Two Typical Symbols in Human-Machine Interactive Interface

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Abstract. In the modern Human-Machine interactive interface, symbol is used to express ideas, and is an important component of information visualization. By analyzing the style of interface design of "skeuomorphism" and "flat" that are two typical symbol designs, we analyze the differences between them, find out the user cases of these two symbols, and explore the future trends of the basic theories about symbol in the contemporary interactive interface. The experimental results show that skeuomorphism is different from flat in terms of five aspects including identity, interest, timeliness, familiarity, and simplicity. At last, we expect our research to provide guidance for the design of interface icons.

Introduction

Human-Machine interactive interface is the medium of information exchange between human and machines (or products). Users can enter information into machines through interactive interface to operate and manage machines. So the indicative icons in interactive interface play an important role in guiding the user operation, which take navigation role [1]. Thus, the indicative icons constituted by symbols has become an important matrix for smooth operations in human-machine interaction.

Symbol can be seen as the "material carriers of information society", which is responsible for carrying and transferring information. Symbol also takes role of emotion expression between human and machines. And symbol has three areas of signifier, metaphor and signified: signifier refers to the carrier of symbols, and means the form adopted by symbols; metaphor represents the specific things; signified is the meaning expressed and interpreted in symbol [2]. E.g., signifier refers to the forms of color, graphics, and texture; signified manifests thoughts and emotions that reflects the content and meaning. A good symbol design must be concise and iconic, in line with the features of user's mental model. It allows users to accurately and quickly understand the semantics expressed by symbols.

On the current view of the styles of symbol design, the debates of symbol design trend including skeuomorphism [3] and flat [4] continue to exist in public. Skeuomorphism can facilitate the identification of patterns, and make figures richer, but its design is complex and cumbersome. Flat is simple and concise, but the emotion expressed is not rich and too cold, its style isn't highly unified, and the implication of flat is very far forced. Facing with the mixed styles of interactive interface design, how to effectively use the theories of semiotics, how to vividly indicate the effects of interface design, how to achieve the consistence of interface style and icon metaphor, and how to easily operate machines, are needed to be resolved in interactive design.

So this paper tries to explore the different attributes and user cases of skeuomorphism and flat. By the analysis of our experimental results, we find that skeuomorphism and flat are two different design styles. Thought flat is concise which can guide users to operate machines, skeuomorphism can get more attentions in some special cases. We hope that our research can effectively help designers to more suitable icons.

Theory of Symbol in Human-Machine Interface Design

Human-Machine interactive interface design relates to computer science, cognitive psychology, art of graphic, and semiotics and so on [5]. The interface is a window to transmit information, and is a two-dimensional media to the response of operations. At the same time, it is more effective to reflect

environment and situation, and to emphasize user experience. And Human-Machine interaction model is as shown in Figure.1.
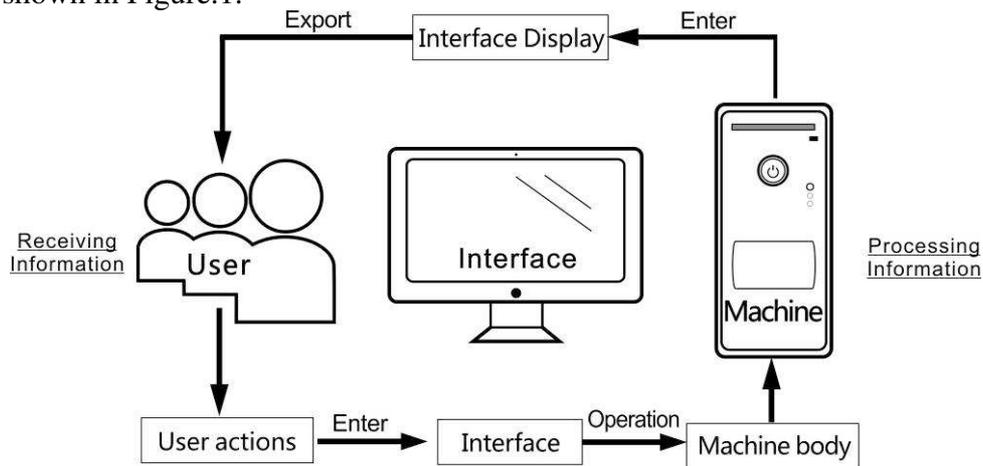

Figure 1 Human-machine interactive interface model

In the process of continuously achieving graphical interface, users try to use letters, icons and other symbols instead of various function and operation information. Users can make cognitive judgment, and complete the process of human-machine interaction, according to their own experience and subjective associations of these symbols. This process is also known as symbolic process. Therefore, interface design is closely related to symbols.

