A Multimedia Museum System for Cross-Cultural Communications

Shiori Sasaki† Yasushi Kiyoki‡

Graduate School of Governance, Keio University† Faculty of Environmental Information, Keio University‡

1 Introduction

Cultural computing is an emerging field of multidisciplinary computer science [1]. Though the subject of this field covers wide domains, the common objective of research is to promote communication and understanding within and between diverse communities and foster creative activities and opportunities. In the near future, cultural computing will contribute to several important applications in the fields of art, the humanities, the social science, education, health care, environment and business issues.

This paper presents a design and implementation of a multimedia museum system for cross-cultural communications and its applications (Fig. 1). The objective is to construct a joint research environment to study culture for remote users in different cultural backgrounds without temporal and spatial constraints. This environment promotes a new form of cultural and academic research exchange among remote user groups by real-time sharing, cooperative manipulation and interactive creation of multimedia contents with discussion in the context of semantic, synchronic and diachronic analysis of media data.

This museum system is constructed based on Hofstede's definition of culture [2]: "The collective programming of the mind which distinguishes the members of one human group from another." We select national culture dimension as target and define "cross-cultural communication" as understanding for national differences (or similarities) in different countries by comparing them. In addition to Hofstede's cultural dimension based on special view, we assume it is important to count temporal view for computing diachronic cultures.

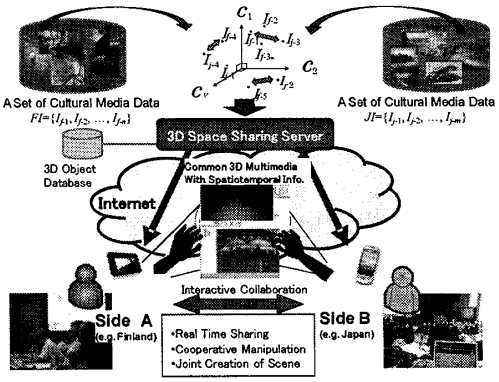

Fig. 1 Overview of a Cross-Cultural Multimedia Museum

Thus, the system consists of semantic, special and temporal context analyzers, and the output is represented as results of dynamic multi-contextual computation mapped onto 3D museum scenes. In cultural computing context, we have two main challenges in how to compute cross-culturality : (1) to apply computational methods to create new cross-cultural knowledge based on in-depth analysis of cross-cultural data [3][4][6] and (b) to design and implement cross-cultural collaborative systems for communication, knowledge creation and sharing [5].

2 System Architecture

The system consists of two types of main functions: **(1)** Operation functions and **(2)** Functions for visualization and manipulation.

(0) Data Collection in Context: Users can set any type of multimedia data, such as images, music, and movies as target data, according to their concern. The data collection, however, is expected to be set by a specific topic for culture-related discussions, for example, "art", "nature", "climate", "food", "annual event", "custom", etc. We call these kinds of topics "context". The context is needed to select a subset from supersets of media data for discussion of cultural/historical background.

(1) Operation Functions: The system provides several operation functionalities for each type of media. These functions are used for feature extraction, element analysis, retrieval, calculation of relationships, and sorting/rendering of target media. The functions classified for each type of media in detail in [5] are used. For example, the element analysis functions for image data are provided for treating color, shape, texture, structure and impression as elements of images [3] with cultural backgrounds, and element analysis functions for music data are provided for treating wave pattern, key, tempo, pitch, rhythm, and harmony as musical elements [4]. The time-series variations of elements of a media data set are calculated with the spatial information of media data.

(2) Functions for Visualization and Manipulation: The system provides several visualization functions as user interfaces so that users can manipulate multimedia data as 3D media objects. 3D scenes are provided as shared spaces for remote users, and 3D objects are provided as

movable media data. We designed two types of 3D scenes: (a) 4D Cyber Space Museum and (b) 4D Cube Museum.

The 4D Cyber Space Museum is designed as an analogy of a real-world museum with time dimension (Fig. 2). Data collection (e.g., images, music, movies) represented as 3D media objects are rendered in this 3D scene by the time of publication (time/day/year), by relevance in elements, by impression, by topics, by authors, etc. There are links to external related documents and views describing the cultural/historical background of the data. Any user can treat multimedia data like a curator in a real-world museum. Thus, this 4D Cyber Space Museum is suitable for sharing, manipulating and comparing collections of art works for cross-cultural analysis and discussion.

