

# USAGE IMAGE STUDY ON THE WAYS OF TAKING PHOTOS BY USING THE NAVIGATION KEYS OF THE CAMERA PHONES

Yung-chin Tsao<sup>1</sup>, Shaio-Chung Chan<sup>2</sup> and Yu-Huan Lin<sup>1</sup>

<sup>1</sup>Department of Industrial Design, Tatung University, Taipei, Taiwan, [tsao@ttu.edu.tw](mailto:tsao@ttu.edu.tw)

<sup>2</sup>Department of Visual Communication Design, Chungyu Institute of Technology, Keelung, Taiwan, [jchan@cit.edu.tw](mailto:jchan@cit.edu.tw)

## ABSTRACT:

The objective of this study is to investigate the usage images on the ways of taking photos and zooming by using the navigation keys on the camera phones. In this study, experiments on the usage image testing are conducted to compose the usage image structures, corresponding relations between the usage image and design characters of the samples are discussed and usage images which mostly affect the overall evaluation of “User Friendly – Non User Friendly” are investigated by employing the method of Multiple Regression Analysis. It is hoped that the approaches and results of this study may help the product designers to establish the contexts of usage images for using camera phones and to identify the design characters of the navigation keys corresponding to the usage images and the overall evaluation of “User Friendly”.

Keywords: KANSEI engineering, use behaviors, user friendly design

## 1. INTRODUCTION

According to a global marketing research, done by ABI Research Institute in U.S.A., mobile phones with built-in mega-pixel camera will take up more than 56% of the market share worldwide in the year of 2008. It is estimated that mobile phones with built-in camera will dominate the market in the future. With the development of ubiquitous computing, users can easily access information through networks, upload or download files and enjoy the multimedia programs provided by the system through high-speed data transmission.

From a designer's point of view, to diversify the mobile phone designs to meet different customers' needs is an important task. However, more attentions should be paid on the interface design, including the software and hardware, and to find out how users "look-and-feel" the products.

A previous study on the usage images of the directional keypads and joysticks of mobile phones showed that the ways of manipulating navigation keys will be changed when the users taking photos and zooming in/out the lens (Tsao, Chan and Ho 2006). Therefore, the objective of this study is to investigate the usage images on the ways of using the navigation keys for zooming and photo-taking.

## 2. METHODOLOGY

The research can be divided into four stages. At the first stage, a market survey on camera phones was conducted to classify the design characters of the navigation keys and representative samples for each category will be selected. The second stage is to select the adverbial descriptions which are most suitable in describing the way of using the navigation keys for zooming and photo-taking. Experiments are conducted at the third stage to investigate the usage images on the ways of using the navigation keys for zooming and photos-taking. Usage image structures will be constructed and image spaces will be established by adopting the methods of Principle Component Analysis and Cluster Analysis. Corresponding relations between usage images and the design characters of the representative samples are also discussed at this stage.

A Regression Analysis will be employed at the final stage to find out how an overall evaluation, “User Friendly – Non User Friendly”, is affected by the usage images.

