The Study on Human Computer Interaction Design Method based on Unified Interactive Mode

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Abstract

Human-computer interaction, also called user interface or man-machine interface, refers to the method and action of transmitting and exchanging messages between man and computer. In its narrow sense, it indicates the interaction between the man and the computer system, namely the user utilizes the computer program me and the program me responding to the man’s operation. This paper discusses the human-computer interaction design of the software based on unified interactive mode.

Keywords: disadvantaged groups, human-computer-interaction design, program me

1. The Principle of Barrier-free Design and Human-Computer-Interaction Design

1.1. Human-computer interaction design

The research on the human-computer interaction design of software aims to make it possible, through designing, planning the multilevel structures of the software interface, and the layout and practicability of the controls, for the software to conform with the operational habit of the user so as to lessen fatigue, reduce errors, improve efficiency and get happier experience when using the software. What the paper deals with herein is the software interaction design concerning the disadvantaged groups.

1.2. Barrier-free principle

The so-called barrier, which means the behavior barrier to different kinds of people who move with difficulty, falls into three categories if A, barrier to movement, concerning those who can not walk or walk with difficulty, or have to depend on others or special devices; B, complex-movement barrier, referring to those who have uncoordinated limbs, incomplete fingers, nervous paralysis and similar problems; and C, information barrier, including blindness, color blindness, color weakness, extreme nearsightedness, deafness and language difficulty. The barrier-free principle indicates a variety of designs that aim to remove and relieve the behavior barriers to human beings. [1]

1.3. The targets of the research on human-computer-interaction design based on barrier-free principle

The purpose of applying the barrier-free principle to human-computer interaction design is to solve the practical difficulties of some special groups of people, achromates, color weaknesses, seniors, children and left-handers, etc., who have trouble in man-computer interaction. So far, however, no better means of interaction have been found to resolve their problems with interaction. It is estimated that the group of color blindness and color weakness alone accounts for 6 to 7 percent of the total population in China. People like the aged and children who are mentally immature constitute a larger proportion. These people, due to their physical weakness, experience greater difficulties than common folks when interacting with a computer. Therefore, their physiological features should be taken into account in interaction design so as to develop the solutions to the interaction suitable for these special groups. But the interaction problem for the weak group,
owing to their physical disadvantage, cannot be solved merely through the improvement of the mode of interaction, since it is difficult to find a means which is able to tackle the interaction problem at its source for the group. This paper, in view of the reduction of interaction difficulties, probes into the possibility of offering interactive aid to the disadvantage group. However, it will take a long time for people from various fields of learning to make joint explorations to settle the essential problems with physical disadvantages for those special groups.

2. Analysis of Physical Features of the Disadvantaged Groups in Software Interaction

This paper is focused on the analysis of physical features of people of color blindness and color weakness, and then puts forward the preliminary solutions to the interaction. It also demonstrates some tentative ideas with respect to the improvement of the interaction design for the elderly and the left-handed.

2.1. Analysis of physical features and behavior characteristics of achromates and color weaknesses

Achromatopsia, also referred to as daltonism, is an illness of congenital barrier to colors. Color blindness and color weakness result from the loss or abnormality of cone cells with which eyeground experiences different kinds of colored light. Color blindness and color weakness, which have no essential distinction, differ only in the degree of loss of ability to distinguish between colors.

Color blindness is divided into several types such as total, red, green and blue-yellow blindness. People of full color blindness, having almost no color distinction, suffer from the most serious barrier to colors. They can only tell brightness from darkness. Red-blindness is not also called the first blindness, patients of which cannot identify red color, nor do they distinguish red from dark green, blue from purplish red and purple. They often see green as yellow, purple as blue. Green-blindness is also called the second blindness, patients of which cannot distinguish light green from dark red, purple from dark blue, purplish red from grey. They see green as grey or dark black. Blue-yellow blindness is also called the third blindness, patients of which, able to tell red from green, confuse blue with yellow.

