

Conference Paper

A Study of the Application of Design By Metaphors to the User Interface of Smartphones

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Abstract

The purpose of this study is to integrate user experiences, semiology, and the design by metaphors into user interfaces by experiments. Designs by metaphors are effectively integrated into the user interface of photo retouching apps on smartphones. Problems with the usage of the original interface can be resolved and the quality of product design can be improved. Current photo retouching apps usually come with a complicated user interface that makes users difficult to figure out a straightforward way of using the apps. Users might have less confidence in using the apps and their willingness of using is greatly reduced. The emerging trend of design by metaphors in recent years has resolved the issues that complicate user perception. It also helps designers simplify complicated user interfaces due to the requirement of multiple functions. An effective approach is proposed in this study to help designers create new user interfaces for photo retouching apps by using signs to simplify operation instructions. The resulting visual designs allow users to associate operations with something they are familiar with so that they can comprehend product functions in an effective way. The resulting design is clear at a glance so that users no longer make unintended uses. Moreover, the experiments in study opened a new horizon for the application of design by metaphors to user interfaces. This approach makes designers value product semantics more. As a result, people can enjoy their life in a more convenient and comfortable way.

Keywords: photo retouching app for smartphones, design by metaphors, operational semantics, semiology, user experience

1. Introduction

In recent years, the population of smartphone users has been greatly increased. Due to the diversity of smartphone functions, many people put a higher standard on the fluent usage of a smartphone, apps, and accessories. Smartphone vendors create additional functions for their smartphones by a variety of apps so that a user can play

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a smartphone in his/her unique way. For modern designers during the 3rd industrial revolution, it is important to emphasize emotional effects. In addition to understanding the functions that are provided by a product, consumers consider a purchase by experiencing the interaction with a product instead of judging from product appearance. As a result, the concept of design by metaphors has been attracting the attention since consumers can generate the sense of recognition for the product itself. Moreover, signs can also reveal the meaning of a product. Due to the enhancing standard of living, people have a higher standard for product designs. The functions provided by a product could be numerous and very complicated. A designer must provide his/her users with a clear guidance. Design by metaphors has been proven to be an effective approach to organize user perceptions and guide users when using a product.

Nowadays, a product needs to not only comply with safety standards and practical requirements, but also satisfy users with the feeling of comfort or aesthetics at the sensory level. Modern smartphones provide a variety of apps and functions in order to satisfy various demands required by users. A user might need spend much time playing with the app by his/her own until he/she is familiar with the operations. This phenomenon indicates the insufficiency of the app's product semantics to convey its functions so that it doesn't provide users with a clear hint of operations.

In order to guide users through app operations precisely on a smartphone with no misplay, the design by metaphors is used in this study in combination with semiology so that app panels can be simplified without losing its functionality. The benefit of this approach is to provide an effective guidance during app operations by considering user motivation, objective, and usage requirements. It allows users to avoid problems such as bad intuitive practice of using an app.

The objective of this study is to help users investigate his/her problems in various ways via user experiences. The intention is to help users understand his/her undesirable problems from a user's standpoint when facing same problems, similar scenarios and is taking same actions. The CK theory and KJ method are used to determine the undesirable problems. A new design approach by metaphors that complies with a user's usual practice is proposed in this study via the theory of style, color, texture, and material. It is expected to avoid a user's undesirable problems with an app's interface by the application of new design approaches so that an app interface is simplified and more artistic.

2. Literature Review

Earlier studies that are related to this research process are reviewed and the essence is summarized into figures and tables for explanation. The first stage deals with the review of literature that is related to semiology and product semantics. The second stage is to review photo retouching apps for smartphones. The available photo retouching apps are classified and the icons of each function and the semantics for each icon are reviewed. The third stage deals with the investigation of relevant technologies such as thinking by associations, operational semantics, and image recognition. After that, the common problems that most people encounter when using an app are investigated. The icons that are designed by metaphors are further analyzed and assessed. The fourth stage is to investigate the current market status and to analyze the functions and icons of the photo retouching apps that are available on the market.

The primary objective of this study is to integrate the research theory into the implementations during manufacturing process via the investigation of the intuitive operations of apps on a smartphone, user habits, usage and analysis of modern technologies, and market analysis.

