The Application of 3D Interactive Software on Virtual Catalogue Design

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Abstract: The interaction between users and commodity catalogue plays a vital role in the behavior of consuming, but it might be difficult to acquire adequate information of commodities from the paper catalogue. This paper tries to borrow the knowledge in cognition psychology to discuss a method on catalogue designing which is derived from the new media and conception of universal design. In order to continue the user's used habit on catalogue, this paper first evaluates the habit of users who utilize the 2D paper catalogue. Moreover, given the result of evaluation, we undertake a design on virtual catalogue based on 3D interactive software. We attempt to utilize the 3D interactive way to improve the limitation of form and design error in the paper catalogue, and furthermore, to rise the cognitive level of commodity affected by the catalogue during the shopping.

Key words: Interaction and Interface Design, Human Behaviors, Universal Design.

1. Introduction

The catalogue is a principal tool which makes customers to acquire the product information and is an interface between consuming and service. An ideal design on catalogue should provide customers with intact product information. Before customers get contact with commodities, an ideal design could also answer the questions about products as much as possible. Therefore, this design helps the catalogue to raise the correction of consuming and to reduce searching or inquiring time.

The usability has become an essential condition in the development of the user center design. Moreover, the usability divides into five stages: survey user information, make usability criteria, task analysis, design, testing and evaluation [1]. Among these stages, the expectations and demands of users are usually inspected by the design principle so that the designers can learn from others' design experience [1-2]. On the other hand, the conventional design on catalogue has several discussions about the influence of catalogue on consuming way [3] or about the cognitive differences of designers and users on commodity design [4]. There are few discussions about cognitive behavior of users on understanding the commodity information through catalogues.

In the conventional researches of visual cognition, the initial step is usually based on the modeling or feature of objects when people undertake the visual identification. However, if we expect to acquire the location of object, we usually feel through the visual depth perception. That is, in 2D graphic, it is necessary to induce the people not to determine the location or scale of the object without explicit and correct perspective in 3D space. Furthermore, the larger differences of 3D scale in 2D graphic, the easier productive of cognition mistakes [5]. No matter how much effort on photograph and arrangement, the paper catalogue still cannot present the whole view of object.

There are three major questions in this research: what's the usage habit for user on paper catalogue? And what are the conventional problems of the paper catalogues? What do the users really need? Meanwhile, to consider the previous discussion on visual cognition, this research adopts the furniture catalogue as the study case, the catalogue that has larger differences of scales of products in the 2D catalogues. And we attempt to use the 3D interactive software to present the whole view of object.

According to the inference mentioned above, this research aims to continue the habit of users who are accustomed to the commodity catalogue. Then, we propose a multimedia prototype in order to intently solve the mistakes on design of paper catalogue and the limitation of commodity information from 2D catalogues as well.

2. Methodology and Steps

Following the research purpose described before, there are three steps in this research. First, we undertake the user and task analysis of 2D paper catalogue to find out the categories of users. Then, proceeding with usability testing experiment on different categories of users, we obtain the need and suggestion of users. Second, we adopt the suggestion and new scenario metaphor as well as 3D interactive software to establish the multimedia prototype design so that continuing the user's used habit on catalogue and solve the design error of 2D paper catalogue. Finally, these different categories of users are asked to undertake the usability testing experiment again in order that we can inspect the new-formed 3D interactive virtual catalogue.

2.1 User and Task Analysis: 2D Paper-typed Catalogue

This is the first of three steps in the research. Before the design of multimedia with 3D interactive software, we undertake the user and task analysis. Mapping the purpose of the research, this step is going to find out the user's habit on 2D paper catalogue, and design problems as well as limitations caused by the 2D form.

2.1.1 Issue Survey and Analysis

Before the user and task analysis, we should first understand the major goal of the users so that we can generalize the tasks that the users adopt when they accomplish the objective. Moreover, we will continue to analyze both the procedure users execute and the problems they face [6]. When we survey the relative product issues, we also search the information from not only users but also stakeholders in particular who is a manager and filled with both experience and knowledge [7].

