Accommodating Both Expert Users and Novice Users in One Interface by Utilizing Multi-layer Interface in Complex Function Products

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Abstract. Rapid development of electronic technology promotes the complex function of a product. Users have to adapt themselves to interface with diverse mental model setting. To improve usability, both resolutions of consistent interface and wizard interface were frequently applied to help novice. However, both of them require as much time for those who are familiar with the system, i.e. expert users. Shneiderman (2000) remarked that Universal Usability requires that software systems accommodate a diverse set of users. Multi-Layer interface might be a solution for complex user interface and satisfy both novice and expert users. The idea of multi-layer interface has been applied to hardware and software interface design. Cases were discussed in which the improved Multi-Layer Interface was analyzed and conclusions made.

Keywords: universal usability, multi-layer interface, consistent interface.

1 Introduction

The IT Industry has been rising rapidly in Taiwan since 1980. Rapid development of electronic technology benefits the complex function of a product. Meanwhile, complicated operation system challenges users, especially novice. Users have to adapt to interface with diverse mental model setting. Programs that deviate from the expected design will almost assuredly confuse the user even if the changes were intended for the user's benefit. Users, especially novice, will probably not want to customize or alter their applications in any way. If they do, the available methods must be as easy and painless as possible (Dan, Paula, and David, 1994)[1].

1.1 Consistent Interface

Many writers have presented the request for user interface consistency. Shneiderman's (1998)[2] first rule of "Golden Rule of Dialogue Design" reads: "Strive

[1] Dan H., Paula F. & David B.: Volume 6A: Motif Programming Manual (2nd Ed.). O'Reilly & Associates. (1994)

[2] Shneiderman, B. Designing the user interface: Strategies for effective human-computer interaction (3rd ed.). Reading, MA: Addison-Wesley Publishing. (1998)

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for consistency". This principle is the most frequently violated one, and yet the easiest one to repair and avoid." Rubinstein and Hersh (1984)[3] concluded their book, The Human Factor: Designing Computer Systems for People, with the directive: "build consistent human interfaces." Such methodological encouragement has been supported with empirical work presented in support of user interface consistency. A set of consistent interface which was designed for universally applying to various fitness equipments will be introduced in this article. The design outcome was verified by comparing the learnability of consistent interface and that of existing interface. The result indicates that both efficiency and error rate of operating the consistent interface was significantly improved.

Electronic science benefits the complex function of fitness equipment which requires efforts to maintain prime usability of interface. There are various operation processes among fitness equipment. Users have to adapt to interface with diverse mental model setting when shifting to different fitness equipment. The control panel of fitness equipment consists of function keys, display screens and selection keys should be a consistent interface. Function keys include TIME, PROGRAM, CALORIES, and LEVEL etc. Display screens include RPM and HEART RATE etc. Selection keys include UP, DOWN and ENTER etc. The observation revealed that displays are not always located adjacent to their corresponding function keys (as shown in Fig. 1).

Fig. 1. The function keys are marked A, B and C; while their corresponding display screens are marked a, b and c respectively. (A: incline, B: speed, C: six types of program)

According to Krahl, LoVerde, & Scerbo (1999)[4], a consistent interface ensures that terminology does not change, that design elements and controls are placed in familiar

[3] Rubinstein, R. & Hersh, H.: The human factor: designing computer systems for people: CA: Morgan Kaufmann Publishers Inc. (1984)

[4] Krahl, K., LoVerde, J. L., & Scerbo, M. K.: Skill acquisition with human and computer teammates: Performance with team KR. In M. K. Scerbo &M. Mouloua (Eds.): Automation technology and human performance, pp. 144–148. Mahwah, NJ: Lawrence Erlbaum Associates, Inc. (1999)

locations and that similar functions behave similarly. Predictability expands this to place information or controls where the user expects it to be. Bear in mind of above principles, an analysis was carried out to build a clear picture of general operation procedure among selected fitness equipments. As a result, a consistent interface was designed for universally applying to various fitness equipments[5].