2.1. Review of literature that is related to semiology and product semantics

It is sometimes called semantics and mainly deals with the dissection and analysis of the signifier and signified relationship of a sign. It was first proposed by American semiology scholar C.P. Peirce who proposed his study of signs. This school of scholars proposed that the study of semantics should be emphasized under the premise that a sign is constructed but cannot be observed. They prefer to investigate the way of referring with more efforts. In other words, semiology deals with the theory that concerns with the way of referring. Their field of research deals with a variety of contexts for the implementation of referring.

Widely considered the founder of modern linguistics, Swiss scholar Saussure (1916) extended the research field of linguistics into semiology. He proposed that signs are the fundamental unit of language and a language is the aggregation of signs. He classified signs into two levels including the signifier and the signified. A signifier indicates the external embodied image of a sign with direct impression. A signified indicates the extended meaning of a sign while the external image is not able to phrase its implication alone as shown in Figure 1.

The semiology proposed by Peirce as a philosopher is to investigate the awareness and experiences. He proposed that every thinking and experience of people is the activity of signs. His theory is to investigate the relationship between a sign and its targets. A sign can be classified into three categories including icon, index, and symbol. A product is equipped with its symbolic meaning and is convincing if it is designed by the theory of signs since a consumer can perceive its design value via the product itself.

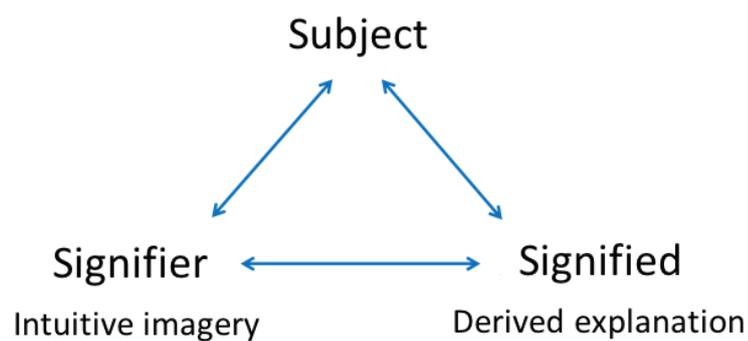


Figure 1: Theory of signs by Saussure.

2.2. Design by metaphors

The theory of semantics is a branch of semiology and a new term “product semantics” is derived when it is introduced into product designs. Product semantics stress the importance of allowing interactions and communication between a product and its users. The product’s own meaning is conveyed by its style and an interface that is easy to understand and convenient to operate can be built by analogy, allegory, and implied meaning. This approach allowed users to understand the embodied functions and implications that a designer is trying to convey via his/her design. Therefore, signs, carriers, meanings, propagation, and communication have become the keywords for product design.

Design by metaphors is one of the commonly used design approaches. It helps a designer to allow his/her users to comprehend, understand, and experience unknown things or something they are not familiar with via the objects that they are familiar with. The visual connection between a product and people’s daily life can be built by metaphor, simile, analogy, and allegory so that the misjudge of a product by a user can be reduced.

Shannon & Weaver (1949) and Barnard (1968) proposed five elements of communication including (a) sender, (b) receiver, (c) message, (d) media, and (e) feedback. The communication process is accomplished by encoding and decoding operations. Among these communication elements, the sender and receiver are affected by their professional background, believe, experience, and attitude so that they might comprehend the message in a different way. A communication message might contain texts, figures, or symbols. The communication media include face-to-face communication, documents, phone calls, and E-mails. Since a message is conveyed to the receiver by media, the type of message depends very much on the media. An adequate way of expressing the message during the communication process also affects the delivery of the message.

Chiu (1996) simplified the process of design communication. In general, a designer convey messages to the receiver via media or channels and the receiver sends feedbacks to the sender via the media.

2.3. Design by subtraction

Ludwig Miesvan der Rohe(1928) proposed the concept of “less is more”. His concept of reducing excessive decorations and unnecessary designs is worthy of thinking. The subtraction design approach gradually removes those product functions that are not really needed by users while only those required are kept. Design by subtraction includes approaches such as slashing, excavating, blanking, concealing, and simplifying. Simplicity in designs can sometimes present more and the philosophy of design by subtraction is to make a product simple, easy to use, and readily available.