Color weakness falls into total and partial categories. Compared with the barrier of total color blindness, the barrier of total color weakness and color sense is to a smaller degree. They have a clear distinction if the color of the object is deep and bright; but they find it hard to tell if the color is light and unsaturated. Among tritanopes, some are weak in red, green or blue-yellow color and so on. Red-green weaknesses have a weak sense of red and green color. Their ability to distinguish colors is almost the same as that of the red-green-blindness when the light is dim, but the ability is near normal with an object in deep and bright color and in a good light.

In Figure 1, the left picture indicates the color sense of normal eyes, and the right the color inclination of the red-green blind. It is thus evident that when the red-green blind face red and green colors, these colors become only names of conception. They can only tell the difference between colors by different degrees of brightness of colors. At the same time, however, people of color blindness and weakness possess advantages, having stronger discriminating power for brightness and darkness of light and color than common people. Therefore, in interactive interface, the change of brightness and darkness attracts their attention more easily. In the research on man-computer interaction based on the principle of color blindness and weakness, the designers can make full use of the feature, customizing a specific interactive mode in auxiliary operation process of interface as well as in auxiliary reading so as to show special concern for them.
2.2. Analysis of the behavior characteristics of the elderly in software interaction

Old people, due to aging and weakening physically and mentally, cannot match young people in reception of software knowledge. Their problems with interaction are mainly focused on the following respects:

1) Slow response to complicated mouse actions including dragging, fast double clicking and operating multi-level menus.
2) Lack of the ability to understand the terms in the software interface and, because of their poorer memory, repeated practice of the software operation process needed.
3) Difficult identification, due to dim eyesight, of the interactive interface with complicated icons and graphs.

2.3. Analysis of physical features and behavior characteristics of left-handers

According to medical law, people who are used to writing or taking things with the left hand are called left-handers, or lefties. In their daily life, the left-handed are not a disadvantaged group. And yet, left-handers are in a comparatively weak position, because almost all of the software interfaces are arranged for the right-handed, with tool bars usually on the right, including “Confirm” and “Cancel” buttons also at the bottom right-hand corner of the window, even the mouse mainly designed for right-handers ì almost everything in the interface is arranged so that the operation distance to the right hand is shortened and the level of operation difficulty lowered. To a left-hander, however, each time he wants to click a control, he probably has to control the mouse across the whole screen for a click on the other side. By contrast, muscular movement of the arm is a motion of the great muscular mass while the accurate clicking and dragging is careful muscular movement. When operating software, a left-handed person needs to shift frequently between the two kinds of movement, getting tired very easily. Interaction designers can settle the problem for left-handers through the change of the layout.

3. The Preliminary Solutions to the Interaction Design of Software Based on Barrier-free Principle

Users differ in software man-computer interaction. For software with a small number of users which is designed for a particular trade, or software developed for a specific group, there can be less consideration for the disadvantaged group because of the smaller proportion of the group. But for common software, such as Microsoft series or Adobe reader, Firefox and the like, with an extremely wide range of users of different kinds, physical features and operating habits of the disadvantaged in interaction should be one of the factors to be taken into account. Since there are diverse physiological inadequacies of various disadvantaged groups, it is hard to resolve all their interactive problems through one solution. A workable method is to design interfaces respectively for different groups like the color blind and weak, the elderly, the left-handed and the disabled. Such designs will not make a big difference to the core of software program me, but they can make great improvement for software usability.

3.1. The Preliminary Interactive Solutions for Groups of Color Blindness and Weakness
Up to now, the problem of people with color-sense barrier has not been able to be smoothed away thoroughly by means of interactive design. In order to reduce the difficulties in interaction, at least two areas should be included in software interactive interface based on the physical features of the color blind and weak, one to be the operating aid, the other the reading aid. Through the two aids, software usability can be improved, the level of difficulty in operating lowered and the barrier to operation reduced. These are the problems that can be smoothly solved in interactive design, with the detailed operational measures as follows:

3.1.1. Operating aid.

Although people with color-sense barrier have trouble distinguishing between colors, they are not unusual in intelligence, and thus the models of mental power constructed in accordance with the behavioral characteristics of ordinary people also fit people with color-sense barrier, with improvement to be made for the color and the layout of the interface. For example, the interface with smaller contrast ratio tends to increase difficulty in identification for people of color blindness and weakness. In addition, if colors of different phases but identical brightness (e.g. red and green of the same brightness) are applied to the interface, people of color blindness and weakness may find it hard to tell them apart. In view of this, at least several changes below should be made in interface design.

