Multi-hierarchy Information Visualization Research Based on Three-Dimensional Display of Products System

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Abstract. Currently, the information on the Web is countless, which is throughout tens of thousands of Web sites all over the world. And the Web site intertwined with each other through hyperlinks between documents. Regardless of such a big scale of the Web information, it will continue expanding. How to access to the information on the Web easily has become a problem needed to be solved urgently. However, the way of accessing to the information is far from satisfactory. Information visualization will play an increasingly important role in helping people understand the structure of the information space, finding information needed quickly and preventing the lost in the information ocean effectively. The paper used the Multi-hierarchy information visualization on a specific e-commerce web site, and established a three-dimensional products display system. According to the analysis of users on business web site, the establishment of a representative user model was established. In accordance with the user model, system function was analyzed and integrated, and task analysis was hierarchical. Based on the user's demand, the paper confirmed the content and the way of the showing. Finally the paper designed the system according to the information structure, interaction and information visualization.

Keywords: user experience, Information architecture, visualization, mapping, Fuzzy Comprehensive Evaluation Method.

1 Introduction

With the promoting of the information-based society and the more extensive of the network, information visualization has increasingly become to be the research focus in contemporary information management field. Cyberspace is becoming the main and foundational part of information systems. Information visualization creates a way to comprehend information space characteristics of the network from a new perspective. The core thought of visualization is that it introduces the reality of space form to the Internet. It made a breakthrough of the space concept which has only the characters, graphics, data and video in the original [1]. It made a new expression space though combining a real space and virtual network stack space to form. This expression reveals multi-dimensional characteristics of the information in cyberspace, and made the network information visualized.

Information architecture emphasizes information organization and show, and then made the objective knowledge space to be ordered. In fact, people acquire, use or

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sharing external behavior and internal cognitive of information which decides in a large extent whether information technology can play a role. So in the management of information we no longer confined to technical aspects, but pay attention to people, information and the interaction between people and information. Information architecture expands the relevance through the user experience, and then achieves the goal of Information architecture [2]. So it must consider the user experience, the relationship among information resources, information space and users, to provide a reasonable scientific resources space.

We achieve the goal of non-spatial information to the user's transmission through interactive three-dimensional systems. It is in fact an effective process of information feedback loop. Non-spatial information transforms into graphics through information visualization system. Through the three-dimensional display system, we implement the compression of the information visualization system signs, which resulting an optimized, more effective way to expression information. In many cases, extraction of information is through interactive, perceptual and cognitive. Therefore, the main function of this system is to research and exploration. This is consistent with human cognitive behavior. Each person has his own style in exploration and cognitive. Three-dimensional display system provides it a great deal of flexibility [3].

2 Information Architecture of the Display System

For this article, Information architecture refers to the organization and classification to the system contents, and visualization implementation of the system interface.

2.1 Goal and Content of Information Architecture

First we should understand and to clarify the system's mission and objectives, and then meet the uses' needs. We determine the system's content and functionality and illustrate how to determine the organizational system, navigation system, marking system in order to help users find the required information [4].

Information Architecture in the Information Organization goals embodied in two aspects: First, from the view of the results, it is necessary to make the information clear and understandable; secondly, from the view of the user, make the information usefulness and availability and user having a good user experience.

According to the uniqueness of information, from the view of information use and users understanding, we can attribute the content of information architecture to the following basic process: conceptual design, organization of information content, to generate information structure, the design of information interfaces, information navigation, and information display and information dissemination [5].

2.2 Based on User Experience to Build Interactive Information

We consider Information architecture model from the perspective of users and services. In user-oriented context, because of users often putting the system as a tool, using it to complete a particular information access and communicate mission, so Information architecture concerned about the main steps in complete their tasks as