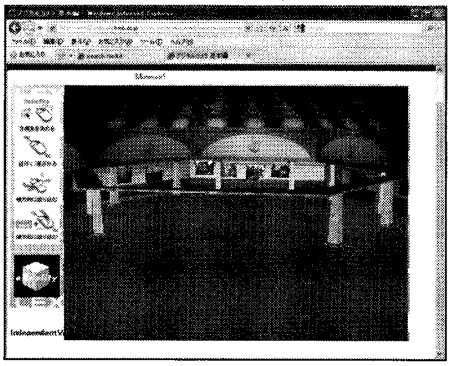

Fig. 2 Interface of 4D Cyber Space Museum

The 4D Cube Museum is designed for deep analysis of data collection (Fig. 3). The relations between the collected data (e.g., images, music, movies) are represented as distances between 3D media objects in a 3D cube scene. 3D media objects are allocated in the 3D cube by the time of publication (time/day/year) or by relevance in elements, according to a user's query. The axes of the 3D cube are variable, so that users can select the type of axis such as time, topic, and media feature. This 3D Cube scene is suitable for the use in ubiquitous situations because it equips high visibility, scalability, and possibility of operation expansion as UI. Each user can also upload sample media data as a query, for example, by a mobile phone, submit a query such as time or impression words, and share the histories (logs) of his/her and other users' manipulations.

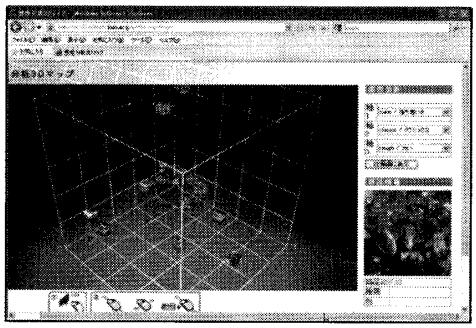

Fig. 3 Interface of 4D Cube Museum

3 Implementation

In the implementation, we constructed a new ubiquitous cultural exchange space to integrate each individual research space. We have connected four laboratories in Japan, Finland and Thailand, and performed several joint experiments to verify the feasibility of this museum system. The prototype systems are (A) museum for Finnish and Japanese art paintings, (3) museum for Finnish and Japanese photos of nature, (B) museum for Thai and Japanese cultural properties. We have applied the Semantic Associative Search Method for multimedia [3][4], and metadata extraction methods for media data [6][7], as the operation functions for finding common and different features of media data. To represent the cultural differences of color semantics in the systems, we used cultural-based color system databases [8][9]. We have also used 3D space sharing and authoring tools [10] for the functions of visualization and manipulations.

4. Conclusion

In this paper, we have presented a design and implementation of a multimedia museum system for cross-cultural communications and its applications in the joint demonstration experiments among Japan, Finland and Thailand. As future work, we have a plan to utilize these systems for real remote interactive research and educational environments and expand the countries/areas/cultures to introduce these systems to research/educational organizations around the world.

References

1. Wang, F. Y., "Is Culture Computable?" A Letter from the Editors, Special Issue: AI and Cultural Heritage, *IEEE Intelligent Systems* **24** (2009), 2-3.
2. Hofstede, G. H. and Hofstede, G.J., *Cultures and Organizations: Software of the Mind,* McGraw-Hill Professional, 2005.
3. Kiyoki, Y., Kitagawa, T. and Hayama, T.: "A Metadatabase System for Semantic Image Search by a Mathematical Model of Meaning," *ACM SIGMOD Record,* **23**, 4(1994), 34-41.
4. Kitagawa, T. and Kiyoki, Y., "Fundamental Framework for Media Data Retrieval Systems Using Media-Lexico Transformation Operator - In the Case of Musical MIDI Data," *Information Modelling and Knowledge Bases XII, Frontiers in Artificial Intelligence and Applications* **67**, 316-326, Amsterdam: IOS Press, 2001.
5. Heimbürger, A., Jaakkola, H., Sasaki, S., Yoshida, N. and Kiyoki, Y. "Context-Based Knowledge Creation and Sharing in Cross-Cultural Collaborative Communities," *Proceedings of the 19th European-Japanese Conference on Information Modelling and Knowledge Bases*, June 1-5th, Maribor, Slovenia, 2009, 78-90.
6. Sasaki, S., Itabashi, Y., Kiyoki Y. and Chen X., "An Image-Query Creation Method for Representing Impression by Color-based Combination of Multiple Images," *Information Modelling and Knowledge Bases XX, Frontiers in Artificial Intelligence and Applications* **190**, 105-112, Amsterdam: IOS Press, 2009.
7. Sasaki, S., Takahashi,Y. and Kiyoki,Y., "The 4D World Map System with Semantic and Spatio-temporal Analyzers," *the 19th European-Japanese Conference on Information Modelling and Knowledge Bases*, pp.11-24, June 1-5th, Maribor, Slovenia, 2009.
8. DIC Color Design Co: <URL: http://www.dic-color.com/ >.
9. EasyRGB : <URL: http://www.easyrgb.com/>.
10. eReality: <URL: http://www.lexermatrix.com/>.