A. Increase the contrast ratio of light and shade of different elements in the software operating interface to make the light color element for controls and buttons brighter and the shady one darker, because people of color blindness and weakness are quick in sensing the difference in luminance of controls, patterns or graphs. And so, to enhance the identifiability of the interactive interface, the background of the window can be brighter and icon buttons or words for controllers darker. For instance, just like Figure 2, the settings of the typical interface of Windows XP are: the background color of the menu bars, R:212 G:208 B:200, grey menu bars and black words, value of R, G and B being zero. For the convenience of the special group, it is proposed that the luminance of the background color be increased and that of the words decreased, just like Figure 3.

![Figure 2: Windows default color of menu bar](image)

![Figure 3: Menu bar of increased contrast ratio](image)

The enhanced contrast ratio of brightness makes it possible for more people with color-sense barrier to discriminate without difficulty the positions of menus and controls, and to tell the difference between workable and unworkable menus. Besides, it is recommended that the multiple colors for the menu bar background be decreased, since the menu bar mainly in black and grey, the striking contrast, tends to be identified more easily. Sometimes shading and color changing gradually are source of identification barrier for people of color blindness and weakness.

B. Decrease the number of icon buttons for a better understanding of interface.

The interactive interfaces used nowadays are mostly based on graphic user interface (GUI). The software icons and controls, in particular, are partly buttons, made on the plane by means of different brightness and contrast ratio, looking like 3D graphs, and partly functional graphic controls on the buttons, based on the function of buttons and controls and designed through graphics and metaphorical method. Most people can easily understand the commonly used Windows standard icon buttons, such as save, delete and so on, but not the metaphorical meaning of the icon buttons with specific functions. Though icons of the buttons similar to those in Figure 4 are exquisitely made, it is not easy to comprehend the information they indicate, let alone the icons with rich colors and multi-level brightness. People with color-sense...
barrier will certainly have more difficulty using them. For such software whose controls are hard to identify, its seemingly great usability will be discounted to a considerable degree.

The example of the software “Ecotect”, which is not commonly used, may seem somewhat extreme, but it suggests that colorful interactive interface with metaphorical icons beyond comprehension will lead to enormous interactive problems for people of color blindness and weakness. Therefore, literal icon buttons, by contrast, more understandable and workable, may be better choices for those special groups. As shown in Figure 5, every icon button has literal explanations for the function of controls, which is not only convenient for people of color blindness and weakness to recognize but also easier for operators to understand. It can be seen that it is a better choice for people with color-sense barrier to use literal icon buttons instead of graphic ones, especially for some widely used software. Even though controls like literal icon buttons take a little more screen pixel than graphic icon buttons, their availability for people of color blindness and weakness are something that the latter cannot match.

3.1.2. Reading aid.

For people of color blindness and weakness, it is not very difficult to read documents or files or do routine work using software, since the main operation interface of most files has black or dark-color words against white background, easy to distinguish as a result of striking contrast. However, when it comes to the identification and comprehension of the graphic images, using software often makes people with color-sense barrier confused, because most of the charts and diagrams are in common colors such as red, green, blue and yellow, which many people with color-sense barrier just have difficulty identifying. To tackle the problem, function of reading aid can be added to interactive interface design.

A. Words prompt: the method, similar to the function of screen word capture for an electronic dictionary, is an application of the mouse monitoring function. When a graphic image occurs in the file and the mouse remains on the spot past the given time, the software should automatically eject the dialogue box with words prompt, displaying to the user the color of the spot. Through automatic identification of software, the user can read graphics without much trouble. In this way, the problem of people with color-sense barrier reading graphics is crackled, without adding to the programme too much pressure of programming.

