論文
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Guidelines on Effective Metaphor Construction applied Gestalt Principles Underlying Conceptual Model in User Interface

사용자 인터페이스에서의 개념모델에 근거하여 게스탈트 원리를 활용한 효과적인 메타포 구축을 위한 지침

김성연(Sung-Yeon Kim)[1)]

Abstract

Throughout the history of computer use, the interface metaphor has been employed to make computers easier for humans to use. Even the earliest command line interfaces used metaphor. Metaphors in user interfaces help to make the software accessible to users and allow the users to communicate with the system as well. User interface guidelines for most of the popular operating systems encourage the use of metaphors in interface design. Thus, metaphor in interface design is employed as central element with a long history.

중략

Therefore, this paper will suggest substantiating guidelines which are based on conceptual model and Gestaltprinciples for successful metaphor construction with a better user interface.

요약

컴퓨터 사용의 역사를 보면 인터페이스 메타포는 사람들이 컴퓨터를 더 사용하기 쉽게 만드는데 쓰여왔다. 심지어 초기의 command line 인터페이스에서도 메타포를 사용해 왔었다. 사용자 인터페이스에 있어서 메타포는 사용자들을 시스템에 접근하기 쉽게 만드는 것을 도울 뿐 아니라 사용자들과 시스템과의 연결 통로라고 할 수 있다.

중략

따라서 본 논문은 사용자 인터페이스에 있어서 성공적인 메타포 구축을 위해 conceptual model을 고려하여 Gestalt 원리를 활용한 지침을 제시함으로써 도움을 주고자 한다.

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1) 정회원 : 홍익대학교

1. Introduction

Despite causing many debates in human-computer interaction (HCI), the term ""metaphor"" remains a central element of design practice. There has been a strong interest in developing the user-centered interface. Interface designers have been incorporating metaphors into user interfaces. Therefore, metaphors are very important for software user interfaces. ""An Interface metaphor is a set of user interfacevisuals, actions and procedures that exploit specific knowledge that users already have of other domains. The purpose of the interface metaphor is to give the user instantaneous knowledge about how to interact with the user interface."" [1] They work with users' familiar knowledge to help them understand 'the unfamiliar.' Interface metaphors have been regarded as a user friendly device of the information retrieval systems. Experiences in using the system alter the model, which again serves as guidance for future uses. The model must be metaphor based to explain the system. It makes the user believe, that the system is similar to something the user already knows. So metaphors provide a powerful way to communicate with the user.

With the exponential growth of Internet technology, the notion of users' cognition has gained prominence as navigating such a vast information space. It's suggested that metaphors can serve as effective tools to scaffold users' mental modeling processes. Donald Norman in his book, ""Psychology of Everyday Things,""describes good interfaces as successfully transferring the system designer's model of the system to the user. This can be done with ""metaphor"". Metaphors are the building blocks in the user's mental model of a task. If we think of a metaphor in this way--as a conceptual mapping or model--we see that metaphors play a vital role in interface design. Metaphors are important to software design because they evoke a connection in the user's mind between the functions of the software and the user's knowledge in a natural way.

The most important concepts in defining the form of software's user interface are conceptual models and metaphor. However, there is still a serious lack of comprehension of what they are and how they workinterface designers have been incorporating metaphors into user interfaces. Since there are no reliable methods to design metaphors, some aspects should be taken as guiding principles. I'll explore Gestalt theory for effective interface metaphor with a new index.

First of all, I would like to mention what a UI is and the definition of HCI & Gestalt theory as well. Also, I will describe why metaphor based on conceptual model in user interface design is crucial. I'll then discuss main concepts contributing human factors underlying good metaphor design, which include mental model,conceptual model, and Gestalt theory in HCI. In addition, I'll analyze ITunes, which is applied well by mental model, and Iconic interface metaphor, which is an important part of user interface. Through these analyses, I'll suggest helpful guidelines underlying these factors in designing good UI metaphor.