In the first of this step, the research refers to the affinity diagram in order to present both problem ranges of the paper catalogue and critical need of users, a certain diagram that are adopted greatly for the arrangement of the response degree of users on most usability research. We have not only interviewed 22 users who practically use the paper catalogue and are regarded as the user representation, but also we have interviewed 8 clerks who are regarded as the stakeholder representation and work at the stores which supply the commodities of paper catalogue. After we have found out the major issues that the users and stakeholders are concerned, we continue to classify the principal goal according to the properties of issues and indicate the specific corresponding objective. Finally, the results referred to affinity diagram are present in Table 1.

Table 1. The analysis of goals and objectives of users

Users' Goals	Characteristic of Goals	Users' Objectives	Characteristic of Objectives
A. Understanding or comparison with commodity information	To understand the characteristic of commodities	Scale, Modeling, Color, Material, Designer and his/ her design concept, etc.	To understand or compare with the appearance of commodities.
		Price, Weight, Volume, Endurance, The place of origin, Assembling, Cleaning, etc.	To understand or compare with the functions of commodities.
B. Learn of commodity faculty	To learn the relationship between commodities and customers	A pillow which fits the height of our shoulder.	To Learn commodities adapted for bodily faculties.
		A piece of office furniture which improves work efficiency.	To Learn commodities adapted for life faculties.
		How to assemble, clean, and repair.	To Learn the commodity usage.
C. Collocation reference	To refer to the collocation between commodities and peripherals	The collocation between a desk and a lamp.	To refer to the collocation between two commodities.
		Spatial planning, Style designing, Lighting, Scenario simulation.	To refer to the collocation between the commodity and space.

In addition to the three kinds of user goal, during the interview, we detect that few of users focus on the other information, for example, enterprise spirit, life attitude, payment option, project planning, after service, mart information, and activity, etc. The information, furthermore, could also induce the users interested besides that listed in Table 1. The research, therefore, retains the information and presents it in the after design, in order to ensure that our design satisfies the need of users as much as possible.

2.1.2 User-task Experiment

This experiment uses usability testing of 2D paper catalogue to response the usage condition of the users who have different goals [8]. In the arrangement of the experimental environment, in order to record in detail the presented visual data of the subjects, the research anticipates setting one camera to record the facial expression of users. The other camera will be set for recording the interaction between the use's hand action and paper

catalogue. Besides, one directional microphone will be set for recording the verbal data when users are undertaking the method of think aloud.

In the experimental design, we refer to the previous collected data and classify the users according to the main goals of their using catalogue. Therefore, we have three user classifications in this experiment of the second of this step, and each classification contains another ten subjects. Based on the characteristics of user objective, we design the executive task for users to accomplish their objectives. Every subject has 45 minutes to execute the assigned user task in the experimental environment. After the task, we proceed with the appropriate interview according to experimental situation of the subjects so that we expect to understand the intact situation when they are using paper catalogue as much as possible. The user classification and assigned task can be seen in Table 2.

Table 2. User classification and assigned task

User Classification	Assigned Task	Task Description
A. A user who takes commodity understanding or comparison for the purpose.	To understand or compare with the appearance of commodities.	Please pick up one of your favorite desk lamps, and by verbal depiction please describe it as five features: scale, modeling, color, material, designer and his/ her design concept, etc. Then, to choose any of the five features, and continue to search another commodity with the same feature.
	To understand or compare with the functions of commodities.	Please pick up one of your favorite desk lamps, and by verbal depiction please describe it as seven features: price, weight, volume, endurance, the place of origin, assembling, and cleaning, etc. Then, choose any of the seven features, and continue to search another commodity with the same feature.
B. A user who takes faculty learning for the purpose.	To learn the commodities adapted for bodily faculties.	Using the paper catalogue to learn how to find out the pillow which fits the height of our shoulder. *Note: the subject can determine the appropriate pillow.*
	To learn the commodities adapted for life faculties.	Using the paper catalogue to learn how to find out the office furniture which can improve work efficiency. *Note: the type of office furniture has no limitation and the subject can determine whether it can improve work efficiency or not.*
	To learn the commodity usage.	Using the paper catalogue to learn to assembly a curtain you like. *Note: the subject can determine whether this study has succeeded or not.*
C. A user who takes collocation reference for the purpose	To refer to the collocation between two commodities	Using the paper catalogue to pick up a bookcase to collocate for the red floor lamp on the front cover. *Note: there is no bookcase next to the floor lamp on the front cover of the paper catalogue so that this condition will not influence the subject's decision. The subject can determine whether the arrangement is appropriate or not.*
	To refer to the collocation between the commodity and space	Using the paper catalogue to plan the living room of the new house. This living room is 6 square meters and 3 meters of height and there is one wall with a side of French window. You can design the living room with any furniture, or decide arrangement and style.