1.2 Multi-layer Interface

Besides consistent interface, the wizard interface was also frequently used to help novice prevent error operation. For usability of software, the wizard interface fulfills the requirements of learnability and memorability. It provides first-time users with explicit guidance through the process of a specific task. However, both of them require as much time for those who are familiar with the system, i.e. expert users. Shneiderman (2000) [6] remarked that Universal Usability requires that software systems accommodate a diverse set of users, and multi-layer interface might be the solution for complex user interface which can satisfy the need for both novice and expert users. Good interface should be able to accommodate both expert users and novice users in one interface (Wu, 2000)[7]. Users are normally classified as either experts or novices, and in some cases somewhere in-between. There is evidence to support the fact that novice and expert users behave differently when using a specific UI. Expertise and skill affects the way users interact with software (Bronwin Jason, Andrè Calitz, 2009)[8].

Multi-layer designs will need careful development and much usability testing to refine the concepts. Shneiderman (2000) remarked on the issues of future research including: How many layers? Should layers have names? Can users modify layers by including/excluding features? How can compatibility of output across layers be ensured? How should training be handled to encourage users to switch layers? Designers also need appropriate principles for design of the layers, including guidelines for multilayer online help and error messages.

Usability testing and user feedback will be essential in helping to refine the principles and develop a theoretical foundation based on appropriate cognitive learning models. Researchers in this area will have to develop novel methods to conduct longitudinal studies and automatically monitor user skill evolution (Shneiderman , 2000)[9].

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[5] T. K. Philip Hwang, Horng-Yi Yu, Terrence Wang & Rong Wu: Consistent Interface for Fitness Equipment: Proceedings of the 3rd International Conference for Universal Design. (2010)

[6] Shneiderman, B.: Universal Usability: Communications of the ACM. 43 (5), pp. 84-91. (2000)

[7] Wu, J.: Accommodating both Experts and Novices in One Interface: Department of Computer Science University of Maryland, College Park, MD 20742 USA. (2000)

[8] Bronwin Jason, Andrè Calitz: A Model for the Adaptation of Contact Centre Computer User Interfaces: 5th annual international conference on computing and ICT research. (2009)

[9] Shneiderman, B.: Promoting universal usability with multi-layer interface design: ACM. Conference on Universal Usability, ACM Press, New York. (2003)

2 Case Analysis

Cases of improved hardware and software which employed Multi-Layer Interface design are examined and analyzed as follows:

2.1 The Hardware Multi-layer Interface

Actually, the idea of multi-layer interface has been applied to hardware interface design including: a remote controller for air conditioner, control panel of a copy machine and keypad of a mobile phone (as shown in Table 1). The less frequently buttons are hided under a lid and the frequently buttons are rearranged on the easily reachable surface.

Table 1. The idea of multi-layer interface has been applied to hardware interface design

Case			
Product	a remote controller for air conditioner	control panel of a copy machine	keypad of a mobile phone
Layer Type	flip cover		slide cover

Most of public service devices are inevitably using by both occasional users and experienced users. In the sense of universal usability, an adaptive interface may lead to a resolution. An operation efficiency of physical multi-layer interface was developed for a TV remote controller. A TV remote controller may contain more than 40 button selections which confuse its user especially younger and older age groups. The idea of multi-layer interface TV remote controller was developed that hiding less frequently used buttons under a lid and rearrange frequently used buttons on the easily reachable surface of the TV remote controller. Finally, the operation efficiency and visual focus shifting frequency of the multi-layer TV remote controller were examined against existing one (as shown in Fig. 2). The result indicated that multi-layer interface TV remote controller presents better operation efficiency and improved user satisfaction[10].