2. UI

The user interface (or Human Machine Interface) is the aggregate of means by which people－the users－interact with the system－a particular machine, device, computer program or other complex tools. The history of user interfaces can be divided into the following phases according to the dominant type of user interface: Batch interface (1945-1968), Command-line user interface (1969-1980), Graphical user interface (1981 to present). A GUI is a type of computer human interface on a computer. As opposed to traditional interfaces, it presents graphical icons, visual indicators or special graphical elements called "widgets". Often the icons are used in conjunction with text, labels or text navigation to fully represent the information and actions available to a user. [19]

Apple's User Interface Guidelines states"Use concrete metaphors and make them plain, so that users have a set of expectations to apply to computer environments." [3] That's easy to say, but the problem is how designers select a metaphor and how they are convinced that it is appropriate. Now, you should consider cognitive factors in design of good metaphor within UI: Mental model and Conceptual model, and Gestalt theory in HCI.

2-1 HCI and Gestalt Theory

At a conceptual level, a human computer interface is a ""means by which people and computers communicate with each other."" [2] A basic goal of HCI is to improve the interactions between users and computers by making computers more usable and receptive to the user's needs. A long term goal of HCI is to design systems that minimize the barrier between the human's cognitive model of what they want to accomplish and the computer's understanding of the user's task. Human-Computer Interface (HCI) design provides users the simple and clear ways to operate the designed product. Meanwhile, the Gestalttheory can be applied to the instructional design, which can facilitate the ways people perceived and understand the contents. Gestalt (shape, form) is a psychology term which means "Unified Whole". It is the whole design that affects people's perception rather than fragmentary elements in the design. The fundamental idea in Gestalttheory is that people perceive a design according to the context, which is the relationship between contents. The central notion behind Gestalt theory is the idea that we tend to order our experience in a manner that is regular, orderly, symmetric, and simple. The theory is composed of the basic terms－figure and ground, and the six principles－similarity, proximity, continuity, closure, symmetry, and area. There are some ideas in HCI design related closely to Gestalt theory. For instance, the rule of ""Strive for consistency"" in the HCI design can be viewed as the practice of principles of similarity, that elements will be grouped perceptually if they are similar to each other, and continuity which continues to another object. It is suggested that the designer should put the consistent actions together so as to facilitate the ways users understand and operate the designed product. In this way, users can perceive the organized contents as belonging to a group or having relationship with one another, so as to reduce their memory load and enable them

to absorb the information much systematically, efficiently, and effectively. [4]

Besides, the rule of ""Design dialogs to yield closure""can be interpreted as the practice of principles of proximity and closure. The author, Shneiderman, of ""HCI Design"" asserts that ""Sequences of actions shouldbe organized into groups with a beginning, middle, and end."" [5] In this way, users can have a complete recognition of the information, which has relationship among each other and is displayed orderly. The application of proximity, which seesobjects close to each other as forming a group, and closure, which is people's tendency to see complete figures so as to get complete information, will be helpful for users to catch the message of the design much quickly and coherently.

The application of Gestalt Theory can make a designed product more easily, pleasantly, and distinctively be accepted, understood, and adopted by the users because the process of perception is simplified and organized. Besides, people can grab the information more quickly and efficiently since they will not be distracted by messy contents, neither do they need to waste time finding information in a chaos or looking for relationship in the contents. Thus, I'll employ Gestalt principles within HCI to build more effective metaphor based on conceptual model.

3. Conceptual Model

Need to first think about how the system will appear to users. A conceptual model is a high level description of: ""the proposed system in terms of a set of integrated ideas and concepts about what it should do, behave and look like, that will be understandable by the users in the manner intended."" [6] Conceptual model is the form in which capabilities are presented to the user. Users form conceptual model of how a system works based upon their own mental model of the system. This is why in casual conversation people so often personalize the actions of a computer. Let's discuss what conceptual model and mental model are.

3-1 Conceptual Model and Mental Model

The first phase of a user interface design process is the conceptual design that in the user's mental model of the high-level use of the system. The HCI design also includes the ideas of conceptual model the conceptual model helps both designers and users to catch the messages being conveyed as well the organization within the messages at a glance.