2.1.3 Analysis Results

In the usability testing experiment of 2D paper catalogue, we obtained two kinds of data to be analyzed: one is visual data, which have recorded two things that is interactive relationship between the user's hand and catalogue, and moreover, the facial expression when they are executing the task. The other is verbal data, which involves two things: one of two is certain data from method of think aloud, the data that recorded the user's thoughts when he was under executive task. The other data collects from the interview of subjects after finishing the experiment. In addition, the content of interview is composed of particular problems we gathered during surveying issues and some information when we observed the subjects in the experiment. The purpose of the interview is to assemble the user's response so that we can figure out their perception and considerations [9-10].

Under user task analysis, we take relevant part of visual and verbal data to analyze, the part that is related to the process on executive task. By sequence model, we can understand the task configuration of objective and the finished order as well as strategy so that to more explicitly figure out the need for testing objects to be supported and modified [8].The classification A, B and C are modeled in Figure.1.

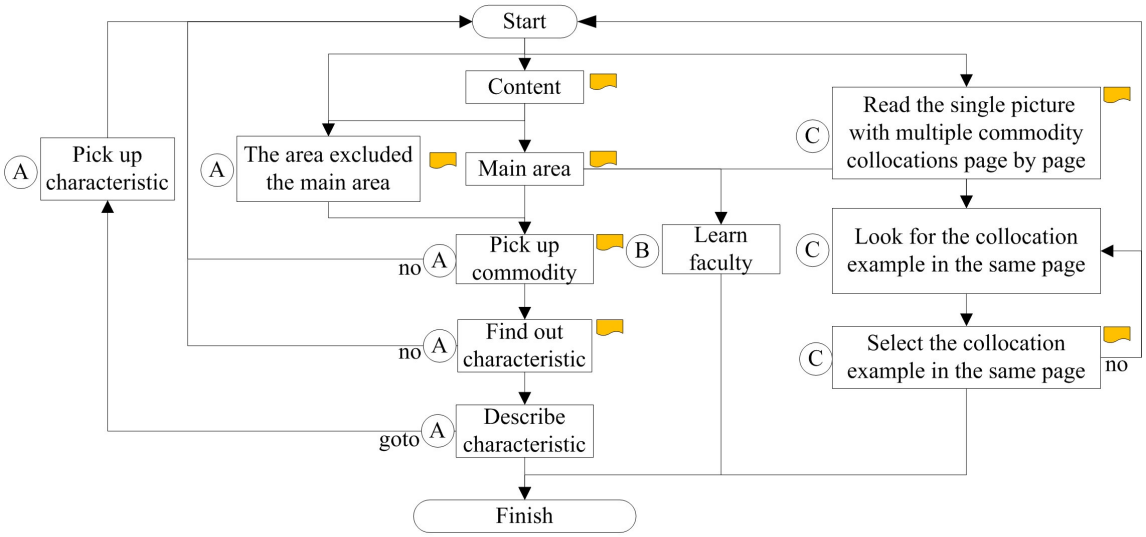

Figure.1 The task flow model of users of paper catalogue.