2.4. CK theory

As the term reveals, the CK theory is divided into two separate blocks including concept and knowledge. In addition to the logic inference approaches, the objective of the CK theory is to utilize simple and effective models. From the aspect of concept, it is required to extend the number of concepts. On the other hand, the aspect of knowledge deals with the common knowledge that is known to average people. The objective is to generate unique ideas and concepts from average knowledge so that innovative designs can be created as shown in Figure 2.

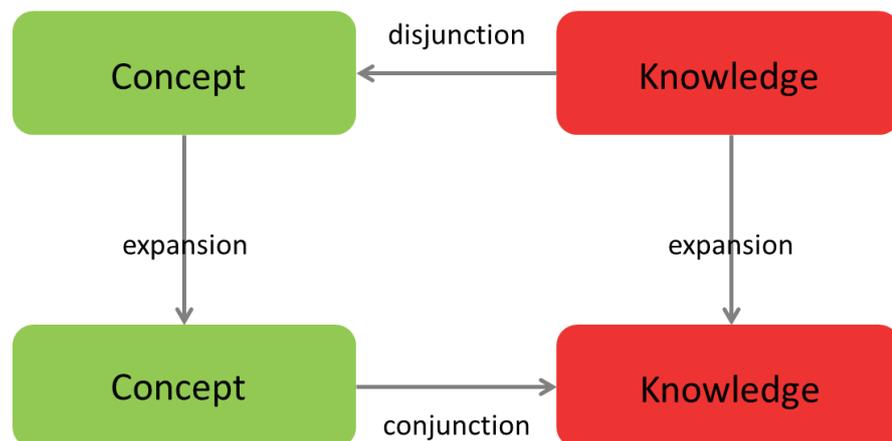


Figure 2: CK theory.

2.5. KJ method

The oral or literal data of relevant facts, opinions, or thinking that arise from the problem from unknown or untouched fields are collected. The internal correlation is determined in order to classify and merge the data into figures. The purpose is to arrange a way of thinking from complicated phenomenon so that the substantial problems can be determined in order to find the solutions to problems. The tool used by the KJ method is the affinity diagram, which classifies and summaries the relationship between a large amount of facts, opinions, ideas, or experiences surrounding a specific topic. The purpose of the affinity diagram is to classify and arrange the correlation between different opinions, ideas, and experiences from different people so that a designer can think outside the box for creative thinking. Different designers are allowed to take collaborative actions in order to find a solution to an existing problem.

3. Methods

New functions icons are created for the photo retouching apps on smartphones by the application of semiology. The interface can be improved by the design of signs and semantics so that the participants' perception of new signs that are conveyed by the icons can be investigated. By trial and error, the participants are allowed to experience operating an oven via their interactions with a combination of new interfaces with new signs. A questionnaire survey was carried out on a number of average people in order to determine the intuitive meanings of signs that are perceived by them. After collecting the resulting data, the CK theory and the KJ method are implemented for analyzing their operational problems in order to obtained more adequate designs by

