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Study on product appearance modeling of knowledge base system based on case product appearance characteristics of knowledge meta-information

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ABSTRACT

Product design is a process that according to users' demand, the designers show the demand with their own design language; it is a combination of the design knowledge and users' knowledge. In order to reduce the labor of the designers and to make them more relax, then the application of computer aided design is needed, which not only reduce the labor in terms of basic knowledge design, but also very useful for design quality and efficiency. This study focuses on how to complete the developmental work of product appearance modeling of knowledge base system based on case product appearance characteristics of knowledge meta-information. There are a variety of needed digital tools, such as Microsoft Access, Visual c + +, ADO, etc. The first step is to start from how to effectively obtain product test samples; generally speaking, there are multidimensional scaling and clustering methodology. And then through the experiment determine the Metadata of sample's appearance modeling characteristics element, this study used the method of combination of benchmark and similar values. The next step is to determine the overall weight and the application of optimizing the product appearance modeling. Finally, to establish BPN model by MATLAB, synthesize the characteristics of users' requirements, to better optimize target function, and to develop product appearance modeling knowledge base system with vc6 + + 6.0. This study takes the appearance of the printers as an example to explain the using process of the whole product appearance modeling of knowledge base system.

KEYWORDS

Product design; Knowledge base system; Appearance modeling; Characteristics of knowledge meta-information.



INTRODUCTION

As an important part in the process of product development, appearance design innovation is the most basic part, which also becomes the important means and methods of the product for the majority of the market. Overall characteristics of products can be influenced by various aspects, mainly including the factors such as product function, principle, shape, material and structure, which have a great influence on final characteristics of products and market competitiveness. But the product appearance design innovation also means certain risk, the main reason is that the design process involved too much personal experience and aesthetic discrimination, therefore it greatly increased the risk, and at this time the subjective factors should be quantified and reused. At present, there have been many researches about the method of product aided design, mainly includes the study based on rules and case-based reasoning^[1], to establish the related conceptual design model; And make use of digraph and matrix to determine the attributes and relations of the products, and it is able to use changing the relationship between attributes to create new innovative concept^[2]. Product appearance modeling design needed to combine the aesthetic experience and the market demand for a better effect, generally speaking a new product appearance modeling design, 40% used the previous design, about 40% is just slightly modified, and a new design concept is only 20%. According to this characteristic, the aided conceptual design lead-in the design of case-based reasoning technology (CBR), that is the technology of case-based design (CBD). This design method greatly reduces the labor of the designer, and has good improvement of the efficiency of product design and developmental costs.

BASIC CONCEPTS AND RESEARCH STATUS

Basic content of product appearance design

Product appearance design, structure and process design, manufacturing, etc are all extremely important link of product development, and there are a lot data exchanging and information sharing among each other. While introducing concept of knowledge in the field of product design can be more effective in design management, and also very effective for the management of "database", the speed and efficiency of product development can be improved a lot^[3]. But the characteristics of product appearance modeling design led to the difficulty of the objective and comprehensive knowledge-base construction, which mainly because of the combination of great uncertainty of the fusion of image thinking and logical thinking. Therefore, to build a suitable knowledge theory model need to pay attention to the unique characteristics of product appearance design and classification research for a good theory support for the product structure design.

The process of product appearance design is the mutual matching process of design knowledge and users' knowledge, it requires the designers use the mind to form product prototype model, and through the design knowledge to form products shape, layout and color texture under a certain constraint adjustment, and then reprocessing with representation through visual equipment for a final product form. The research object design knowledge in this study mainly has the following two parts: the product function and user cognitive information. And the user cognitive information can be divided into three categories: form, use-pattern, culture and fashion. Figure 1 shows the design knowledge classification model of common product appearance modeling.

