

INQUIRIES ON THE DEVELOPED MACHINE DESIGN OF THE ARMED WORKS OF CONTROL PANEL BASED ON MAN-MACHINE ENGINEERING CONSTRAINT

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Abstract

Based on Ergonomics and the basic requirements of control panel design, this paper studied the computer-aided design method based on man-machine principle restraint with control panel modeling, color and other man-machine elements being chosen as research subjects. The study realized the restraint design from the product structure to size, ameliorated the human machine interactive relationship from the aspect of human physiological and psychological demands and improved the comprehensive quality of control panel.

Introduction

Control panel is the component of information displaying and controlling of a product. Users get to know the executing process of the product and pass the operating orders by the control panel. Therefore, the control panel is the most straightforward and important component for the information communication between products and operators. The design of the human machine interface of the control panel influences the efficiency of information communication between products and operators directly. With the rapid development of computer technology, the human machine interface design of the control panel has the following changes: (1) high-tech. For example, monitors tend to be flat and thinner; the input methods are becoming

diversified. (2) more natural. In interface design of software, natural language, image, text, light and other forms are being used to make the screen space more lively and natural. In the interface design of hardware, the buttons are set clearly and the operation mode is natural, so that the interface of software and hardware together could become more harmonious. (3) Humanity. In the design of control panel, on one hand, the size of the control panel ought to fit human's physiological structure and suitable for operation. On the other hand, the shape, color, decoration, and other aesthetic factors of the control panel ought to satisfy people's aesthetic and cognitive needs. The design task of modern control panel has become more and more complicated because of hundreds of

elements and operation units. The requirement of delightful design of control panel provides the human-machine design and industrial design with a broad stage. Meanwhile, human-machine performance requirements of the control panel are getting higher and higher.

2. The status of the control panel design

Due to the impact of traditional design ideas, the layout of the control panel design is chaotic, and the shape and color are monotonous; in the operation aspect, the various physiological and psychological characteristics are not considered comprehensively enough. Those questions are mainly reflected in the following two aspects: functional actualization of the control panel design is more considered, but less is done in the research and application of ergonomics; 2, the design process is basically completed by the former experience of the designers, it causes inadequate consideration of design factors. This phenomenon makes the control panel fail in fully meeting the needs of users and easily results in unnecessary fatigue and misuse. Consequently it cannot create a good human-computer operating environment for the operators as well. Therefore, it will be the industrial designers' and machine designers' common goal and task to apply the industrial design and ergonomics technology to the design of control panels to create control panels without only good quality, beautiful form, but measuring up the principles of pleasant operation.

The paper is based on ergonomics design and made second development of the computer-aided design software and embodied the ergonomics design principles

as the restricted condition in the software system, in order to improve the man-machine intelligence and the friendly interactive interface. Therefore, it ought to improve the efficiency in the usage of the control panel, and to create a good "human-machine-environment" system.

METHODOLGY

The method of the design based on the principles' restriction was used in the field of artificial intelligence before; it provided a new theory and possibility of practice to solve the pleasurable aspect of the operation problem of the control panel by applying the method of the design based on the principles.

The so-called ergonomics design principles' restriction is the ergonomic need in control panel design, it reflects that the operation of the control panel should meet the ergonomic requirements and its composing form and represents that in achieving its function on the basis of use, it adopts the appropriate design methods according to the physiological and psychological characteristics, operating habits and design knowledge and design criteria. It is the complement and improvement to the relations of human and products by introducing the theory into product design, so that the design is no longer limited to the field of structure mapping, but will improve the design both structurally and functionally.

In the field of product design, the design is to meet the functional requirements and improve performance as a precondition. The design results--the structure and the shape of the product is carrying its function and the function of the product is

expressed by its structure and shape. The purpose of ergonomic design is to make the machine's product's function achieved by humans safely, comfortably and in a better environment. The object is the principles related to product structure, shape and positioning, location, and etc. The basis of design is the relevant principles of ergonomics and data. That is to say, the purposes of ergonomic design is to support and meet the functional requirements, it solves the problem of the product's functional improvement. Therefore, to introduce the ergonomics design principles' restriction to the control panel design has a significant meaning.

According to the technology development level of the current computer hardware and software, it can be determined that the ergonomics design of the control panel should be solved in accordance with multi-constrained optimized problem methods and the object-oriented theory and technology should be also introduced into the analysis of function units and tasks to further deal with the restraint appropriately and seek more effective methods for calculating search and to carry out the space search and comparison that meets the constraints to receive the most optimal or a satisfied solution.

The construction of restriction database

After extracting and sorting the ergonomics information, we use C++ programming language to construct the restriction database of the ergonomics principles' restriction.

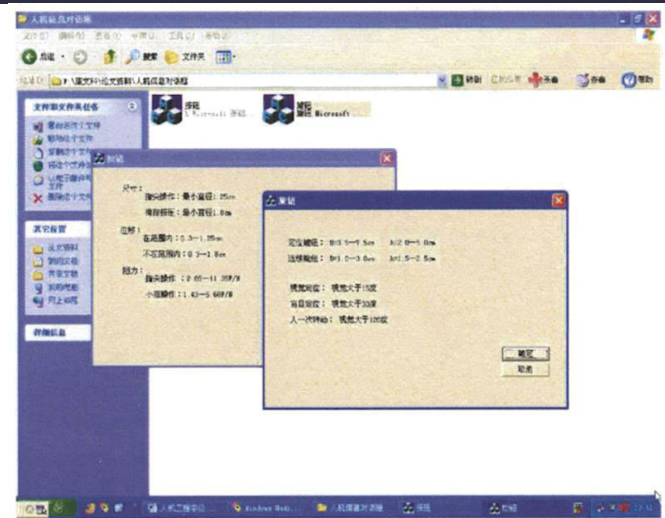


Figure 1. The construction process of the restriction database of the ergonomics principles' restriction
The construction of the components database

In this module, in the purpose of user-friendly design and operation, this paper provides a more convenient method for rapid design, which is the control panel components aided design methods based on the ergonomics principles' restriction. Parts of the control panel are the standard units, this module provides the standard control panel components, the database includes almost all the standard parts in current market and every type of components has formed the corresponding series. The sizes all come from national standards; there are some other parts without standard and they are established in 3ds Max based on the human physiological parameters and functions and features of the specific components, then save these parts into the library.