The analytic results reveal that the users of classification A will use or skip the catalogue to link the main area or outside the main area to find out the commodities. In particular, if the catalogue supports the appearance information more than functional information, it indicates that much of information user are concerned about does not be presented in catalogues, as shown in Table 3. Despite the scale of commodity depicted as words and pictures, the subjects still do not feel enough. The reason is that when subjects are watching the picture with multiple commodities juxtaposed, it is likely to mislead the users into the wrong scales of commodities if the catalogue arranges the different size of commodities into the same scale of pictures. On the other hand, that may be because the presented pattern of commodity in the picture is shrank or the overlap between other commodities, it causes to reduce the chance to exhibit the more appearance of commodities. Moreover, with regard to the subjects who have few concepts of spatial scale, it is difficult to receive the correct scale by mere words. The

subjects concern some issues. For example, in modeling, they worry about the unshown view of the commodity in the picture different from their expectation like the back side. And they also worry about the unexpected texture and color due to the inaccuracy of painting, photographing, function working, and unlike looking under different lights. The subjects even express that if the location of price tab is next to commodities, they can immediately evaluate the purchase effort. Besides, the price tab next to the commodities in the picture with multiple commodities juxtaposed indicates which product is really going to be sold.

Table 3. The source and extent of the acquired information of subject of classification A

Appearance	Scale	Modeling	Color	Material	Design		
Form text	◎	◎	◎	◎	○		
Form picture	◎	◎	◎	◎	○		
Functions	Price	Weight	Volume	Endurance	Original Place	Assembling	Cleaning
Form text	◎	※	※	※	○	※	※
Form picture	○	※	※	※	※	※	※
Description: ◎ Provide ○ Partial provide ※ None provide							

With regard to classification B, they rely on the catalogue to search for the part which meets the need so as to accomplish the task that takes the learning for the purpose. In the experiment, the subjects of classification B retard to finish the task due to the mixture of the part which introduces the function and the other part which sells the commodities. The subjects of classification C could either find the main area through the catalogue, or find the suitable type for collocating through the single picture which involves multiple commodity collocations page by page. However, they express that consulting the collocation type by the catalogue is only helpful for certain part which focuses on the appearance element such as the style design. Because of the uncertainty of the actual scale of commodities, it causes that the catalogue is not helpful for the spatial planning. In addition, the users in all classification have requirement for marking the principal pages, as shown in yellow part of Figure.1.

To generalize the response of the subjects in the three classifications above, we summarize into two levels of design problems: the first level comes from the original design error and none inclusive part. The second level comes from the constraint of 2D form; that is, even the design is correct, but could not display the whole information. These two levels of design problems are summarized in Table 4:

Table 4. The response of users on two levels of design problems

Level 1: Problems from Design Error	Level 2: Problems from the Constraint of 2D Form
P1. Unclear or lack of information.	P7. Single picture with multiple commodities juxtaposed easily causes the users to erroneously evaluate the specific scale of commodities.
P2. Lack for links between information.	
P3. Could not satisfy the need of marking pages.	P8. Single picture with multiple commodities collocated easily causes the commodity information to be sheltered or shrunk.
P4. Information index consists of the spatial category but the commodity category.	
P5. Both teaching information and commodity information are mixed and hard to search.	P9. The users need to have good concept of spatial scale if they acquire the scale of commodities by words.

2.2 Multimedia Prototype: Design on 3D interactive virtual catalogue

According to the design process based on multimedia prototype of user center, this paper can immediately and directly receives the response of the target user and to obtain the more real feedback of users. Many usability researches present the constructive issue of testing object by the build of user environment design model. This way makes the designers to understand the request of function and how to organize the interface so that the users could detect how the suggestion is reflected on their new design [8]. Meanwhile, by this way the research also makes designers to determine whether the novel product is worth developing and the new design can be accepted by users or not .

According to the previous results of the user and task analysis of 2D paper catalogue and task, the research proposes three resolutions to be the criteria of the multimedia prototype design, as shown in Table 5. We use the software, Autodesk 3ds Max 2008 to build the virtual prototype of commodities and exhibitive space. Then, we take the virtual prototype into another software, Quest3D 3.6.6, so as to set up the interactive and finally export it to a general personal computer to play. Besides, to consider the display device and the way of browsing the catalogue in general, we choose the common personal computer but the much real display with VR-Cave and 3D glasses or Head-Mounted Display (HMD).