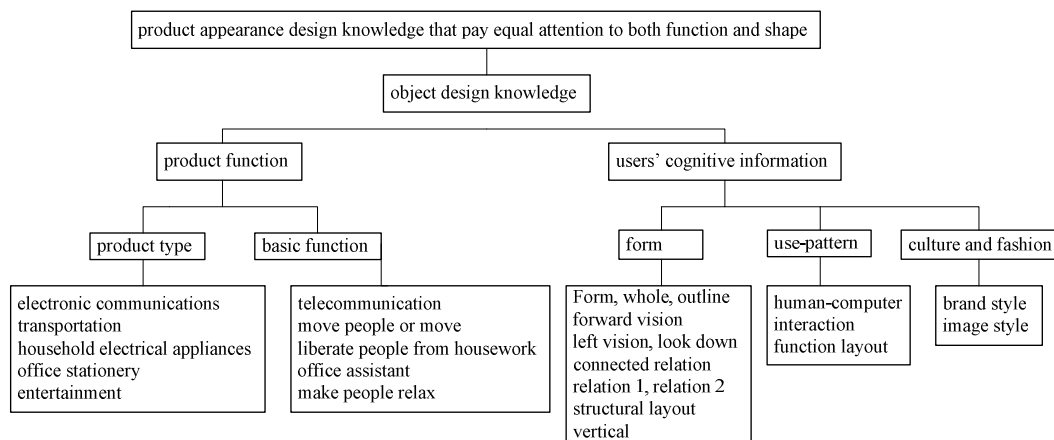


Figure 1 : Classification of product appearance design knowledge

Product appearance modeling design in modern design pay more attention to the product form and the man-machine interface, so that the user's aesthetic, emotion and experience are need to be fully considered. And the problems in design process need designers with professional knowledge and experience to solve, but in most of the time, the designers' professional ability in this field have a lot of fuzzy nature. Figure 1 shows the major factors about product appearance are mainly the graphic decoration, the connection relationship and use-pattern, etc. But because of the development of modern technology, the connection between product components is very close, and the influence of the product appearance modeling

is very small. Figure 2 shows the common product appearance modeling knowledge structure in product appearance knowledge-base:

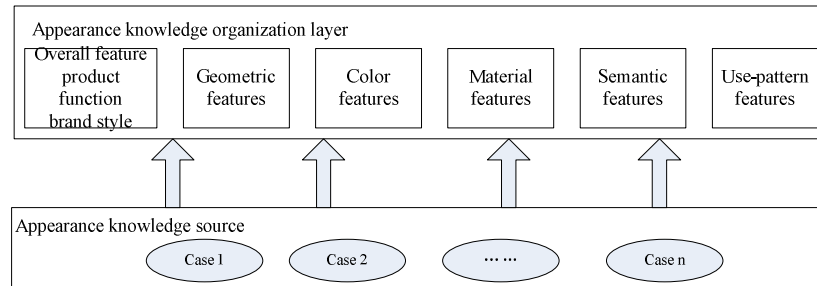


Figure 2 : Product appearance modeling knowledge structure

Research status

The development characteristics and direction of modern product design is intelligentize, networking and integration, and man-machine integration of intelligent integration system is the inevitable development route of product design in the future. As one of the links, the product appearance modeling design must be integrated into the system and cannot leave isolated route. But the current study solutions still have some shortcomings, which mainly displays in the product classification, the exploration of practical application and the establishment of corresponding knowledge base. There is also a lack of high practicability and valuation is too rough, and more suitable for a single product type, which means the lack of good performance.

The related research content in domestic and foreign are mainly: classification method, intention acquisition, knowledge base construction and optimization scheme, etc; the study forms are intention scale, perceptual technology, etc. Research process has three stages, respectively test, statistics and computer system analysis, which is mainly about how to obtain and express the users' perception process. Involved references have the following several directions:

(1) Based on a series of process of the cognitive and design to divide product appearance modeling design knowledge into two categories: object knowledge and realizability knowledge; object design knowledge can be divided into product function and users' cognitive information; realizability design knowledge included the contents of design process, innovation, appearance repair and artificial lamp^[4].