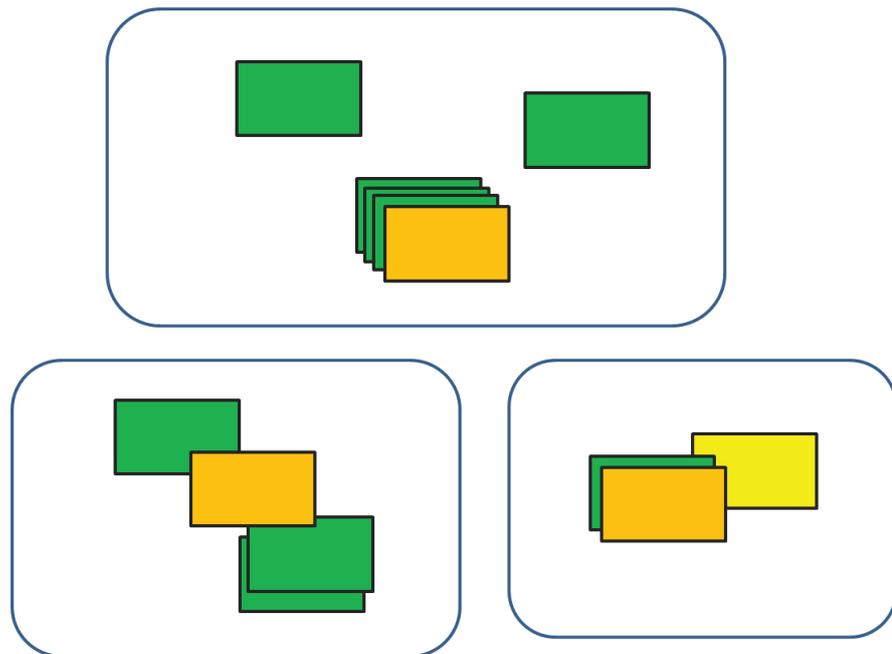


Figure 3: Classification by the KJ method.

metaphors. After considering the above problems and modern trends, the resulting research framework is shown in Figure 4 as follows.

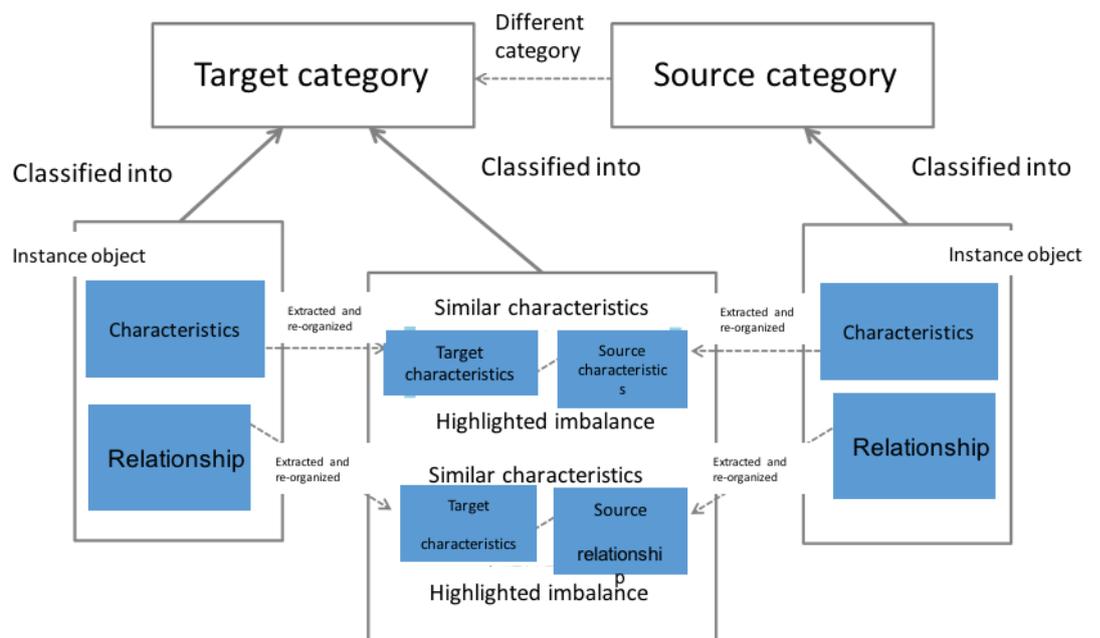


Figure 4: Research framework of design by metaphors.

When a sign is used to represent a group of objects that have common features, it is called a concept (Chung, 1990). The formation of a concept is based on the human capability of abstracting objects. It is an activity that is similar to classification or archiving and is carried out continuously and autonomously as shown in Figure 5. Similarities

are extracted from people's experience via this type of approach so that a design can be renewed by generating connections between existing objects and new objects. When a common concept is generated, its representative signs can be accepted by the public.