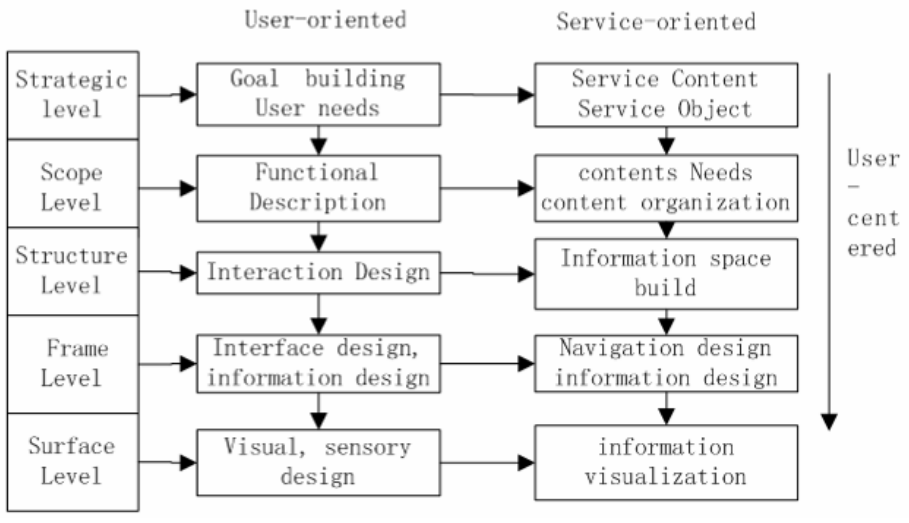


Fig. 1. Based on the user experience the interactive platform for building a model of information

well as the user how to complete the tasks. In services-oriented context, Information architecture concern about the information provided by system as well as the practical value to the users [6]. Figure 1 is the Information architecture model for oriented user experience.

The model is fully taken into account users' different preferences, different working environment and physical ability. It understands user's sensory system (visual, auditory, tactile), and then perform the information using appropriate technical.

On the view of this system, in the strategic level, we target on the general users. So the information architecture and design is to help ordinary users, to provide users with as much information as possible. By comparing recommend, users can their interesting products more convenient. In scope level, the system allows users have a positive user experience in browsing products through user-friendly design [7]. The platform collect the information that user interested and browsing history using software. The system recommends products for users may be of interest to at any time and recommend products the user's friends are interested in.

In structural level, the system emphasizes professional design. Columns are set clear, and plate structure is reasonable distributed. In frame level the interface is friendly, and recommend is clear. Popular products are recommended to users through the depth of analysis and integration of the information. In Surface level web page is simple, and the functional set highlights the principle of user centered [8].

From the above analysis we can see that information architecture model based on the user experience design by the combination of user-oriented and service-oriented. We put emphasis on visualization and understanding of information. And we put emphasis on the combine of content expression and user needs which resulting in improved user experience.

3 System Visual Simulation

The paper mainly studied information classified and graphics performance. Through analyzing people's cognitive Features, selective attention, and using of eye-movement apparatus, this paper researched the cognitive graphics and established the mapping between the information type and graphics performance.

We look for a of visual form match user's mental model. Then it will make the visual model and the user model match.

3.1 Visualization Variables Study

Traditionally, visualization has seven variables: position, shape, orientation, color, texture, gray level and size. However, in order to express the uncertainty and time-dimensional information, visualization variables will be extended to 10 kinds, such as putting color into hue, lightness and saturation. Different combinations of these variables can also constitute different. Different visualization variables express different property of spatial information. (As shown in table 1). The selection of Visualization variables will directly affect the quality of information.

Table 1. The perceptual nature of Visualization variables

	Connectivity	Selective	**sequence**	Quantity
position	**+**	**-**	**-**	**-**
shape	**+**	**-**	**-**	**-**
orientation	**+**	**0**	**-**	**-**
color	**+**	**++**	**-**	**-**
texture	**0**	**+**	**+**	**-**
gray level	**-**	**+**	**++**	**-**
size	**-**	**+**	**+**	**+**

In information visualization process, the information is expressed and transmitted through a series of symbolic. In order to reveal the nature and law better, to facilitate human understanding and using visualization information, expression and transmission of information need to use some intuitive symbols and visual form. these symbols is not only easy for human identification, memory, analysis, and can also be identified, storage and output by the computer.