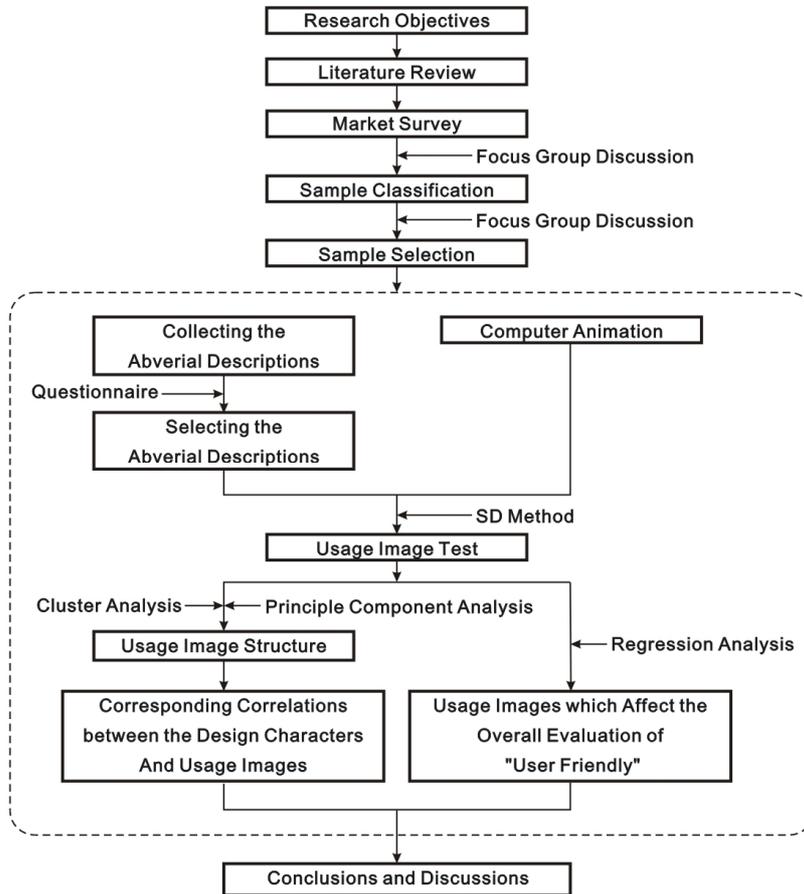


Fig 2-1 The research flowchart

### 3. LITERATURE REVIEW

Kansei engineering is the technique to translate consumer’s feeling and image about a product into design properties (Nagamachi, 1995). Developed by Prof. Nagamachi in 1970s, this technique has been successfully applied in many fields such as automobile, cosmetics, interior and landscape designs since then (Nagamachi, 2002). Most of the kansei studies are focused on the impressions built from human senses of sight, hearing, feeling, smell or even taste. However, to a certain degree, users’ behaviors, use experience, cultural background and their kansei to motions are also influenced by the usage situations and the ways of operation. Boulding K. (in Rapoport, 1977) claimed that all behaviors were related to their images. In fact, the usage of

device was depended on the messages conveyed by its appearance. In his research on performance and shape of adverbial image with the sitting method of chair, Tsao (1996) proved that there was a close relationship between design characters and adverbial image of sitting behavior. Furthermore, Tsao (1998) described such operational action associated from the design characters as the usage image.

For the use of mobile phone, Chen (2002) pointed out that mobile phone is considered as the most used consumer electronics products in the world. With the compact size but enormous functions embedded, usability has become a critical issue for mobile phone design. The design of navigation key is one of the key factors that influences the way of operating.

Konrad & Bruce (2000) also indicated that one key for one function has become in feasible since the multiple functions required for consumer electronics products. Organizing functions in a hierarchy menu and browsing by navigation keys might help to reduce the number of keypads. However, study on the interaction between the software and hardware has become an important issue for designers (Liu, 2000).

## 4. USAGE IMAGE INVESTIGATION

### 4. 1. SELECTING THE REPRESENTATIVE SAMPLES

50 mobile phones with built-in camera are collected from market survey. A focus group with design background is invited to classify those samples according their design characters. The criteria for classification are based on the overall shape and profiles of the operational zone (see Fig 4-1).

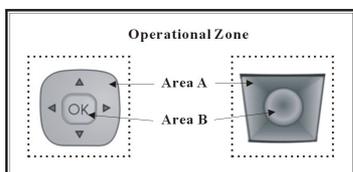
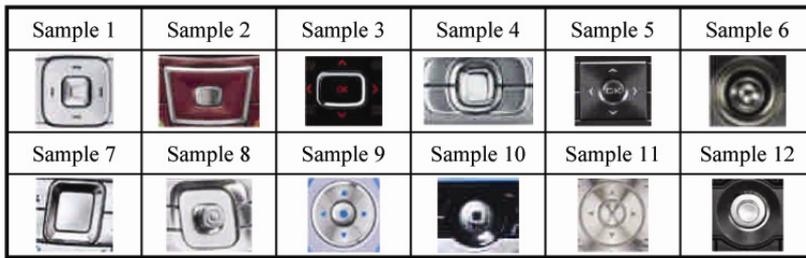


Fig 4-1 Classification criteria of the operational zone

Samples are classified into 12 categories and, for each category, one representative sample is selected by the focus group (see Table 4-1).