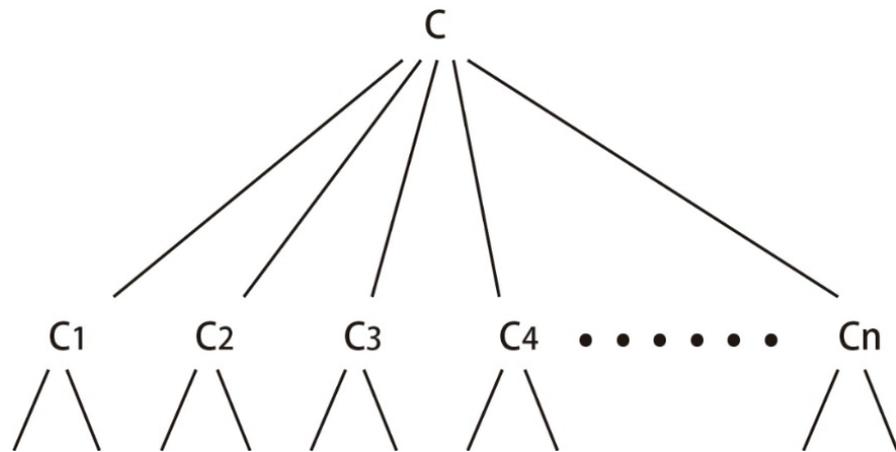


Figure 5: Extraction of concepts and common similarities (Chung, 1990).

4. Results

The existing icons of photo retouching apps that are available on the Internet serve as the control group in the experiment. The experimental group includes newly designed icons by the researchers. The experiment includes three stages which are respectively data collection and integration, intuition test, and data analysis with redesigns. The icons of the experimental group are compared with those of the control group during each stage as described below. The participants' responses are collected from a questionnaire survey in order to determine the effect of the new design approach that is proposed by this study.

4.1. Data collection and integration

The icons of existing apps such as Instagram and Candy Camera are collected for the investigation in this study as shown in Table 1.

4.2. Intuition test on participants

A total of 85 college students are randomly selected for the questionnaire survey of the intuition test in this study. There are 25 males and 60 females who participated the

TABLE 1: Icons of existing apps.



experiment. The average age bracket of the participants is 19-24 years old. All of the participants have more than 1 year of experience with photo retouching apps. More than half of the participants have experienced misleading icons with the existing apps.

After icons are collected from existing apps, participants are asked to carry out the intuition test by Google Sheets which contains these sample icons. The questionnaire survey is carried out anonymously. The purpose is to determine whether participants of different age brackets have consistent perception of the icons or if these icons could be misleading for them. The intuition test is carried out by Google questionnaire and the exiting icons are classified into several blocks for evaluation. The order of icons for the intuition test is shown in Figure 6. The participants are asked to carry out this test on existing icons and the redesigned ones in order to determine whether their perception difference is reduced for the redesigned icons.

4.3. Data analysis with redesigns

After the first stage of questionnaire survey, researchers redesigned the icons based on the participants’ responses from the first stage of questionnaire. The resulting icons after redesign by metaphors are shown in Figure 7 as follows.

A total of 166 participants including 40 males and 126 females are invited to carry out the second stage of questionnaire survey. The percentage of correct answers for icon Saturation in the first stage is 27.1% and it is improved to 44.8% in the second



Figure 6: The order of icons for the intuition test.

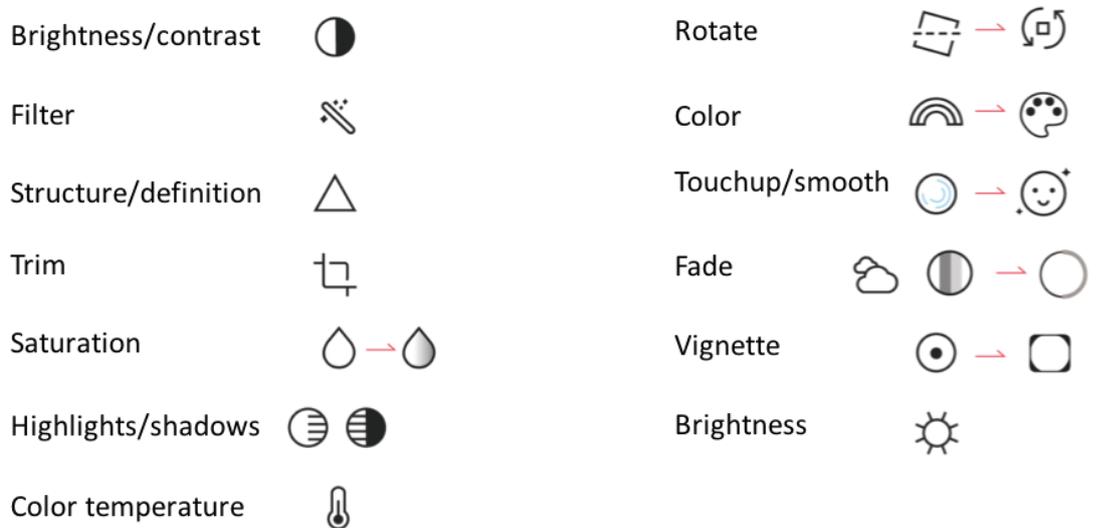


Figure 7: New icons after redesign by metaphors.