The existent significance of symbol lies in information convey. People can accurately communicate with applications, which is mutual agreement with the significance of symbols. Therefore, the development process of graphical interface can be seen as an evolution of symbols. So symbol has extremely important meaning on human-machine interactive interface.

What Symbol means?

The core of symbol is a system including communication and directive function. Simply, to study what mean interfaces represent, to study why it would represent such a meaning, and to study how the symbols convey this meaning are the content of symbol.

Symbol is the visible part of human-machine interactive interface, which includes information input and information output [6]. It is also the communication channel between users and machines. It can be divided into three levels: First, it is visual level, which contains all visual elements of graphical interface, such as text, graphic, icon and blank; Second, it is interactive level, which refers to feedback on people from machines, when users are being in operation of interfaces; Third, it is experience level, which refers to the overall of user feeling brought by graphical interface based on visual level and interaction level [7].

From visual aspects, all meaningful visual elements in interface are formed by symbolic modes. From interactive level, all information feedback in interface meets the exchange rules of symbol. In fact, the design process of interactive interface is the process symbolizing interactive interface.

Reflection of Symbol in Human-Machine Interactive Interface

The user interface develops from character to graphic. It can be regarded as a graphical symbol. Effectively conveying information to achieve semantics consistency in human-computer interface by using symbol truly achieve the incorporation of form beauty and operation ease [8]. From the perspective of symbols, it refers to signifier, and the content refers to signified, as shown in Figure 3. When signifier and signified can meet the user cognitive meaning that interface operation can be carried out smoothly, users will complete information exchange. If not meets, it will affect user cognitive, and bring inconvenience to user operation.

Based on such a perspective, the present study commonly adopts skeuomorphism design and flat design, which analyzes their features in icon design, to truly understand the advantages and disadvantages of two styles. In order to achieve the theories of symbol in the future design, to deepen

the interface design, easy to make the icon be understood and be remembered, and to reduce obstruct of user operation, it will now make the principles of interface design more clear and standardized.
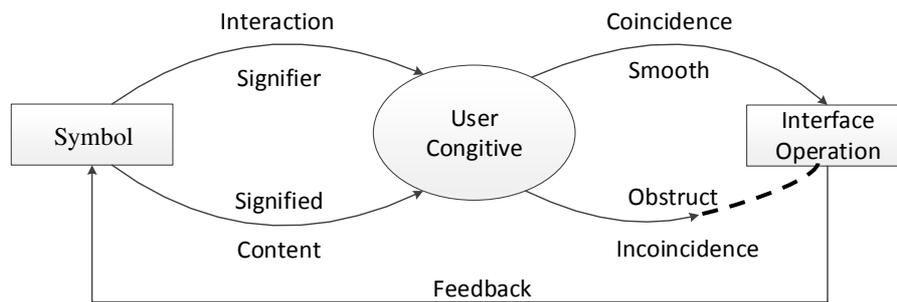

Figure 3. The significance of symbol in Human-Machine interactive interface

Two Typical Symbols in Human-Machine Interactive Interface

Symbols in Human-Machine interactive interface include skeuomorphism design and flat design. Skeuomorphism design is a simulation of the real world, and flat design is the information itself.

Symbol of Skeuomorphism Design

Skeuomorphism refers to the simulation of the appearance and behavior of objects in the real world. The skeuomorphism design has become a mainstream design, because it enables users to quickly and easily identify the original form that signifier refers to and produce the corresponding association. The symbol of skeuomorphism design is image symbol, which uses objects in real life to reflect their functions, as it is the feedback of the real world. For example, Apple products once used such the graphic design of video website and compass, as shown in Figure 4.a to pursue the details and skeuomorphism, and to let the user know its function at a glance through the image.