2.2 The Software Multi-layer Interface

The Taiwan High Speed Rail (HSR) is a fast and convenient way of the trans-island travel linking north to south of Taiwan. Moving at top speeds of 300 kmh / 186mph,

[10] Horng-Yi Yu , Jui-Ping Ma and T. K. Philip Hwang: To Substitute Fast-Forward/Backward Keys for Numeric Keypad of TV Remote Controller: The HCI International 2011 Conference Proceedings. (2011)

Fig. 2. The design of multi-layer TV remote controller was developed that hiding less frequently used buttons and rearrange frequently used buttons on the easily reachable surface of the TV remote controller

the HSR shortens travel time between Taipei & southern city Kaohsiung to as little as 80 minutes on its non-stop route. The ticket vending machine of HRS is to supplement the requirement of urgent ticket purchase at HRS stations. Tickets can be booked five minutes prior to the departure time scheduled for the Train. Observed evidence noted that many passengers used the ticket vending machine with anxiety about catching the train. The software wizard interface of HRS presented a user with a sequence of nine dialog boxes and led the user through a series of well-defined steps before completing the purchase task. The users who were familiar with the software wizard interface felt niggling about the step by step operation.

Moreover, we noticed that the first time users were confused with the interface of Microsoft Word 2007 Ribbon. The traditional file menus have been replaced with the new Ribbon feature. The Ribbon motivates the change from the traditional icon sizes, which are shortcuts for the UI features, to the new icons found on the Ribbon. Now upon viewing the icons a user will notice the new icons are labeled with significantly larger clickable images. More than 40 icons display in the Ribbon did confuse users in the first instance. Colazzo, L. etc. (2008)[11] also observed that users with a higher familiarity on the "old-style" UI experienced more difficulties to perform tasks, while

[11] Colazzo, L., Molinari, A. & Tomasini, S.: Is new necessarily good? Testing usability of the new Office 2007 user interface. In J. Luca & E. Weippl (Eds.): Proceedings of World Conference on Educational Multimedia, Hypermedia and Telecommunications, pp. 1371-1379. Chesapeake, VA: AACE. (2008)

users with less familiarity experienced fewer difficulties. The problem is more noticeable when interaction style is completely different from the traditional one. This critical state regards mainly habitual users that experiment more difficulties to perform tasks than new users, and this seems to be in contrast with some claims that point on a higher usability of the new interface.

Accordingly, the application of software multi-layer interface includes the homepage of University of OXFORD[12] (as shown in Fig. 3) and National Digital Library of Theses and Dissertations in Taiwan[13] (as shown in

Fig. **4**) etc. The former accommodated diverse users (staff, students, alumni and media), with different layers (web pages). The latter adapted various web pages to novice and expert users.

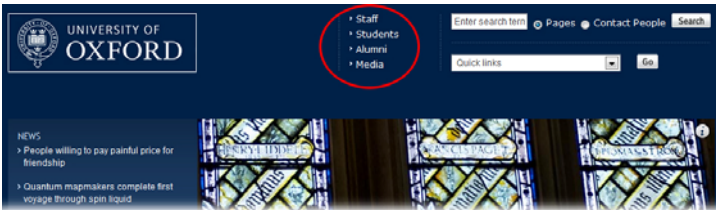

Fig. 3. The homepage of University of OXFORD

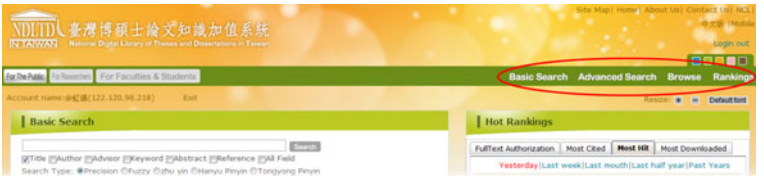

Fig. 4. The homepage of National Digital Library of Theses and Dissertations in Taiwan

3 Conclusion

The wizard interface provides novice users with comprehensible support. However, the step by step operation is niggling for experienced users. On the other hand, a consistent interface ensures that terminology does not change, that design elements and controls are placed in familiar locations and that similar functions behave similarly. It improves learnability. A good interface should accommodated both expert and novice users. The case studies indicated that multi-layer interface provides designers with a resolution for complex user interface and would satisfy both novice and expert users.

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[12] University of OXFORD, 2011.04.03, http://www.ox.ac.uk/

[13] National Digital Library of Theses and Dissertations in Taiwan, 2011.04.03, http://ndltd.ncl.edu.tw/cgi-bin/gs32/gsweb.cgi/ccd=ndZrJF/webmge?switchlang=en#XX

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