The content of the prototype is a 3D interactive virtual scene. The user can take a walk within scenes and have a browse through the models of 3D commodities; at the same time, employing the voice guide to understand the commodity information. Furthermore, the operation mode of the prototype is to utilize a handy rocker back and forth. The left button is to open the function menu; the right is to switch the Initial setup of XY axis to YZ and XZ axis so as to a 360-degree view.

Table 5. The criteria of the design on multimedia prototype

Solutions	Function Interpretation	Mapping problems
First-person perspective	To provide 3D space of commodity exhibition from first-person view point. The metaphor of design is based on the catalogues and physical stores. There are two index modes including spatial classification or commodity classification for browsing. For instance, regarding a living room as the theme visit or displaying all of the lamps involved in a catalogue on the exhibition of virtual space, as shown in figure 2. At the beginning, letting the user determine his height through a menu so that to visit the space in the correct height. In addition to the two main index modes, also the particular commodity can be inspected in 360 degree through the menu during the browse, as shown in figure 3.	P7, P8, P9
Option-on-demand table	To provide a menu on demand which consists of the index of space classification, index of commodity, index of marking, teaching information area, picture marking, height marking, 360-degree view of goods and voice explanation switch, as shown in figure 4. Among these, picture marking is to solve the need of users for marking the important page. Moreover, due to the 3D scene from first-person view point, the metaphor is set to be picture function. The stored scenes which the user photographs can also provide the users to search.	P2, P3, P4, P5
Dynamic trigger information	When users close to the commodity, they employ dynamic trigger to display the commodity information. Then, as they left, hiding any information expect for the name and price of the commodity to decline the amount of information on space and adjust the lights of exhibition through the inspection of 360-degree view in the menu and control the commodity function, as shown in figure 5.	P1, P6

Figure 2. The left one is to browse through the index mode of space classification, and the right one is to browse through the index mode of commodity classification

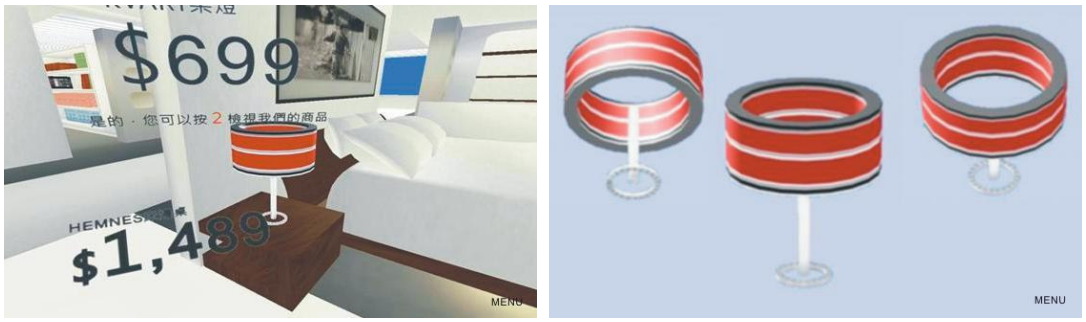

Figure 3. The left one is to inspect commodities through original degree, and the right one is to inspect commodities through 360 degree.

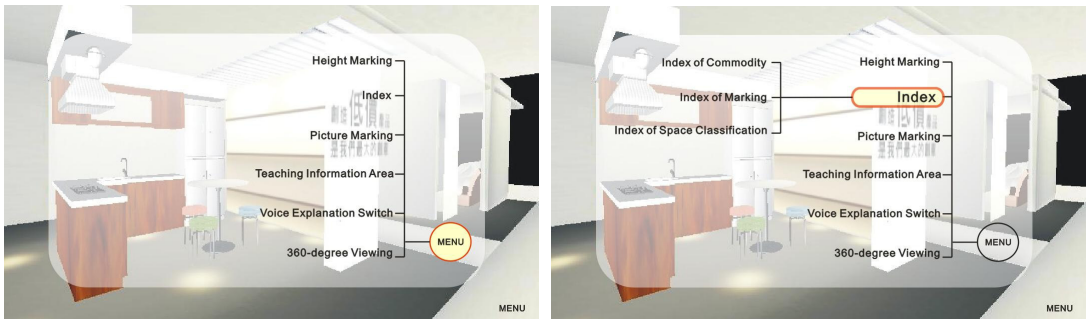

Figure 4. The left one is about the users opening the form, and the right one is about the users browsing the form.