stage. Similarly, the percentage is increased from 43.5% to 94.5% for icon Rotate, 44.7% to 90.3% for icon Color, 37.3% to 82.4% for icon Touchup, 27.1% to 41.8% for icon Fade, and 7.1% to 85.5% for icon Vignette. The results indicated that the proposed approach of design by metaphors did successfully guide the participants through intuitive operations.

5. Discussion

New icons are created in this study via the integration of design by metaphors and the classification of users' usual practices. The data that is obtained from the experiment in this study is analyzed and assessed by Google Sheets in order to evaluate the

mental and intuitive responses of participants. The results indicated that over a half of the participants had the experience of undesirable operations when using an app interface intuitively. There is a divide on the perception of functional icons so that the participants developed a habit of relying on text descriptions in Chinese/English for operations. For follow-up studies, more photo retouching apps can be included into investigation by comparing their popularity and determine which apps are used widely in order to enhance the research credibility. Moreover, ten of the commonly used apps on the market are selected for experiment. However, the user group of these ten apps are dominated by females. Therefore, follow-up studies are advised to consider other apps which have more balanced gender usage in order to avoid gender difference. For the preparation of functional icons, Adobe Illustrator is used to analyze and prepare new icons. However, some function icons are not intuitively recognized by more than half of the users. This could be due to the fact that the influence of the function on the usage scenario and perception difference is not fully clarified. Therefore, researchers are advised to include more participants of different combinations of age bracket, gender, operating environment, and usage purpose. On the other hand, the photo retouching apps are of single purpose in this study. Follow-up studies are advised to include other apps of different purposes so that functional icons can be designed by metaphors and the resulting photo retouching apps will look very different from those that are available on the market. The credibility of the experimental results can be further enhanced.

6. Conclusion

The most important finding of the research is described as follows. (1) Via data collection and analysis, the design by metaphors can effectively summarize perception differences and reduce the possibility. The approach that is proposed in this study serves as a good reference for follow-up studies by vendors or investigators. (2) After being summarized and analyzed by the CK approach and the KJ method, photo retouching apps have been improved and the participants are able to pick the correct answers intuitively. The finding of this study indicated that the design by metaphors and the semiology being summarized can effectively reduce the participants' rate of undesirable operations. Their intuitive feeling of comfort is enhanced and the improvement does enhance the participants' mental and physical comfort. (3) The finding also indicated that the accuracy of using the correct icons in a photo retouching app is enhanced. This is due to the fact that most photo retouching apps on the market

provide users with a brief description for each functions. As a result, the effect of the improved new functional icons is better highlighted. A participant's interest of using an app is greatly enhanced since this approach allows users to run an app in a more accurate and fluent way.

References

- [1] Shannon, C.E., & Weaver, W. (1949). *The mathematical theory of communication*. Urbana: University of Illinois Press.
- [2] Barnard, C. (1968). *The Functions of the Executive*. (pp. 40-61). Cambridge: Harvard University Press.
- [3] Chiu, M.L.(1996). Architectural design and collaborations under distributed environment: The communication and management of cross-sectional and three dimensional drawings of floors and spaces of an entire building. *Journal of Architecture*,17,5-49.
- [4] Wang, H.H. (2012). *Design by metaphors*, Sunggood Books, Co. Ltd.
- [5] Hekkert, P.&Cila, N. (2015). Handle with care! Why and how designers make use of product metaphors. *Design Studies*, 40, 196-217.
- [6] Samur, D., Lai, V.T., Hagoort, P., &Willems,R.M. (2015). Emotional Context Modulates Embodied Metaphor. *Comprehension. Neuropsychologia*, 78, 108-114.
- [7] Chung, W.J. (2015). Theoretical Structure of Metaphors in Emotional Design. *Procedia Manufacturing*, 3, 2231-2237.