The designer analyzes the content to be taught, the task to be performed or the information to be displayed, and defines its structure and functionality. This structure in the designer's mind is called a conceptual model. The user also has a model, a mental model which he has built up according to his experiences. The structure of the mental model corresponds to what it represents, and users acquire their mental models through interaction and explanation. In particular, the user's mental model of a software product, and their interaction with it, is defined by the way in which users perceive the jobs they want to do and how the program helps them to do it. [7, 8]

Most software reflects the implementation model of its design, instead of the user's

goals and the tasks required to accomplish them. However, the user's mental model of a software product is often distinctly different from the software's implementation model because the complexity of the software's implementation can obscure its functionality from the user's perspective. This gives rise to a third model in the digital world: the conceptual model [18]

In the article "Some Observations on Mental Models" Norman distinguishes between mental models and conceptual models: "Conceptual models are devised as tools for the understanding or teaching of physical systems. Mental models are what people really have in their heads and what guides their use of things." Mental models often take into consideration existing conventions that humans commonly use to interpret the world. Ideally, these conventions should be followed in design. In other words, the designer designs a conceptual model into the system in order for it to appear graspable and coherent to the user. [9]

If he or she manages to get the conceptual model right, the correct mental model will follow the user will begin to develop his/her own mental map, based on his experiences. These terms have been usedto refer to the mental model designers intendtheir user to follow when using their product. That is, they reflect the way designers choose to represent the workings of the program to the user. Conceptual design techniques aim to specifically assist a user in understanding a system. User interfaces that are based on the software's conceptual model and assist the user to form a matching mental model make a software product easier to use. [8]

However, if the conceptual model of the system is substantially different from the user's mental model, the user may find the system difficult to use. In other words, if the user's mental model is different from the designer's conceptual model, errors will occur and the user will become confused or frustrated. In designing a conceptual model, the closer your design matches familiar situations, the easier your system will be to use. Always keep in mind when making design decisions how the user will understand and remember the underlying conceptual model.

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3-2 Designers' model vs. User's model

The interface components and relationships intended to be seen by users and intended to become part of each user's conceptual model are described in the designer's model. This model represents the designer's intent in terms of components users will see and how they will use the components to accomplish their tasks. The designer's model identifies objects, how those objects are represented to users, and how users interact with those objects. More recently, the object model is the main component of the designer's model in an object-oriented user interface. The "look and feel" aspects play a supporting role.

By relying on a few basic classes and relationships, the designer's model should be easy for users to learn and understand with well-defined distinctions based on user task needs. For the designer's model to be consistent with the user's conceptual model, the designer must know the users, their tasks, and their expectations. If the designer's model closely matches a user's conceptual model, the user should learn quickly and apply knowledge correctly in new situations. In other words, the user will

feel the interface is intuitive. Designers can help users to develop a closely matching conceptual model by creating a clear and concise designer's model. And, a designer's model is clear and concise when it has made a minimum number of distinctions among objectsthe distinctions are clear and useful to users, and they are consistently conveyed throughout the interface.

In summary, the designer's model is the model of objects, properties, behaviors, and relationships that the designer intends the user to understand. The designer's goal is that each user's conceptual model exactly matches the designer's model. Users who perceive the interface at this level have a precise understanding of the interface and can take full advantage of the capabilities intended by the design.

3-3 iTunes and Gestalt theory

As I described above, the user already has a mental model that describes the task your software is enabling. This model arises from a combination of real-world experiences, experience with other software, and with computers in general. Based on this, the user has a conceptual model of this task that includes certain expectations. A good example of how reflecting the appropriate mental model results in a clean, intuitive user interface is the iTunes application the world's largest and helped sales of its Macintosh computer range

Before you design application's user interfaceas a designer, try to discover your users' mental model of the task your application helps them perform. Apple designed iTunes to reflect the mental models that people associate with playing music and managing their music collections. For example, in an uncluttered window, iTunes displays individual songs, playlists, and playback and search controls in a song-centric arrangement. The largest pane displays a list of songs, which clearly sort by categories such as title, artist, and album. The smaller pane displays the playlists and collections, which control the list of songs currently displayed, just as the disk and folder icons in the Finder sidebar control the display of files, folders, and applications. The prominent playback controls look like similar controls on radios, CD players, and the iPod. The search field is identical to the search field in Finder, Mail, and countless other Aqua-compliant applications. Because the iTunes user interface reflects a well-defined mental model, instead of forcing users to adopt unfamiliar concepts, even novice users find iTunes intuitive and easy to use it correctly matches designer's conceptual model.

