Psychological Analysis of User Interface Design in Computer Software

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Abstract. Currently, technology and machine-based design ideas can hardly solve the massive problems in the user interface (UI) design of application software. The “people-oriented” and “user-friendly” design ideas are put forward to address this issue. These ideas have gradually gained attention and been valued by people. The user interface design of software (including fixed standard, semantics, etc.) should start with human cognitive psychology, and comply with human perceptual characteristics based on the normal thinking and action characteristics of people for the human-computer interface design.

Keywords: Software, User Interface Design, Psychology, Matching, Feedback, Semiotics, Semantics

1. Introduction
Since the industrial revolution, functionalism can solve a lot of design problems. But with the coming of the new scientific and technological revolution marked by nuclear energy and electronic computers [1-2], more and more electronic information products are produced, and they are no longer operated by physical force but by mental thinking [3-4]. Therefore, the functionalist thinking and machine-based human-computer user interface design thinking are no longer sufficient to design satisfactory products, while the computer software user interface design is helpless [5]. In the design of the human-computer interface, the psychological analysis of humans has become more and more critical [6].

The design problem of this application software interface is the problem of the “relationship between objects and people”. Human cognition has become a critical aspect of user interface design. The design of the software user interface (UI) should meet the needs of users, which means that it should meet the needs of users’ perception, cognition, operation, and emotion. To provide users with cognitive conditions and cognitive guidance, explicitly, to give the users thinking guidance, communication guidance, cooperation guidance, memory guidance, attention guidance, planning
guidance, information guidance, and evaluation guidance.

2. Gui and its characteristics
GUI is defined as a form of human-computer interaction using four basic components (window, icon, menu, and mouse pointer). GUI is sometimes referred to as the wimp interface, which is the abbreviation of the window, icon, menu, and pointing device.

Among the basic characteristics of GUI, the essential inherent characteristics are intuitive operation, mouse or pointer support, graphics, and application software functions and areas. The initial discussion of the GUI style basis is to separate the application level of application software based on GUI.

The graphical UI cannot guarantee proper usability. However, for specific task skills, well-designed application software based on the graphical UI is superior to similar software without a graphical UI in effect and satisfaction. For novice users, the initial challenge was to learn how to use pointing devices and select commands from menus.

For a graphical UI, it takes only an hour for the user to get a basic understanding of its use. However, learning to adapt to pointing devices can take a long time, which has a lot to do with personal habits. Users need to cultivate a habit to adapt to hand-eye coordination.

Over time, users will master other hidden advanced functions to improve their work efficiency. Once the user has established a proper way of interaction, they will ignore the similarity of GUI features in different environments and pay more attention to the use of GUI.

3. User psychology model and analysis
The psychological model is the result of the interaction between the knowledge system and the current environment. It has the characteristics of stereotype and uncertainty. The psychological model embodies a way of thinking, and becomes “a perspective, a schema, a framework, a model” for people to consciously or unconsciously understand things. From the linguistic point of view, the cause of the psychological model refers to the internal knowledge structure of an individual's mind, which can be summarized into two aspects: proximity and convergence. As shown in Fig. 1, it is more convenient to understand the relationship between these concepts. With the expansion of the application scope of the user psychological model, it also has a profound impact on the field of user experience design, which can be considered as a problem in the design stage. Specifically, the design model is the design concept in the designer's mind, and the user model is the user's operation behavior to the product. Hence, the system image is particularly important.
The process of seeing and listening constitutes perception. Images and sounds are encoded in an abstract way as the characteristics of the stimulus. The input and memory information is compared to obtain the explanation of stimulus, which is the cognition process. The human body information processor includes sensory, short-term memory, long-term memory, and its associated action processor and cognitive processor. Among them, the work of the cognitive processor is often referred to as thinking. The result of thinking is either stored or sent to the action processor to control the action.

$P(n)$ represents a smooth Riemannian manifold, through $P(n)$ From the unit element $I$, Along $u \in T_{p}P(n)$ there is only one geodesic:

$$ P_{x} = P_{x}^{1/2} \exp(u)P_{x}^{1/2} $$

Therefore, the iterative form from the current step to the next step can be written as follows:

$$ A_{k+1} = Q_{k}{1/2} \exp(-\alpha(t)G_{k})Q_{k}{1/2}, $$

Where exp represents an exponential map, $-G_{k}$ represents the direction of descent.

