How To Visit Dunhuang Without Travelling To Central Asia

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Abstract

The Mogao Grottoes are situated near the oasis town of Dunhuang in the Northwest of China. They are an important place at the ancient silkroad, object of research for scientists around the world and a fascinating destination for visitors.
This paper discusses the aim and creation process of Dunhuang InfoWeb. It explains the preconditions to be settled and the steps to be taken in order to develop an integrated multimedia application for the World Wide Web.

1. Motivation

The cave site in Dunhuang is one of the major and best-preserved cultural relics of the ancient silkroad. Over a period of one thousand years, Buddhist monks dug and lavishly decorated hundreds of caves for meditation and living purposes. Today, there are about 570 caves with nearly 60,000 square meters of painted murals and more than 3,000 statues preserved. About 40 caves are open for visitors.

In order to develop a computer-based environment that supports the preservation[1], restoration[2], publication and replication of Dunhuang Art a cooperation was set up between Zhejiang University in Hangzhou, China, and Fraunhofer IGD in Rostock and Darmstadt, Germany. One result of this cooperation is the Dunhuang InfoWeb, a Web-based information system which presents Dunhuang Art in a multimedia framework.

Dunhuang InfoWeb has been designed for publication purposes. It combines various VR techniques with multimedia information and innovative interaction techniques in order to provide a high-quality, vivid and realistic multimedia application. Dunhuang InfoWeb is not supposed to be a database system providing scientific information about Dunhuang. On the contrary, it is an edutainment software to present the Dunhuang cave site and invite people to explore the content by themselves. Begin of evaluation showed, that Dunhuang InfoWeb introduces a new quality of presenting Virtual Museums and Cultural Heritage on the World Wide Web.

2. Developing a Virtual Museum

Following our classification [3] Dunhuang InfoWeb is a "Presentation instead of a Museum" in contrast to "Presentation of a Museum" and "Presentation in a Museum". It is a computer representation of a museum not existing in the real world. The cave site in Dunhuang and its accompanying exposition may be visited. However, they are much to remote to be visited by as many people as would like to see the caves.

For this reason, the following three points have been settled as preconditions for developing the information system:

1. Subject The information system has to show origin and development of the cave site as well as its current state and its significance for China and the world.
2. Target Group Dunhuang InfoWeb addresses people interested in culture and history. They may come from all around the world and are possibly interested in visiting Dunhuang, too. It can not be assumed that all users of Dunhuang InfoWeb understand English. For this reason, text information has to be offered in more than one language.
3. Appearance The system is meant to be visually attractive. A consistent and appropriate screen design should integrate different media types and make the hypermedia structure easy to navigate.

The information space has been fixed following the first point. The second point was determining for specifying a technical basis, namely Web technology. The third point was

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vital for developing the screen design and modeling the virtual caves.

It has been obvious from the beginning that some caves will be modeled in virtual reality. Many virtual exhibitions use VR presentations to mediate an impression of reality. In contrast to a static picture and a description they are able to provide a much better feeling for the natural physics of the exhibit. An additional effect of interactive virtual models is that they empower the visitor to change the exhibit according to his or her will.

For this reason the development of Dunhuang InfoWeb has been split up into two tasks:

1. Creation of virtual caves in view of the fact that they will be part of a Web-based information system
2. Development of a Web-based information system bearing in mind that virtual caves will be integrated

This paper will explain, how the Web-based information system has been developed. For a discussion of other aspects of the Dunhuang Art Cave Project see [4] and [5].

3. Dunhuang InfoWeb

Dunhuang InfoWeb is a multimedia information system based on Web technology. It was developed for making known Dunhuang Art and may be accessed by people around the world. The presentation contains information about the cave site itself, three virtual caves, as well as background information about ancient China, the principles of Buddhism and tourists information.

3.1. Information Space

The first thing we did was working out the information space. We decided about information chunks to be included or to be left out. Having a fairly good impression of the cave site in Dunhuang and its significance, the information space has been defined as shown in Figure 1. It has been divided into three sub-spaces to cover spatial information, culture and history as well as tourism.

The information space has been worked out without consideration of available material or feasibility. It seemed more appropriate to cover the subject as a whole and include all information possibly interesting for the target group. The information space has later been adapted to available material, production time and costs. Thick lines in Figure 1 show the sections finally presented in the Dunhuang InfoWeb prototype.