B. Voice prompt: the method, also available for reading aid to charts and images in files, is an interaction of multimedia. With this function added to the software, the user, when coming across a graphic image that needs to be identified carefully, can keep the mouse on the image and the software helps the reader through automatic voice prompt to identify the color of the spot. Making use of multimedia in concert like this has a better effect than the individual interactive method, but with a great amount of audio files added, the scale of the software may be enlarged slightly.

3.2. The concept of interactive interface for the elderly

There are more difficulties in the research on interactive interface for the old people, a great number of field investigations have to be made and experimental proofs given. This paper only puts forward some comments on the improvement of software interactive method with regard to several of the most common phenomena.
1. Improving the operation of multilevel menus and reducing complicated mouse actions such as “dragging” and “double clicking”. Multilevel menus, as shown in Figure 6, and daily used mouse gestures, like dragging and double clicking, are hard for old people to learn, since they are not dexterous with their fingers. This often results in resistance of the old people who use software for the first time. In addition, even for the old people who have some experience in operating a computer, positioning the mouse accurately is not an easy job. Thus, multilevel menus should be minimized in interactive design, and if possible, the menu contents in wide and shallow style, not narrow and deep, are preferred. Complicated operations including clicking and dragging should also be minimized to lessen the burden on hand movement.

2. Increasing the image pixel and displaying controls with large icons and big words. To solve the problem of weakening eyesight of the aged, efforts should be made to set simpler interfaces, larger controls and icon buttons and words. The tool icons in tool bars Windows usually adopts are of 16X16 pixel, and 8 to 10 point words. What MacOS adopts is larger and better than that of Windows, so it is necessary for software based on Windows to use larger icons and words to facilitate the interaction.

3. Adding more detailed functional notes to controls. Windows programme have notes to each control. Most of the notes, however, are usually not specific enough and thus hard to play a leading role. As for the similar method shown in Figure 7, the icons on the buttons are replaced by words, though seemingly somewhat dull, and yet, the functions of the controls can be indicated more specifically. What is more, short sentences, used as functional notes, provide more specific words and more organized explanations so that old people will not be confused with complicated operations. Methods like this can play a more active part in leading the elderly in their application of software.

3.3. The concept of the interactive improvement for left-handers
1. Concerning the left-handed people, when operating, the software should first determine the habit of using the mouse. The Windows has two kinds of settings of the mouse for both the left- and right-handed users. While making the judgment, the software should determine different interface layout. In the interface for left-handers, most of the tool bars and controls should be arranged on the left side of the screen, with “Confirm” and “Cancel” buttons at the bottom left-hand corner of the dialogue box correspondingly. However, in view of the reading habit of the left-handed still from left to right, the arrangement of words and settings of windows should still go from left to right.

2. Accelerator keys are set, in most software, on the left half of the keyboard, according to the general habit of operating the mouse with the right hand and accelerator keys on the keyboard with the left. But for left-handers, if they use the mouse with the left hand, accelerator keys should be distributed on the right half of the keyboard to suit their convenience for right-hand operation. Therefore, at least two sets of accelerator keys should be designed in the software, conforming to the corresponding habit of the two groups. If there are too many accelerator keys, making it hard to set up two schemes, the method of user custom accelerator keys can be adopted so that the user is able to determine by himself the positions of accelerator keys according his own operating habit.

4. Conclusion

With respect to the interactive interface design for the disadvantaged group, it is unlikely to resolve all the problems with a unified interactive mode, due to diversified disadvantaged groups and their different physical features, so there should be various interactive modes to fit their operating habits and fulfill their needs. According to Alan Cooper in his<About face-The Essentials of Interaction Design>, the interactive mode which is the most appropriate to a different group is one customized specifically for the group. There is every chance to make designs of different interactive interfaces for the disadvantaged groups. As for designers, they should have not only a succession of design thoughts, but also a loving heart for the disadvantaged groups.

6. References