The mental model the users have should infuse the design of the application's user interface. It should inform the layout of your application's windows, the selection and organization of icons and controls in the toolbars, and the functionality of panels. In addition, you should support the user's mental model by striving to incorporate the following principles: One is the law of Familiarity. The user's mental model is based primarily on experience. As described above, the iTunes application displays playback controls that use well-known symbols users associate with play, pause, and rewind. A Mac OS X user automatically knows how to use such standard user interface elements, regardless of the application in which they appear. The other is simplicity. In the iTunes

application, for example, the basic task components of playing songs, selecting playlists, and searching are prominently featured. However, these are supplemented by easily accessible menu items and controls that perform additional tasks, such as ejecting a disk, shuffling a playlist, and displaying song artwork. [10]

Simplicity also correlates with familiaritysince things that are familiar often seem simpler. Whenever possible, one should try to build connections that draw on the users' existing knowledge and experiences. These come from the Gestalt theory, which is a way to visually connect information, by using the laws of proximity, closure, similarity and good continuation. These show how similar objects close to each other are perceived to be connected and can thereby be seen as a group. Providing actions that match interpretations and making outcomes of a system obvious makes it clear what is possible to do. Thus, system that provides affordancecorrelating with conceptual model allows users to know how different aspects of it should be used. [11]

4. Metaphor

Metaphors are used as models, which is a way of describing how the system works. The employment of metaphors for user interfaces is a well-tested method for user interface design. One of the first commercial graphical user interfaces, the XEROX STAR, introduced the well-known desktop metaphor (12) that almost became a dogma for user interface designs.

The use of metaphors is widespread. Often people do not notice that they are communicating through metaphors in their natural language. These unnoticed metaphors might be the best ones, because they are obviously understandable.

Finding good metaphors is an essential part of the design process. The effects of metaphors on learning have been proved by many studies. Take advantage of people's knowledge of the world by using metaphors to convey concepts and features of your application. Use metaphors that represent concrete, familiar ideas, and make the metaphors obvious, so that users can apply a set of expectations to the computer environment.

Since metaphors function by providing familiar concepts that help learners to construct new knowledge, metaphors' effects may be more apparent to novice learners: As a good metaphor example, there is iTunes playlists which represent real-world music playlists. A good metaphor makes it much easier to anticipate actions.

Metaphors are the result of our embodied human experience. As such, they remain a vital, internalized means of structuring our understanding of a system. And so we see that metaphors play a vital role in how we understand the world. These metaphorsshape the design of system, and they are the medium of communicating that system to users.

4-1 The Gestalt Metaphor

Human beings do not simply choose to use metaphor but do it naturally, and perhaps they must in order to reason and learn. At the core ofthe metaphor is recognition and categorization. This is the revelation of Gestalt psychology. The Gestalt view presents metaphor as a complex combination

of ideas that becomesone new idea through a process of mixing and deleting. Metaphor operates as a combination of the words and the ideas behind the words coming together in new relationships. The use of metaphor promotes the transfer of understanding in one field to another based on the belief that they are similar. This is the value of analogy, borrowing a notion from one place and applying it in another. But we must be constantly aware that our analogies, constructions, and views of reality are unique and personal. Cognitive style is a crucial factor that can significantly affect users' learning performance.