3.2. Hyperstructure

The hyperstructure has been worked out considering the logical consistency of the information space on the one hand and an optimal implementation on the other hand. Usually,

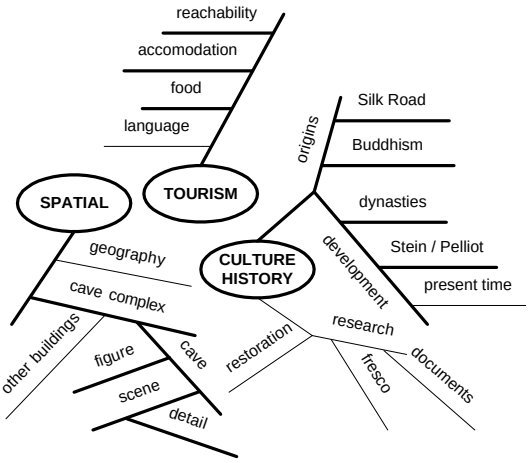

Figure 1: *The information space for Dunhuang InfoWeb.*

a hyperstructure consists of nodes and links between nodes. Related nodes may be combined in chunks. Each node is represented through a multimedia document, either text, an image, an audio file, or a virtual world [6].

Following this concept we combined text and image information in a chunk to represent a card. Each card covers a topic. A collection of cards covering the same topic may be grouped together to form larger chunks of information. The different cards of a collection are linked to each other. Collections or single cards are accessed via content menus. Having a collection of cards, only the first card may be accessed via menu. Content menus are nodes themselves, represented through images. They are linked to each other.

The hyperstructure of Dunhuang InfoWeb is hierarchical. It consists of five content menus: one main menu and four sub-menus for each of the four parts of the InfoWeb. The main menu is linked to each of the sub-menus which themselves are linked to collections or single cards. Cards of a collection may contain links to other cards outside the collection.

3.3. Navigational Structure

The hyperstructure defines some connections between content menus, cards and collection of cards. However, these connections are not necessarily bidirectional links.

In our opinion, different means of navigation have to be provided for a virtual museum. Browsing is the most important one: it simply facilitates easy access to the content. However, for a virtual museum guided tours under different themes may be interesting, too. We decided to implement the means of navigation for browsing the hyperstructure first. Functionality for guided tours is contained in the virtual caves and will later be developed for the hyperstructure of Dunhuang InfoWeb, too.

The following conditions have been fixed for the navigational structure:

- The start screen of Dunhuang InfoWeb has to be reached from all other screens.
- The start screen of each of the four main parts has to be reached from all other screens.
- The different topics of a main part have to be reached from all screens of this part.
- Having a collection of cards, the first card of this collection has to be reached from outside the collection as well as from each card of the collection.

To make orientation as easy as possible the Dunhuang InfoWeb provides a large amount of one-click navigation: The start screen can be reached from all other screens by clicking just once, the start screen of each of the four main parts can be reached from all other screens by clicking just ones, etc.

3.4. Screen Design

Good screen design facilitates a uniform presentation of different kinds of data. It is supposed to be attractive, not boring. It should emphasize points of interaction and make a "look and feel" easier.

Taking the conditions defined in the last section into account, a simple screen design for Dunhuang InfoWeb may consist of various navigation screens and several anchor points on each screen, even on card screens. To begin with, this would have been extremely boring, a "look and feel" would have been difficult. Furthermore, we wanted to avoid pure navigation screens. Each screen should provide at least some information. In addition, we did not want to strew the whole screen with anchor points.

Our solution is a uniform screen division in connection with implicit anchor points hidden in images, virtual caves or text information. The different content menus are translated into images containing anchor points and, at the same time, providing status information. The screen division and content menus can be seen in Figure 2. To make a "look and feel" easier, we defined different stylistic means to be used for integrating multimedia elements. Syntactic means of style include the screen division as well as background, font, colors, etc. Semantic means of style have to be taken into account while preparing images, graphics and content menus. This includes the scrolls for the main menu, the design of maps, the style and border of photos (see Figure 3) etc.

3.5. Implementation

Dunhuang InfoWeb has been implemented using HTML with frames and Stylesheets, JavaScript and Java. Three virtual caves implemented in VRML97 and a QTVR object movie are part of the InfoWeb. The prototype can be accessed via World Wide Web. See http://www.egd.igd.fhg.de/~dunhuang/ for more information.

4. Current Work

The implementation of the Dunhuang InfoWeb prototype has been finished. We are now going to evaluate the system. Two main points of this evaluation are efficiency of the navigation and efficiency of the implementation. We will be sending questionnaires to people who have been testing the Web version and to people who have been testing the CD-ROM version of Dunhuang InfoWeb. First reactions are enthusiastic, especially of specialists in Asian Studies or History and of people who have been in Dunhuang.

Furthermore, we plan to extend the prototype. In addition to browsing and searching the Dunhuang InfoWeb, guided tours examining special topics will be available. Such a guided tour may have a look at the depiction of Buddhas companions in different dynasties. The guided tour mechanism will be working on top of the hyperstructure and show cards of all different parts. The Dunhuang InfoWeb may than be used for education and training, too.

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Figure 2: *Cave No. 272 of the Dunhuang InfoWeb.*

Figure 3: *Sematic means of style: scrolls for the content menu, design of maps, border of images.*