Table 4-1 Illustration of the 12 representative samples



## 4.2. COLLECTING THE ADVERBIAL DESCRIPTIONS

Referring to related literatures and previous studies on usage image, 100 adverbial descriptions are collected. 30 respondents are asked to tick from those descriptions which are the most suitable in describing the way of using the navigation keys for zooming and photo-taking.

11 most ticked adverbial descriptions with most ticked times and their opposite descriptions are added as word-pairs for follow-up study. An overall evaluation, “User Friendly – Non User Friendly”, is also added as the 12<sup>th</sup> word-pair in order to investigate how this overall evaluation is affected by those adverbial descriptions. 12 sets of word-pairs are listed in Table 4-2.

Table 4-2 Twelve pairs of adverbial description

Readily - Awkwardly	Speedily - Slowly	Conveniently - Troublesomely
Skillfully - Unfamiliarly	Elegantly - Rudely	Flexibly - Clumsily
Simply - Complicatedly	Clearly - Ambiguously	Decisively - Hesitantly
Effortlessly - Laboriously	Precisely - Roughly	User Friendly – Not User Friendly

## 4. 3. INVESTIGATION ON THE USAGE IMAGE STRUCTURE

Based on the previous studies, experiments are conducted to investigate the usage image structure on the ways of using the navigation keys for zooming and photo-taking. 25 students from Tatung University participated in this experiment. In the first section of the experiment, the respondents are asked to view one computer animation, which shows how user manipulates the navigation keys to zoom in and zoom out the lens. Then, the respondents are asked to evaluate the representative samples regarding to the adverbial descriptions by using a 7-scale SD method. For the second section of the experiment, the respondents are asked to view another computer animation, which shows how user manipulates the navigation keys to take pictures. The

evaluations on usage images are also recorded. The average score is analyzed by using the method of Principal Component Analysis.

For the usage image structure of taking photos (see Table 4-3), the result of the Principal Component Analysis indicates that the usage image structure is composed of three factors: the first factor, composed of the “Flexibly - Clumsily”, “Speedily - Slowly” and “Conveniently - Troublesomely” images, is referred to the context of “Usability” and can be explained as the “Easily - Difficultly” image; the second factor, composed of “Clearly - Ambiguously “ and “Decisively - Hesitatingly” images, is referred to the context of “Comprehensiveness” and can be explained as the “Intuitively - Dubiously “ image; and the third factor, composed of the “Precisely - Roughly” and “Elegantly - Rudely ” images, is referred to the context of “Handling” and can be explained as the “Delicately – Straightforwardly” image.

Table 4-3 The usage image structure for photo-taking

Adverbial Images	Factor 1	Factor 2	Factor 3
Flexibly -- Clumsily	0.942	0.257	
Speedily -- Slowly	0.935	0.258	0.104
Conveniently -- Troublesomely	0.899	0.306	
Readily -- Awkwardly	0.892	0.368	0.127
Skillfully -- Unfamiliarily	0.834	0.470	-0.133
Simply -- Complicatedly	0.811	0.550	
Clearly -- Ambiguously	0.311	0.935	0.128
Decisively -- Hesitantly	0.378	0.901	0.126
Effortlessly -- Laboriously	0.412	0.788	0.413
Precisely -- Roughly	-0.163	0.250	0.930
Elegantly -- Rudely	0.596		0.745
Eigenvalues	5.510	3.257	1.686
Pct. Of Variance	50.095	29.608	15.329
Cumulated Pct. Of Variance (%)	50.095	79.704	95.032

Rotation Sums of Squared Loadings

Table 4-4 The usage image structure for zooming in/out

Adverbial Images	Factor 1	Factor 2
Clearly -- Ambiguously	0.956	0.190
Effortlessly -- Laboriously	0.932	0.232
Decisively -- Hesitantly	0.912	0.242
Skillfully -- Unfamiliarily	0.778	0.436
Precisely -- Roughly	0.764	0.508
Flexibly -- Clumsily	0.174	0.938
Simply -- Complicatedly	0.174	0.938
Speedily -- Slowly	0.345	0.893
Readily -- Awkwardly	0.510	0.803
Conveniently -- Troublesomely	0.635	0.693
Elegantly -- Rudely	0.569	0.661
Eigenvalues	4.969	4.715
Pct. Of Variance	45.173	42.865
Cumulated Pct. Of Variance (%)	45.173	88.038