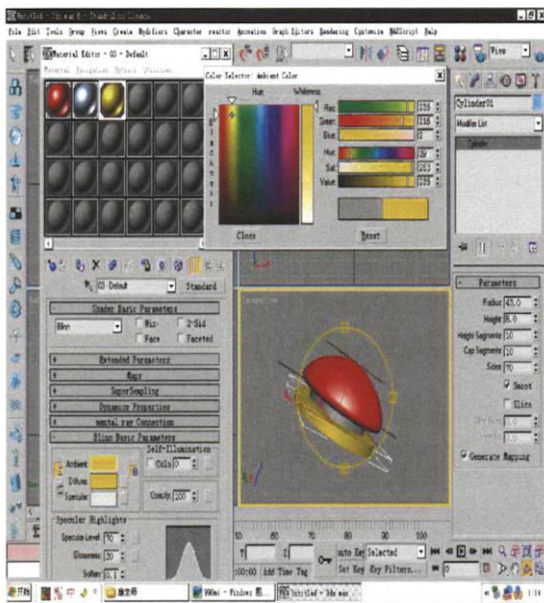
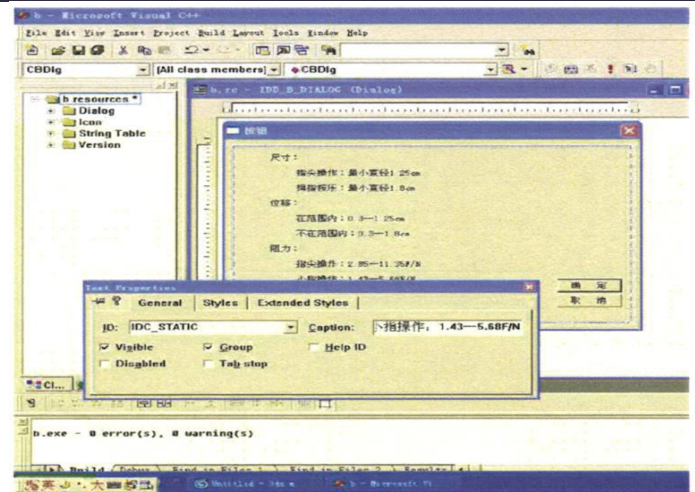


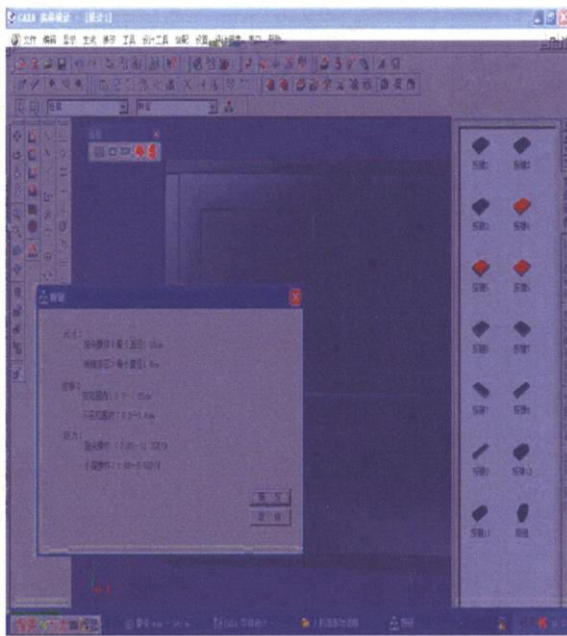
Figure 2 The construction process of the parts

S.2.The realization of ergonomics principles'restriction in the component design

When designers use the library, he can use "drag-and-drop" combination of parts of the configuration directly according to functional requirements and ergonomics principles' restriction in the CAXA system. After importing the parts into the scene, it will build a new component element database, then drag the imported parts into corresponding library and name it to complete the construction of the components (as the Figure 3 below).



For example, in the design of the overall control panel, adopt the proportion of the golden section rectangle, root section rectangular and the F rectangle according to the characteristics of human vision to ensure good visual effects and to meet people's visual requirements of the information access. At the same time, on the overall control panel size basis, it uses rectangular dividing method to divide some same or similar rectangle and guarantee the whole panel and the various parts have Coordination when arranging buttons, monitors and other components in the similar rectangles. In the design of the control devices like button, select the appropriate size of the ergonomics measurements depending on different modes of operation (fingertips operation: the minimum diameter of 1.25cm, choose 1.4cm thumb pressure; the minimum diameter of 1.8cm, choose 2.0cm) as the size of components to guarantee the realization of information of the ergonomics principles restriction (as shown in Figure 4).



Conclusion

By introducing the approach of "soft: constraints" and "hard constraint", we put the requirements of the ergonomics design into the design process. Meanwhile we combined the restriction method and computer-aided design technology so as to improve quality and efficiency of the control panel of human-computer design greatly.

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