Figure 5. The left one is the situation about information of regular commodities presented, and the right one is the situation about information of triggered commodities presented.

2.3 Usability Evaluation: 3D interactive virtual catalogue

In the last of three steps, we exploit the design of 3D interactive virtual catalogue to proceed with the second user and task experiment, and then, to use design principle to inspect whether there is a need to improve the novel design of catalogue. Corresponding to the purpose of the paper, this step is to discover if the 3D interactive virtual catalogue really solves the design problem of 2D paper catalogue and the constraints from 2D form. At the same time, to view the new type of catalogue to see whether it will generate a new burden on the users.

In the second user and task experiment, we again invite the thirty subjects of the first user and task experiment at section 2.1.2 to undertake the same task in the same experimental environment. The only difference is that this experimental system is a 3D interactive virtual catalogue. The same after the implementation of the task, we proceed with the appropriate interview based on the situation of users in the experiment. In order to a more detailed evaluation of the structure and interface of the prototype, we apply the results of both tasks and interviews of users in the second user and task experiment to the seven design principles of Norman [2], as shown in Table 6.

Table 6. The inspection of design principle

Design principles	Experimental results
Use both knowledge in the world and knowledge in the head.	The metaphor of walking in the shopping malls is the same as the real world. The menu which emerges from the lower right corner of the screen resembles the behavior of taking something by the right hand, but the users usually bow their heads to see the menu. The design is now more like a window appearing on the screen. 360-degree view needs to adjust or rotate the screen; however, it is difficult for the user without an axial concept.
Simplify the structure of tasks.	Manipulative interface has just single menu and the menu does not have more levels of function options so that the users can easily select the operation. But when users choose the 360-dgree view, the screen suddenly jumping to another scene allows them to worry about whether it is difficult to return the original scene. The same situation also occurs in the browse mode switch. Through the handling of transitions, and as far as possible, to perform the function at the same screen is more able to resolve this problem.
Make things visible.	Dynamic trigger not only packs up information but also shows the appropriate name and price of commodities so that the users can easily know which products can be purchased. When the menu expands, the selected position by a cursor displays a small window to introduce certain function so that to allow users to easily realize the meaning of the function and whether it can be selected.
Get the mappings right.	When choosing the 360-dgree view, the user thinks to pick up the commodities to inspect, but instead, the screen skips to another scene to use a rocker to view; however, it does not meet the actual expectation.
Exploit the power of constraints and affordances	Walking around the 3D scene through controlling the rocker allows the user to realize that because of the constraint, they cannot lay back in bed or sit down, but instead, only to maintain a upright height to walk and view.
Design for error.	The connection between the systemic functions is so intact that to allow the users to try anything without causing any mistake.
When all else fails, standardize.	Even if the action of first-person view point through controlling the rocker is different from that actually through feet and eyes, but however, the users can learn it immediately after a short time of trial.

3. Conclusions

In this paper, we have presented a 3D interactive virtual catalogue for the novel type of multimedia prototype, in which the interactive scene allows the users intuitive way to inspect, learn and collocate the commodities through the metaphor of walking in shopping malls. Moreover, the original 3D models of commodities during the process of the design on commodities are directly introduced to the users. If discussing this study at the level of demonstrational prototypes, we could discover that the established habit could synchronously accompany the preliminary research structure of the transformation of design media. In addition to solving the original design error, meanwhile, we also try bringing more possibilities to meet usage requirements. Finally, future work will connect platforms and resources on internet so as to support the design which is full of functions of information communication and to step toward the better user center commodity catalogue as much as possible.

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