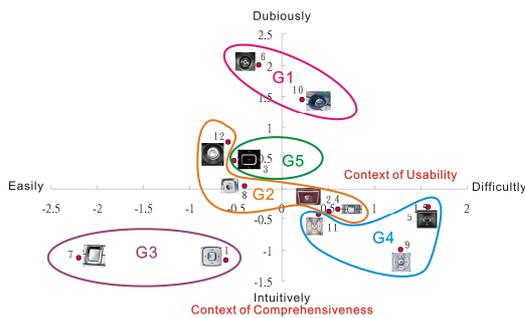
Rotation Sums of Squared Loadings

For the usage image structure of zooming (see Table 4-4), the result of the Principal Component Analysis shows that the usage image structure is composed of two factors: the first factor, composed of “Clearly - Ambiguously “, “Effortlessly – Laboriously” and “Decisively - Hesitantly” images, is referred to the context of “Comprehensiveness” and can be explained as the “Intuitively - Dubiously“ image; and the second factor, composed of the “Flexibly - Clumsily”, “Simply - Complicatedly “ and “Speedily - Slowly” images, is referred to the context of “Usability” and can be explained as the “Easily - Difficultly” image.

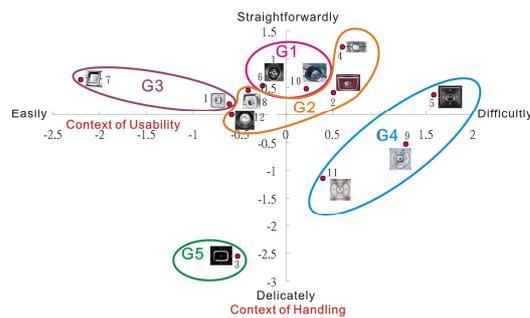
It is found that the usage image structures for both photo-taking and zooming are similar. However, the contexts of which the structure is composed are slightly different.

#### 4. 4. CORRESPONDING CORRELATIONS BETWEEN THE DESIGN CHARACTERS AND USAGE IMAGE

To find out the correlations between the design characters and the usage images, a Ward's Minimum Variance Method was employed according to the scores gained from the Principal Component Analysis (see Fig 4-2~4-5).



(The first and second contexts)



(The first and third contexts)

Fig 4-2 The usage image space for photo-taking.

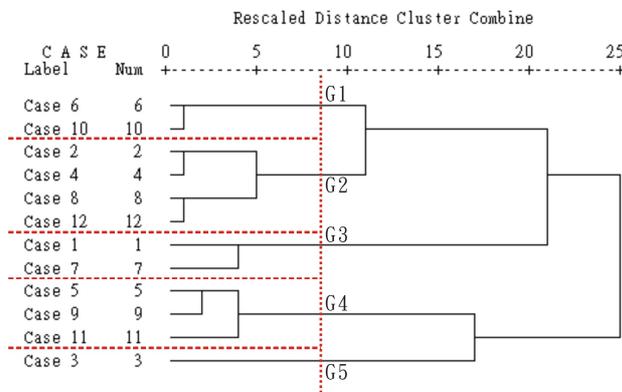


Fig 4-3 The result of Cluster Analysis for photo-taking.

For the usage image of photo-taking, detailed analysis on the corresponding relations between the design characters and usage images of each group are discussed below:

G1 group: Samples in this group are mobile phones with joystick. Design character of the operational zone in this group is a round shape with a concave, while the joystick is standing out from the bottom of the concave. There is no tendency in the context of "Usability". However, the corresponding usage images of this group tend to be "Dubiously" and "Straightforwardly".

G2 group: Most samples in this group are mobile phones with joystick. The common design character is that the joystick is out-standing from the operational zone. There is no tendency in the context of “Usability” and “Comprehensiveness”. However, the corresponding usage image of this group tends to be “Straightforwardly”.

G3 group: In this group, the overall design of the operational zone is a square shape with a slope surrounded. With the larger-sized push button in the middle, the corresponding usage images of this group tend to be “Easily”, “Intuitively” and “Straightforwardly”.