(2) The product appearance features and personalization imagery to establish the best mapping relation with regression tree technology, and then build the modeling characteristics prototype of each brand and obtain the user's recognition^[5].

Generally speaking, a whole CBD modeling design system firstly is to complete the acquisition of case appearance, and then to establish a set of perfect knowledge base with the knowledge according to certain method, so that the knowledge content could be recorded. Product appearance modeling design knowledge and be divided into type, level and specific content of the three levels^[6].

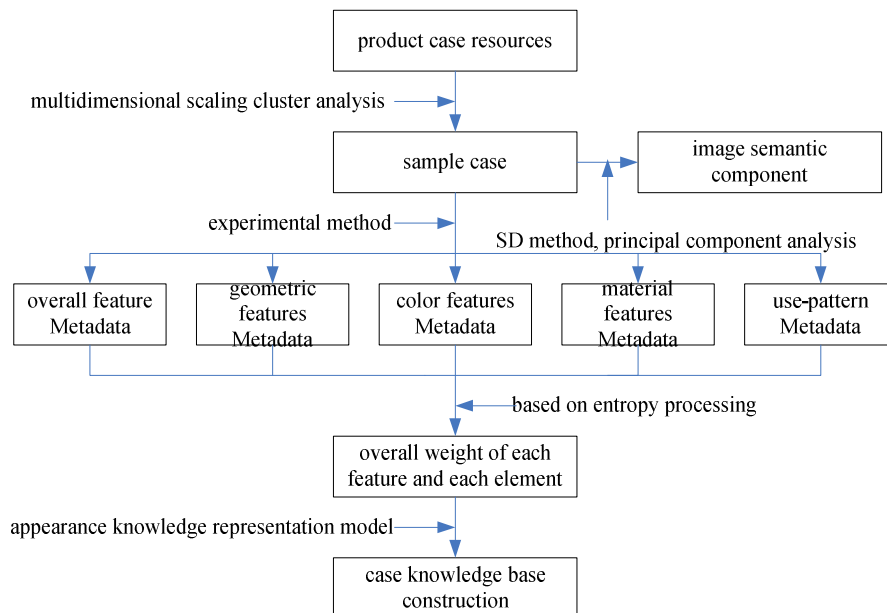


Figure 3 : Structure of product appearance modeling knowledge base system

PRODUCT APPEARANCE MODELING OF KNOWLEDGE BASE SYSTEM

Product appearance modeling of knowledge base framework

The establishment of appearance modeling knowledge base needs a further study on how to combine the model with specific products, such as the selection of representative samples, selecting typical vocabulary, etc. Figure 3 is a common structure of product appearance modeling knowledge base system:

Sample selection is generally achieved by multidimensional scaling and cluster analysis, so as to lay the foundations for the selection of representative image words. As a kind of common non-attribute basic method, multidimensional scaling is firstly used by testers for an overall judgment on various things, and evaluates the similarities between things, and then analyses the characteristics and properties of the results between these data^[7]. The advantage of multidimensional scaling is that there is no need to consider too much or to know in advance the factors that influencing differences, the potential cognitive space can be judged and established. Through the analysis of the appearance modeling knowledge classification, appearance modeling representation model, an appearance modeling design knowledge base model can built as shown in Figure 4. Although the function and appearance modeling knowledge of different products are not same, both of which have the similar acquisition method of appearance modeling knowledge database.