It is expected that the user's perception of psychological data can be accelerated by using the thought of psychological analysis for reference. For any two points on the positive definite user perception of psychological data, they are not on the same tangent plane and cannot be combined linearly. Considering that the operation of user-perceived subjective data is a matrix multiplication in common sense, only multiplication can keep the manifold structure of the group. Therefore, $A_{k}$ and $A_{k+1}$ are used to obtain the transition matrix $Q_{k}$ along the geodesic line, keeping $Q_{k}$ on the manifold.

$$ Q_{k} = A_{k}\frac{1}{2} \exp(\beta \log[A_{k},A_{k+1}])A_{k}\frac{1}{2} $$

In the above equation, it is pulled back to the positive definite user perception mental data through the exponential mapping and get the next iteration matrix along the geodesic line to ensure that every step is always on the manifold.
4. Cognitive requirements for UI design of application software

According to user psychology and cognitive science, the following basic requirements are proposed to guide the software UI design.

In terms of the task, information expression, interface control, and operation, it should be consistent with the familiar mode understood by users. The symbol is the carrier of thinking and the medium of communication. All thoughts and experiences of human beings are symbolic activities, so symbolic theory is also the theory of consciousness and experience. All human experiences are organized on three levels, namely, sensory activity, experience, and symbol. Symbols include what makes the process of connection begin, its objects, and the effects of symbols. In a broad sense, the impact of symbols is the meaning of symbols.

The primary purpose of using symbols instead of words is to make users more visual and easy to understand the operation methods, for example, in Photoshop, \( \text{\includegraphics[width=0.05\textwidth]{symbol1.png}} \) represents the graphic magnification function, in 3DMAX, \( \text{\includegraphics[width=0.05\textwidth]{symbol2.png}} \) represents image function, while some UI designers ignore the understanding and communication function of symbols, pursue innovation aimlessly, or create many icons by themselves, which causes many difficulties for users to understand and operate. Hence, the conceptual model of icon should match the user's cognitive psychology, rather than turning icon design into painting. If the designer does not provide such a natural matching relationship, which shall be created by the users. The results are often prone to error, bringing trouble to the users. The matching principle is a critical link in excellent UI design.

All kinds of similar software, especially some operation commands in drawing software, are often used and have cognitive commonness, which can be designed into the same functional operation. For example, the image function, mobile function, and text editing function in various software have basically the same operation effect. Instead, the gradient symbol in Photoshop is \( \text{\includegraphics[width=0.05\textwidth]{symbol3.png}} \); And the gradient symbol in corldraw is \( \text{\includegraphics[width=0.05\textwidth]{symbol4.png}} \), the magnifying glass symbol in most software is \( \text{\includegraphics[width=0.05\textwidth]{symbol5.png}} \), and the magnification symbol in 3DMAX is \( \text{\includegraphics[width=0.05\textwidth]{symbol6.png}} \). Many other beginners often make mistakes in the process of software interface conversion. Is this the fault of users? No, it's a big mistake in design. It is the impression of the cognitive symbol in the programmer's own mind, which is designed from the perspective of most novice users.

Similar to the engineering software Pro/E, each completed operation command will be followed by corresponding possible operation command prompt or display status, etc., which greatly facilitates the beginner's understanding and operation. It can be said that it is a model of paying attention to process in software UI design.

5. Evaluation of software UI design

There is no unified standard at present on how to evaluate the quality of a software UI design. In general, a friendly interface should have the following characteristics at least: simple operation, easy to learn, easy to master; a nice interface, comfortable operation, quick response, reasonable response; easy to understand, consistent semantics. It should be noted that the quality of a user UI design is ultimately determined by the user. As software is designed for users, the users of the software are the ones who have the final say. Hence, the UI design of computer software is closely related to human psychology. Both programmers and designers should review and consider the UI design of software from the perspective of most users' psychology.
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