G4 group: Samples in this group are mobile phones with directional keypads. The overall design of the operational zone is a round shape with a flat surface. A small push button in the middle is slightly protruded from the surface but there is no clear gap in between, the corresponding usage images of this group tend to be “Intuitively”, “Delicately” but “Difficultly”.

G5 sample is a mobile phone with specifically designed directional keypads. A large operational zone with a clear boundary push button, it provides the usage images of “Easily” and “Delicately”.

In general, for the usage image of photo-taking, mobile phones with joysticks tend to provide the usage image of “Straightforwardly”, while the mobile phones with directional keypads tend to provide the usage image of “Delicately”. Regarding the size of the push button, Samples with large size push button tend to provide the usage image of “Easily”. However, the small size push button tend to provide the usage image of “Difficultly”

For the usage image of zooming, detailed analysis on the corresponding relations between the design characters and usage images of each group are discussed below:

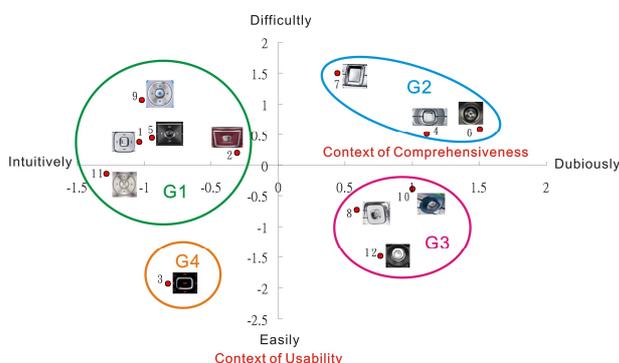


Fig 4-4 The usage image space for zooming

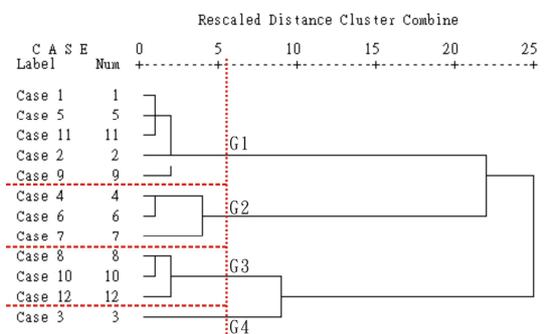


Fig 4-5 The result of Cluster Analysis for zooming

G1 group: Samples in this group are mobile phones with directional keypads. Surface of the operating zone in this group is flat and a push button in the middle is slightly protruded from the surface. With clear direction icons on the keypad, the corresponding usage image of this group tends to be “Intuitively”.

G2 group: The common design character is the manipulating area of this group is relatively small. It provides limited space for user to manipulate. Therefore, the corresponding usage images of this group tend to be “Dubiously” and “Difficultly”.

G3 group: Samples in this group are mobile phones with joysticks. There are some spaces around the joystick, the corresponding usage images of this group tend to be “Easily”. However, there is no direction icons for orientation, the corresponding usage images of this group tend to be “Dubiously”.

For G4 sample, large operational zone with clear direction icons provides the usage images of “Easily” and “Intuitively”.

In general, for the usage image of zooming, small navigation keys of mobile phones tend to provide the usage image of “Difficultly”, while a large tolerance for manipulating the navigation keys tends to provide the usage image of “Easily”. Regarding the direction icons on the navigation keys, Samples with direction icons tend to provide the usage images of “Intuitively”. On the other hand, samples without the direction icons provide the usage images of “Dubiously”

#### 4. 5. INVESTIGATE ON THE USAGE IMAGES WHICH MOST AFFECT THE OVERALL EVALUATION OF “USER FRIENDLY”

To find out the adverbial descriptions which most affect the overall evaluation of “User Friendly”, a Regression Analysis was conducted at this stage. In the test, the overall evaluation of “User Friendly” is set as the dependent variable, while the other usage images are set as the independent variables. The results of the Regression Analysis (see Table 4-5 and Table 4-6) indicate that the usage image of “Effortlessly” and “Decisively” are the most affected factors on the overall evaluation of “User Friendly” for both photo-taking and zooming.