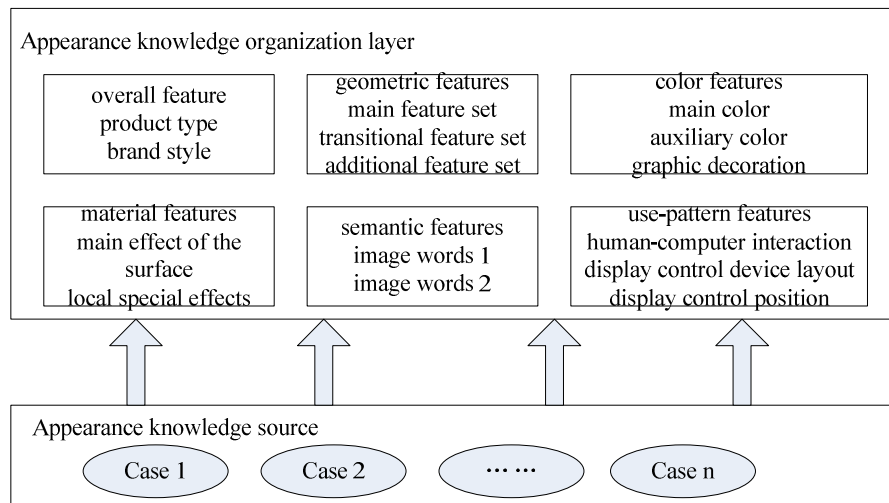


Figure 4 : Appearance knowledge base model that pay equal attention to both function and shape

Acquisition and representation of case product appearance characteristics of knowledge meta-information

Disadvantage of geometric feature element method is that Metadata is from the sample feature line within the same group, it will lack some information of the other samples, and the result is the relatively narrow search space and can not a optimal result. Therefore it needs a further improvement for a better application, and the methods are mainly included:

- (1) To get the geometrical features elements of various printers by features line, and use the previous representative feature line as its datum^[8], so that all types of printers can be divided into various combinations and corresponding datum;
- (2) By making questionnaire, invite professional designers to evaluate and make scores for product features line of each group and the similarity value of datum, score rules are shown in Figure 5:

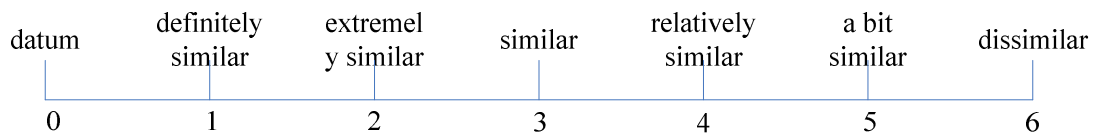


Figure 5 : Score rules of similarity value

(3) The average value made by the testers will be the similarity value of any sample and datum in every group, so that every case geometric feature can be stored as datum and similarity value in constructing database, and the storage rate and retrieval rate improve obviously, and can also reduce missing product information.

Case product appearance knowledge system architecture

In order to make the designers get more detailed and clear products appearance modeling content, product appearance modeling knowledge base system can play a good supplementary role, finally with the method of human-

computer interaction to provide the optimal design program for the customers. In general, case appearance knowledge system has four function modules and interfaces: users' information management module, product appearance modeling knowledge retrieval module, design demand retrieval module and new design storage module. The system architecture is shown in Figure 6:

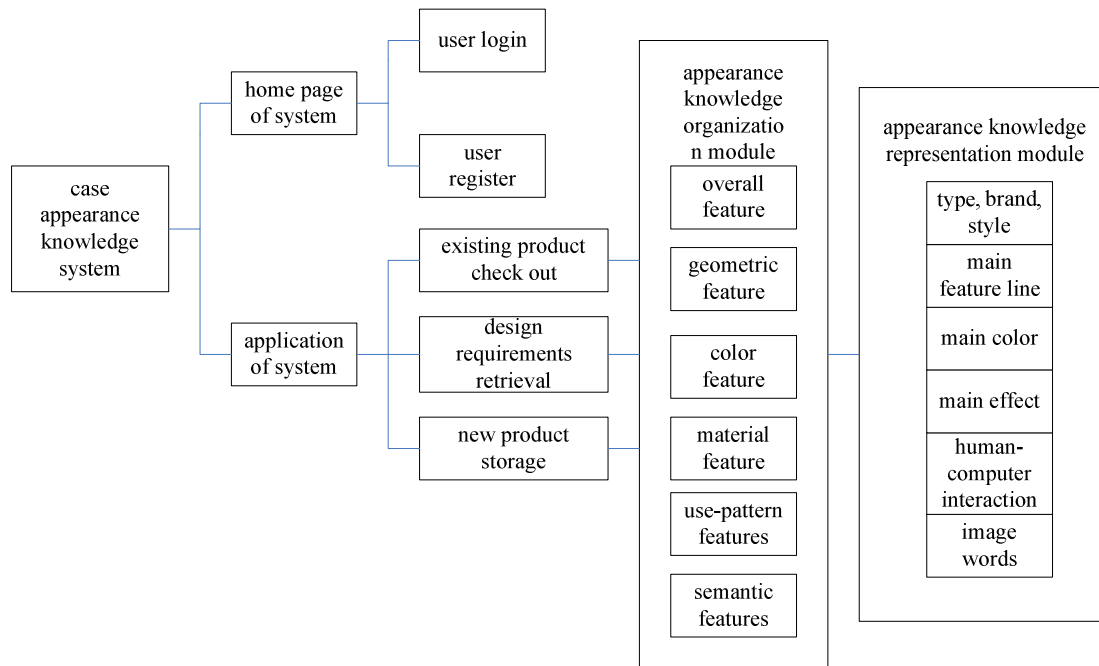


Figure 6 : Case product appearance knowledge system architecture

Through the visual C++6.0 software platform to develop the product appearance modeling knowledge base system, and the background database used relational database, its access is mainly through ADO technology to realize, and the main contents are as follows:

(1) Database management system used Microsoft Access 2003, which is very suitable for small and medium-sized database management, and the basic functions are the modules of the construction of data report and database content, search, modify, and add, etc;

(2) Visual C++6.0 is a very popular development language, it can achieve seamless connection very well with Microsoft Windows operating system, and can reduce the difficulty of development very well;

(3) ADO connection technology is the most popular database programming technology currently, and it is a kind of high-level interface, when the database access middle layer it is the fastest way, so its application range is very wide;

(4) Photoshop, Coreldraw as interface software.

In the design of the database what should be considered is that it holds the extremely important data resource, so the security and integrity is necessary in database design. The database structure of this study is as follows:

(1) User information table is typically used for storing use's information, it usually automatically store the user's login name and password after the match of each other when user's registration is completed;

(2) The overall features information table is mainly for storing overall features information of cases, through which users can automatically search related issues;

(3) The semantic feature information table is for storing the scores of case for corresponding image words, when users need to search related content, the semantic feature information table can be connected and show the contents after the completion of search;

(4) Geometric feature information table is that when users search the geometric features of the case, it will automatically display the related content of information on the page;

(5) Color feature information table is that when users search the color knowledge, it will automatically connect to the table and display the information on the current page;

(6) Material feature information table is that when a user searches material effect, it will display corresponding satisfied information content;

(7) Use-pattern feature information table mainly shows the information of the use-pattern of the case products.

Through the above content, when build a case appearance knowledge base system, comprehensive utilize the combination of neural network model and genetic algorithm these two kinds of technology to develop a new type of case modeling system, which is benefit for the balance between implementing users' requirements and designers' aesthetic design.

CONCLUSION

The main content of this study is the knowledge of product appearance modeling characteristics, it is a representation collection of various appearance characteristics set, and then the study carries on the theoretical research on product appearance knowledge base system, which laid a foundation for later perfection of knowledge base. As a research about the collection of computer technology, artificial intelligence software, design psychology of such advanced disciplines, the product appearance modeling knowledge base system is a innovative solution of product design. It mainly used the multidimensional scaling and cluster analysis, which can be used as a basis for product appearance modeling design knowledge classification, and can complete the design tasks of the product modeling innovative solutions very well. Finally use Visual C++ 6.0 software to build product appearance modeling knowledge database system, which can make designers modify parts individually of the overall in combination with the actual needs, so that the design reliability and validity can be well improved. Although, of course, the content of the research have certain progress, there are still many deficiencies, which mainly need to expand information database system, to fully consider various factors in the design, to further refine each characteristic element, and need comprehensive consideration of the cost and manufacturing, etc.

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