Symbol of Flat Design

The flat design is the similar to "two-dimensional" interface, which gets rid of shadow, gradient, perspective and other design elements, to build information organization of "broad and flat", "fast and complete" [3], as shown in Figure 4.b. The highly summarized symbols convey semantic information, which can more effectively improve the efficiency of access information, and is adapt to the characteristics of different screen sizes of intelligent mobile devices. Symbolic features with concise and flat bring a new trend for interface design.

a. Typical skeuomorphism designs   b. Typical flat designs

Figure 4 Two typical symbol designs

Experiment and result

According to the investigation of software applications based on future prospect and theoretical analysis, software applications can be divided into six categories: communication application (e.g. QQ, mail), media application (e.g. book, micro-blog), life-aided application (e.g. payment, purse), entertainment application (e.g. game, audio and video), tool application (e.g. calculator, compass), and industrial application (e.g. WPS2013, Office). This paper based on the six categories compares the advantages and disadvantages of skeuomorphism design and flat design.

Experiment environment

Experimental test investigates 50 people, which includes 20 interface designers and 30 users. And we based on the above six categories of skeuomorphism design and flat design select several typical software applications including communication application ▢▢, media application ▢▢, life-aided application ▢▢, entertainment application ▢▢, tool application ▢▢ and industrial application ▢▢. The above array of icons includes one skeuomorphism design and one flat design, which the first symbol is skeuomorphism design and the last symbol is flat design.

Result

We contrast two symbol design including skeuomorphism design and flat design, in terms of identity, interest, timeliness, familiarity, and simplicity. And the subjects can grade software applications according to their emotion and feeling, as shown in Figure 5.

Category	Skeuomorphism / Flat	Identity	Interesting	Timeliness	Familiarity	Simplicity
Communication	(skeuo)	4.26	4.51	2.95	4.20	4.45
	(flat)	4.23	3.84	4.75	4.07	4.80
Media	(skeuo)	4.55	3.98	3.98	4.95	4.24
	(flat)	3.84	3.70	4.24	4.12	4.87
Life Aided	(skeuo)	4.13	3.25	3.90	4.57	3.52
	(flat)	3.88	3.35	4.27	4.15	4.55
Entertainment	(skeuo)	4.34	4.13	2.85	4.58	3.04
	(flat)	2.03	4.00	3.97	3.56	4.20
Tool	(skeuo)	4.85	4.36	3.75	4.97	3.57
	(flat)	4.82	4.35	4.96	4.58	4.79
Industrial Applications	(skeuo)	4.17	4.59	3.85	4.34	2.76
	(flat)	4.11	4.35	4.82	4.02	4.58

Figure 5   The scores of software application given by subjects

The attribute values of skeuomorphism design and flat design are as follows by using the average formula.

	Identity	Interesting	Timeliness	Familiarity	Simplicity
Skeuomorphism	4.38	4.13	3.55	4.60	3.60
Flat	3.82	3.93	4.50	4.08	4.63

In order to further analyze the difference of skeuomorphism design and flat design, we calculate the average score of two symbols, as shown in Figure 6.
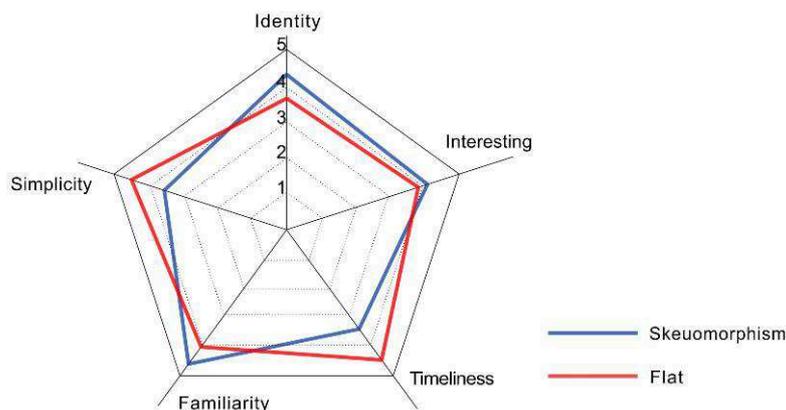

Figure 6 Radar-graph of two symbol

Analysis

From the perspective of interface design, skeuomorphism design can better meet the user cognitive and emotional experience, but it lacks the time sense, makes time-consuming, and has low spread in mobile devices from the overall development trend. The following chart shows its advantages and disadvantages, as shown in table 1.

We can clearly see the advantages and disadvantages of skeuomorphism design. Such familiar feeling can encourage users to product more new products, and reduce the user fear and disorder. But we are also not difficult to find that visual sense of icon and overall interface is relatively old, which is lack of concise modern language and impact force. At the same time, we can see the icon details only on the big screen. Once the screen size changes small, it becomes complicated graphics point, which will bring trouble to icon recognition.