Table 4-5 Results of the Regression Analysis for photo-taking

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	0.446	0.234		1.907	0.089
10 Effortlessly - Laboriously	0.530	0.141	0.601	3.757	0.005
9 Decisively - Hesitantly	0.407	0.162	0.401	2.506	0.034
Dependent variable: Easy to Use – Not Easy to Use R <sup>2</sup> =0.956					

Table 4-6 Results of the Regression Analysis for zooming-in/out

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	0.790	0.227		3.476	0.007
10 Effortlessly - Laboriously	0.375	0.123	0.528	3.047	0.014
9 Decisively - Hesitantly	0.419	0.154	0.471	2.721	0.024
Dependent variable: Easy to Use – Not Easy to Use R <sup>2</sup> =0.948					

Referring to the design characters, for photo-taking, navigation keys with a large push button or a button protruded from a flat surface provide users with the image of “User Friendly”. Meanwhile, for zooming, a flat navigation keys with direction icons tend to have the “User Friendly” image.

## 5. CONCLUSIONS

The results of the Principal Component Analysis show that the usage image structure on the way of taking photos is composed of three contexts: “Usability”, “Comprehensiveness” and “Handling” while “Usability” and “Comprehensiveness” are the contexts which compose the usage image structure on the way of zooming lens.

Referring to the design characters, mobile phones with joystick tend to provide the usage image of “Straightforwardly” on the way of taking photos. In contrast, mobile phones with directional keypads tend to provide the usage image of “Delicately”. Regarding the dimensions of the navigation keys, samples with large size push button or with a large tolerance around the navigation keys tend to provide the usage image of “Easily”. However, users tend to have the “Difficultly” image when manipulating small-sized navigation keys. Navigation keys with direction icons tend to provide the usage image of “Intuitively”. On the other hand, samples without the direction icons provide the usage image of “Dubiously”

The results of the Regression Analysis indicate that the overall evaluation of “User Friendly” for both photo-taking and zooming are most affected by the usage images of “Effortlessly” and “Decisively”. Referring to the design characters, users tend to have the image of “User Friendly” when manipulating a large push button or a button protruded from a flat surface. Furthermore, flat navigation keys with direction icons also help to provide the “User Friendly” image.

In this study, the respondents are asked to evaluate the samples by computer animations instead of real mobile phones. Usage images profile might be different when respondents physically manipulate the real models in hand. It is suggested for the future study to utilize real models for evaluation in order to avoid the experiment biases.

## REFERENCES:

Chen (2002) An Ergonomic Design and Performance Evaluation of Cellular Phones, Master Thesis, National Cheng Kuan University.

Han, Kim, Yun, Hong, and Kim (2004) Identifying Mobile Phone Design Features Critical to User Satisfaction, *Human Factors and Ergonomics in Manufacturing*, Vol. 14 (1), pp. 15–29.

Konrad & Bruce (2000) *User Interface Design of Electronic Appliances*, TF-CRC.

Liu (2002) A study on the Interaction between Hardware and Software Interfaces of Mobile Phones, Master Thesis, National Chiao Tung University.

Nagamachi (1995) Kansei Engineering: A new ergonomic consumer-oriented technology for product development, *International Journal of Industrial Ergonomics* 15, pp.3-11.

Nagamachi (2002) Kansei Engineering as a powerful consumer-oriented technology for product development, *Applied Ergonomics* 33, pp.289-294.

Rapoport (1977) *Human Aspects of Urban Forms: Towards a Man-Environment Approach to Urban Form and Design*, Franklin Book Co., N.Y.

Studio 7.5 (2006) *Designing for small screen*, AVA publishing, Switzerland.

Tsao and Lee (1998) Research on the Form of a Container Can and the Adverbial Images on Its opening Motions, *Proceedings of the 3th Asia Design International Conference*, pp.473-477.

Tsao, Chan and Ho (2006) The Usage Images of the Directional Keypads and Joysticks on Mobile Phones, *Proceedings of the 11th Annual International Conference on Industrial Engineering – Theory, Applications and Practice*, Nagoya, Japan, pp. 320-325.

Tsao, Kazuo and Yamauchi (1996) The Form of Chair and the Adverbial Expression of Its Usage Image, *BULLETIN OF JSSD*, Vol.42, No.5, pp.7-16.