The Gestalt Principle states that people use a top-down approach to organizing data. This principle can influence how one should organize graphical information on the screen. The Gestalt school of GUI designers has attempted to identify criteria that cause people to group certain items together in a display. Proper grouping results in a necessary redundancy of selection information that aids the user. For example, if users know where one item in a group is on a screen, they will expect other like items to be there also. If one groups the items in line with this expectation, it allows for accurate locating and better transfer of information to the user. The top-down approach also allows for the development of emergent features. An emergent feature is a global property of a set that is not evident when one views each item locally. Since global processing tends to be automatic, one can argue that an emerged feature reduces the attention demand as a user operates a multi-element display. For this performance enhancement, one must use the Gestalt Principle in the initial placement, and the resulting organization must be compatible with the user's cognitive view of the task [13, 14]

4-2 icon metaphor

Understanding how users process the information available to them through the computer interface can greatly enhance the abilities to design usable systems. That is the effect of interface style on user performance, knowledge acquisition and conceptual model development. Closely associated with the idea of a visual metaphor is a conceptual model that helps interpret what is shown in a graph. A visual metaphor could improve the quality of mental formation. In web environment, we accept most of useful information visually. Icon is a channel, which people explore information through, and they need icon design to deliver information clearly and quickly to users whoaccept information visually. Especially, the icons used in the various windows interfaces use metaphors to suggest the function of the tools behind the icon.

Studies on icon have been carried out vigorously according to system environment, styles and characteristics of users. Icons are used extensively for communication purposes. The term icon has been adapted from its Russian origins -'ikon' meaning a religious painting or statue. Within the context of computing the word is used to refer to a small image which embeds 'meaning'. More specifically, an icon is a symbol or graphic representation of a program, resource, state, option or window. As such, icons form an important part of graphical user interfaces. [15] Icons used in such interfaces are usually (but not always) 'reactive' - that is,

they can be used to initiate various types of process when selected by a user.

A good GUI would use a lot of icons. However, the level of communicativeness of an icon can also cause problems in iconic interfaces. [16, 17] In particular, when low or poor use is made of interface metaphors, icons can be severely restricted in their ability to transmit their meaning, and thereby their function to users. In other words, even after recognition of the pictorial representation, the meaning within the context of the interface still needs to be recognized. So, if users fail to understand the implications of the metaphor, then it is of no value. This becomes particularly critical in iconic interfaces where it is even more difficult to identify a useful metaphor. Besides, too many randomly placed icons violate the limits of absolute memory. As I mentioned by using the Gestalt Principle one can group like items together using factors like color to add more informational dimensions. The user then begins to concentrates on the GUI. One can derive basis GUI standards from basic human factors. These standards are the presentation of information, the grouping of information, and information sequencing. Proper grouping improves the information's readability and can highlight relationships between the information. [13] In addition, the similarity between function and elements of design increases the level of recognition of metaphor icon proportionally.

The interface that is derived from a metaphor must be a suitable one for the target end-user population that is to use it. Due to the technological improvements that have taken place in computer hardware and software over the last few years the use of icons within graphical user interfaces has become extremely popular. If an icon is highly communicative, it is much more likely to be easy to learn.

5. Conclusion

Metaphors are always part of user interface design. The best approach for developing a metaphor is to collaborate with prospective users--a metaphor, after all, is a tool to link your product to the user's mental model. Thus, I discussed how user interfaces that are based on the conceptual model and assist the user to form a matching mental model, make metaphor easier to use. Besides, since there are no reliable guidelines to design metaphor, I believe that Gestalt theory should be taken as guiding principles because the heart of a metaphor is recognition and categorization: Gestalt principles guide how one should organize and identify criteria that cause people to group certain objects. Proper grouping, which results in organization and simplification, must be compatible with the user's cognitive factor. For designing good metaphor, I employed Gestalt principles as an index under HCI theory, as I described: Similarity, Continuity, Proximity, Closure, Simplicity, and Familiarity. Despite correlating with each other, these principles can provide effective metaphor by matching user's conceptual model and by perceiving quickly and easily the meaning as a group.

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약력 및 관심분야

1996. 뉴욕대학교 (NYU) Mass Media Communications 졸

1998. 뉴욕대학교 동 대학원 Graphic Communications Management & Technology 석사

1998-2000. 신성산업 디자인 팀장

1999. 인덕대학 멀티미디어과 강사

2000~2003. 용인송담대학 멀티미디어과 전임강사

2005. 뉴욕대학교 Interactive Telecommunications program (ITP) 석사

2006~현재. 신성산업 디자인 고문

2007~현재. 홍익대학교 영상대학원 겸임교수

관심분야: IT 분야