Table 1   The advantages and disadvantages of skeuomorphism

Advantage	1. Familiarity. Users are familiar to skeuomorphism design, which are regarded as control elements in the real world to make users easily infer to the icon function and the method of interface operation. 2. Interest. Icons adopt a variety of graphical symbols according to the real objects, and use the rich content in limited areas.
Disadvantage	1. Limitations of identity. People with different regional cultures and life background, understand the difference of the same object design. 2. Limitations of timeliness. And the image is too complex, which does not meet the requirements of concise and clear design idea.

Compared to skeuomorphism design, flat symbol is too concise, which may not be able to meet most of the user cognition. It needs a certain time to understand in the aspect of identification. At the same time, too rational and general symbol is lack of emotion. However, flat design is concise and clear, which doesn't need long time to update the new version of interface icons. The advantages and disadvantages of flat design are summarized as shown in Table 2.

Table 2   The advantages and disadvantages of flat design

Advantage	1. Simplicity. It is adapt to the short process, many branches, and wide trend of information dimension; It can improve the information transmission capacity of single page, reduce the page switching and is adapt to the different screen sizes of electronic equipment. 2. Timeliness. Reducing the path length of access information can make users quickly find the target information, to help users to observe global information.
Disadvantage	1. Limitations of identity. Too planar may cause operation hesitation; Symbols escape from their own functions, which is not easy to be identified. 2. Limitations of interest. Because flat design only adopts simple image and little text, so it can get attentions from some users.

The information structure of mobile phone software is also tend to be wide and flat, which presents the categories of information to users as far as possible. Flat design presents all the information, reduce the message across the page to avoid causing user loss, because of repeated page switching by compression and widen of information structure. These are highly desirable, but its disadvantages are also obviously. With a button as an example, designers put each element in the same plane with the removal of the gradient, fillet and shadow. At the same time, without more specific tips, users will be inevitable doubt in interface operation. Whether this is a key or a pattern can be clicked? The flat design advocates to pay great attention to human factors, but it neglects the function, indifference and human caused by reducing the way of image expression.

Development Trend of Interactive Interface

With the development of the information society, flat design is the main development trend of interactive interface for the future. It is the concise and strong indicative interface style, which requires users to have certain cognition for symbols. This cognitive comes from long time living habits and extensive social conventions. However, flat design may not be consistent with the cognition and operation habit. We present some principles for symbol design based on our experimental results, to provide guidance for icon designers.

1. Meeting user psychology. Skeuomorphism design is familiar to some extent, which can guarantee universal cognition "signifier" and "signified". Skeuomorphism design contains information, mode of operation and the results, which conforms to the user's mental model and establishes a broad cognitive for symbol system, to make the interface information be conveyed smoothly among users.

2. Enhancing user experience. Technology is only a mean, and experience is the purpose. From the user aspect, flat design combining with ergonomics, usability engineering, synthetic vision, layout, interaction and operation makes user experience natural and efficient. Flat design has strong generality by cutting out the superfluous, to let users clearly find main functions within small steps.

3. Function over form. In order to the long-term use of software application, flat design is clear, concise, and easy to be operated. It can reduce the length of the page and the page jump, which is convenient for the user to access to information. Flat design is outstanding to pursue the visual effect and not to neglect functions.

4. Consistency of interactive information. Reasonable information architecture, unified icon style, coordinated page jump, and a unified standard of symbolic form in flat design can avoid the various forms of symbolic language in a page. But it may bring confusion and distress to users.

Summary

Symbol style not only is beautiful, but also should have clear functional directivity and symbolic metaphor. And the shape, color and texture of graphic elements in Human-Machine interactive interface should clearly point out its function and interaction to establish the effective information feedback.

Flat design is the inevitable result of symbol evolution based on our experimental results. However, these two typical symbol design always cannot coexist and cannot be replaced by each other. So the flat interface cannot replace skeuomorphism design. Because skeuomorphism design has its advantages and social significance. It is vivid and exquisite, which pays attention to personality and emotion. In the higher digital equipment today, skeuomorphism design can bring the good and unique visual experience for people. But it has more complex specification, which contains a large number of information, and its function is also stronger. Thus, In the process of portability of future systems, flat design is undoubtedly design trend, and skeuomorphism design may be adopted in some places.

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