3.2 System Simulation

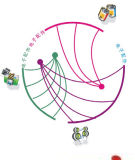
When the display data is large and multi-variable, users need to filter certain data to complete several goals - to remove the data users not interested in. users only want to see dates meeting specific conditions in order to understand the relationship between the different properties of the dates. A number of properties of the Data can be

selected interactively. For example, when mouse roll over, normally the data will be seen which suggests that a detailed description of this object. Click or double-click will take the user to some other related page.

The home page used the open three-dimensional space, allowing users to see the products in all categories. When users enter the system, the system will recommend a category user maybe interested in based on a user's browser history, such as electronic product category. In the internal region of the open space, there are the various types of popular products recommended, which is based on the number of buy or browse. When your mouse scrolls over a popular product, the details of the product parameters will appear in the right side In the home page, users can also see friend' position.

Fig. 2. The home page

When a user clicks the camera button to enter the secondary interface, the secondary interface to the subscriber information includes the following information:

the camera-related products  ,

cameras surrounding information  ,

personal collection of records  ,

collection records of friends  ,

recommend the camera  ,

which also includes recommend the type of products and recommend related products. In three-dimensional model, we use a complementary form to express the relationship between the two types of products. Color and size represent the range and attention of recommended products.

Fig. 3. The second page

When you click on a specific product, you enter the third interface. It simple and clear, enabling users to be more concerned about the product itself. When you move mouse over the graphics, a specific parameters description will appear.

Fig. 4. The third page

4 System Evaluation

Fuzzy evaluation is a kind of safety evaluation methods which is used the principle of "fuzzy comprehensive evaluation" in fuzzy math. It belongs to qualitative evaluation methods. Fuzzy evaluation method is based on the "fuzzy set" concept in fuzzy math. It is set up by people's accumulated knowledge and experience in practice. Therefore, on one hand people's awareness of the objective laws is restricted and limited; On the other hand it minimizes the impact of man-made one-sidedness. This approach allows evaluation to be more accurate, reasonable.

The system will use fuzzy evaluation method to be evaluated.

(1) Determine the factors set and evaluation set

The factors of the display system content a total of six areas: information comprehensiveness, structure clarity, color coordination, quick visit, and recommend reasonable.

Set a factor set R = ⎪ R1, R2 ... ... R5 ⎪. R1, R2 ... ... R5 separately represent information comprehensiveness, structure clarity, color coordination, quick visit, and recommend reasonable.

We determine the evaluation set V = (0.2, 0.4, 0.6, 0.8, 1.0), which represent (v1 (bad), v2 (poor), v3 (general), v4 (better), v5, (good)).

(2) Determine the evaluation matrix

We get the evaluation matrix by calculating the questionnaire results which has been gathered statistics. S_{ij} is the ratio of the number of users who made the j lever to the i factor to the total number taking part in the evaluation.

$$S = \begin{bmatrix} 0 & 0.15 & 0.3 & 0.35 & 0.2 \\ 0 & 0.1 & 0.2 & 0.5 & 0.2 \\ 0 & 0.2 & 0.25 & 0.4 & 0.15 \\ 0.1 & 0.2 & 0.2 & 0.45 & 0.05 \\ 0 & 0.25 & 0.4 & 0.25 & 0.1 \end{bmatrix}$$

(3) Calculate the weights of factors

Based on the user's questionnaires, we get the factor weight coefficient vector:

A = (0.25, 0.3, 0.1, 0.15, 0.2).

(4) Calculate fuzzy comprehensive evaluation vector of the factors

Here we use the M (●, +) model.

B = S ● A = (0, 0.1675, 0.285, 0.395, 0.1525)

(5) Determine the overall evaluation effect. W = B × V = 0.7065

0.7065 is the overall evaluation of the display system. We can see that the users are basically satisfied with the system. Therefore, the system can do a good job in next perfect job applied to this information.

5 Conclusion and the Future Work

According to the user analysis of the Product display system, we set up a representative user model, and against the user model, a systematic functional is analyzed and integrated and hierarchical task is analyzed. In accordance with the user's needs, we customized display contents and graphical display mode. Finally we designed the system from the structure, interaction and information visualization.

There are still many deficiencies in this paper, such as the lack of the navigation system; and for the needs of special populations inadequate; evaluation factors relatively easy and so on. These problems will be focused in the future research.

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