode, the system may provide the attribute

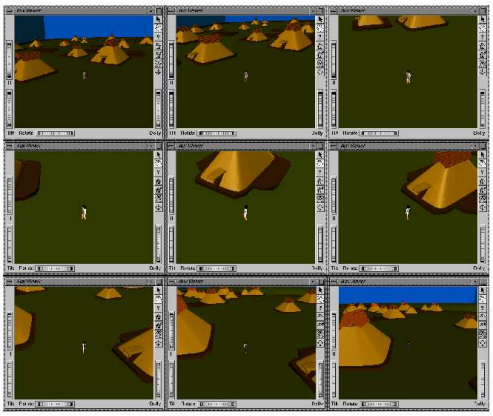

Figure 3: A view-point reference agent in an ancient village

information of the piece such as a text information of the year and place.

An HMD with position sensors is necessary for a location sensitive viewing mode. We are currently investigating various sensors, such as Infra-Red and video camera. Video-see-though provides a reasonable match of the composition between the real and virtual scene. However, it may not be a great idea in this context because video capturing could degrade the sensation of reality.

An additional advantageous feature of a guide receiver is location awareness. The system should know the visitors position and situation to provide appropriate information and guidance.

2.2 Personal guide agent

Life-like character agents should inhabit the Meta-Museum to guide and give a reference of dimensions and attributes to the visitors in the cyberspace. The exhibit course and schedule will be shown multimodally by the mixture of verbal and nonverbal languages. Two functions are being developed, i.e. route guiding and view-point reference functions.

The route guiding agent appears on HMD and will lead the route of visitors. Rather than showing the map, it will show the way that the visitor may have chosen previously or that an autonomous agent may selects and suggest based on the visitors interests and past visit records. Figure 2 is a computer animated character we designed whose running/walking movement is animated automatically with a small number of parameter settings[2].

The view-point reference agent appears mostly with the virtual exhibits to show the relative size of the things presented in the virtual world. Also, it can be an anchor to know the current location in the bird-eye view (see Figure 3).

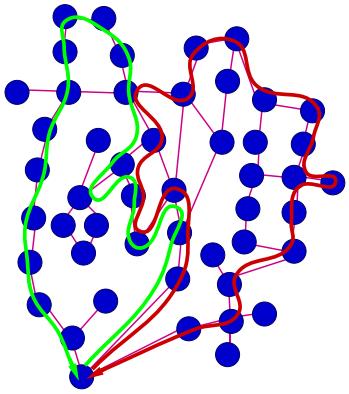

Figure 4: Personalized exhibit (model: a floor plan of British Museum)

2.3 Personalized experience and exhibit

Wide variety of people visit the Meta-Museum distinguished by, e.g. age, occupation, race, education, interest, etc. It is difficult to provide satisfaction to all the visitors by the same exhibits. Exhibit and experience can be personalized by (i) selecting and reorganizing the prepared exhibit and (ii) providing a way to explore what is behind the general exhibits. Because the prepared exhibit usually contains a lot of items, the first method could provide enough satisfaction if the items are appropriately selected (see Figure 4).

We have identified the following parameters that are useful in selecting items: the personal profile (background) data, the past visit records and the interaction records of the day. These records are kept by a personal mobile agent which exchanges necessary information to plan the tour and modify the plan dynamically during the visit.

3 Archaeological Meta-Museum

An archaeological Meta-Museum is being implemented in the moment. Technically it focuses on supporting knowledge discovery for users. Hence, expert support is provided in the first place. The facilitation of communication between experts and non-experts can emerge from the provision of such a tool to experts, then allow non-experts to access hypotheses built by experts.

The VisTA system has been developed as a part of an interactive knowledge discovery system for archaeological data[3]. VisTA assists visualization of the evolution of an ancient village letting users interactively set and modify the lifespan of each house in the village and allowing them to walk through the village (see Figure 5). It uses a very simple and intuitive

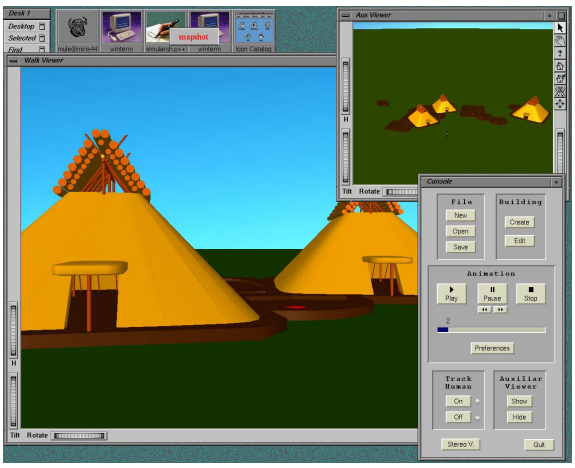

Figure 5: Reconstructed Ancient Village and Interactive Visualization Tool

graphical interface, through which the users can create new huts and set the life term and characteristics of each existing hut, in accordance with the valid vestige marks pattern discovered in the raw real excavation data.

As experimental data, the excavation site of Otsuka (a town of Yokohama today) has been selected[1]. This site belongs to the Yayoi era. This era provides an interesting case of study because at this time the social and spatial organization of the Japanese ancient villages start to become cities. To visualize the evolution of the villages in this era seems to be very helpful in an archaeologist's work.

Figure 6 shows an experimental setup of Meta-Museum research. A wall size screen is installed in a corner of laboratory where cameras are looking at the people from the top of screen and from the ceiling. The cameras can extract simple human actions such as pointing[4] and raising hands[8]. This vision sensor output will be fed as a control device for walk-through command and selection of object on the screen. The wall display supplements the exhibits within the same space. For instance, replicas of artifacts such as ancient pot placed in the space has a hyper-link and the system will provide the appropriate information if a visitor shows an interest in it.

We also plan to incorporate a see-through HMD for information supplement. Figure 6 illustrates a imaginary picture of how it looks. All the objects within the MetaMuseum should have a link to annotating an object which is invoked either on the screen or on HMD. A WWW browser may be used to provide such annotating information.

4 Conclusion

The concept of Meta-Museum is a concrete project of our research subject of communication support. This paper presents initial discussion to establish a framework for this project and some initial progress.

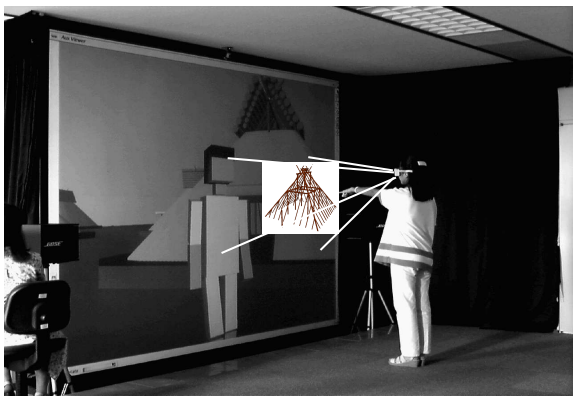

Figure 6: Display of village on a wall screen. (HMD displaying and gestural access to information is overlaid as an imaginary picture.)

Acknowledgment

The authors would like to express their gratitude to Kazushi Nishimoto and Eduardo Neeter for their help of constructing the experimental interactive environment and the interactive visualization tool, respectively. The authors would also like to thank Armin Bruderlin, Sidny Fels and other ATR MI&C members for their suggestions and discussions on this project.

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