

Identifying the Features of Friendly User Interfaces from Emotional Perspectives

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Abstract. Ever since people considered “user-friendly” as the key requirement of user interfaces, the term had been used in many cases. However, what do people really mean by saying an interface is user-friendly remains vague. In order to achieve successful user interface design, the requirements have to be precise and well-documented for designers. Therefore, the objective of this research is to identify the features that contribute to friendly user interfaces. A survey of user experiences was conducted to collect the cases of interactions and the emotional responses of users. After protocol analysis of these data, twenty features that contributed to positive emotions were identified. These features were further categorized into six groups, i.e., Ease of use, Reliability, Inclusiveness, Tolerance, Considerateness, and Attractiveness. The features with two levels of hierarchy could serve as a checklist to guide design. Furthermore, the checklist was applied to a case study, in which a bar table prototype with a multi-touch screen was evaluated by a focus group. The result showed that the requirements of design improvement could be determined systematically with the help of such a checklist.

Keywords: User Friendly, User Interface Design, Emotional Design.

1 Introduction

“User friendly” has been commonly used as the criterion to guide user interface design. However, what do people really mean by saying an interface is user-friendly remains vague. In order to achieve successful user interface design, the requirements have to be precise and well-documented for designers. Therefore, the objective of this research is to identify the features that contribute to friendly user interfaces. In order to identify the features of friendly user interfaces, the author started with a survey of user experiences to collect the cases of interactions and the emotional responses of users. Hierarchical features that would contribute to positive emotions were then

identified using protocol analysis and Principal Component Analysis. Detailed procedures were discussed in the following sections.

2 Literature Review

User interface usability is always an important issue for practical designers. In order to ensure usability, many scholars have developed design principles and rules for UI designers to follow at the design stage [1, 2, 3, 4, 5, 6]. These principles and rules of user interface design were summarized in Table 1. Although there were many in common, some principles differed in not only the point of views but also the level of abstraction. As emotional concerns in user experiences become more and more important [7], whether these principles and rules are enough to address the emotional perspectives of user interface design is an issue deserving much research efforts.

Table 1. Principles and rules of user interface design

Literature	Principles and Rules
[1]	Suitability, Legibility, Self-descriptiveness, Learnability, Familiarity, Semantic language, Feedback, Understandability, Affordance, Feed-forward, Constraints, Prioritization, Grouping, Consistency, Transparency, Error tolerance, Satisfaction
[2]	Simplicity, Structure, Consistency, Tolerance
[3]	Predictability, Learnability, Structure, Consistency, Memorability, Familiarity, Recognition, Visibility, Simplicity, Substitutivity, Feedback, Error indication, Synthesizability, Responsiveness, Recoverability, Flexibility, User control, Customizability, Effectiveness, Efficiency, Effort Minimization
[4]	Visibility, Feedback, Constraints, Consistency, Affordance
[5]	Visibility, Consistency, Familiarity, Affordance, Navigation, Control, Feedback, Recovery, Constraints, Flexibility, Style, Conviviality
[6]	Strive for consistency, Cater to universal usability, Offer informative feedback, Design dialogs to yield closure, Prevent errors, Permit easy reversal of actions, Support internal locus of control, Reduce short-memory load

3 User Experience Study

In order to identify the features of friendly user interfaces, the author started with a survey of user experiences to collect the cases of interactions and the emotional responses of users. Sixty people with age ranging from 20 to 56 were invited to provide their user experiences and emotion responses using self-report approach. More than 300 cases were reported during the period of the survey. Since these experiences were expressed with layman language, the author had to encode the keywords and organize the qualitative data into representative outputs. Therefore, similar cases were grouped and ranked based on the frequency of similarity. The top-ten user experiences that invoked positive and negative emotion responses were extracted and summarized in Tables 2 and 3, respectively. These data served as the input for further analysis of features.

Table 2. User experiences with positive emotion responses

Emotion Responses	Cumulated Percentage	Representative User Experiences
Satisfied	10%	Only a few steps to compete a task with complicated procedures; A user interface can help people organize and search personal data or files easily; Users know exactly how to interact with a user interface without learning at the first time;
Feeling safe	11%	The system automatically checks and notifies the mistakes of input data while filling a form with many items; The system provides a summary page of ordering and reversal links to change data for the transition of online shopping;
Surprised	5%	Receiving the latest news of a friend who has lost contact for a long time in an online social network site; Receiving a recommendation list of new products or services that are attractive and match personal expectations;
Proud	2%	Having the capability to operating a high-tech device that is ideologically considered as a companion of younger people;
Delighted	12%	Family members take turns using a system without adjustment before usage; Playing with a game which is aesthetically appealing

Table 3. User experiences with negative emotion responses

Emotion Responses	Cumulated Percentage	Representative User Experiences
Upset	8%	No response after pressing a button and waiting for a long time while sending personal and private data through the internet;
Confused	5%	Unnatural mapping among switches on the wall and lights in the room; Accidently inserting the power charging connector to the earphone hole on an electronic dictionary; Difficult to recognize the graphics of icons;
Annoyed	8%	Too many windows are triggered automatically and overlapped to each other while interacting with a website; No information about the remaining time for downloading a webpage;
Anxious	3%	Don't know how to start using a system at the first time under time pressure; The time for confirming the account number and amount of money for transferring through ATM is not long enough;
Embarrassing	4%	Struggle to switch a mobile phone to the silent mode while it is ringing in a meeting or a quiet library;
Frustrated	2%	Not easy to scroll to the expected position in a document;

4 Identification of Features

After protocol analysis of the above data, twenty features that could contribute to positive emotions were identified. Furthermore, a questionnaire survey of 66 respondents was conducted to obtain the response about the degree of importance of these features using 7-point scales. Principal Component Analysis was then used to extract six major factors (Table 4). They cumulatively explained, 72.32% of the total variance. These factors were named as Ease of use, Reliability, Inclusiveness, Tolerance, Considerateness and Attractiveness (Table 5). Ease of use included Low Mental Workload, Low Physical Workload, Informative Feedback, and Sense-of-Achievement Experience. Reliability consisted of Robustness, Ease of Navigation, Intuitive and Natural Control, as well as Safety. Inclusiveness consisted of Appropriate Notification, Adaptivity, Accessibility, and Pleasurable Experience. Tolerance consisted of Predicable Output, Error Recovery, Error Prevention, and No Time Pressure. Considerateness included Real-Time Help Instruction, Maintaining Privacy, and Flexibility. Attractiveness included Elegant Design, which was the only feature in this category. The factors and features within two levels of hierarchy could

Table 4. The six factors extracted by Principal Component Analysis

Features	Component					
	1	2	3	4	5	6
Low Mental Workload	.824	.220	.202	-.012	.093	.144
Low Physical Workload	.813	.223	.217	.021	.140	.173
Informative Feedback	.669	.232	.116	.176	.063	-.311
Sense-of-Achievement Exp.	.572	-.398	.121	.436	.260	.321
Robustness	.042	.837	-.058	.159	.233	.103
Ease of Navigation	.226	.729	.199	.279	-.069	-.237
Intuitive and Natural Control	.268	.703	.154	.152	.207	.082
Safety	.389	.530	-.143	.060	.195	.171
Appropriate Notification	.149	.188	.816	.126	.000	-.252
Adaptivity	.146	-.051	.802	.177	.197	.180
Accessibility	.248	.173	.642	-.096	.123	.392
Pleasurable Experience	.464	-.104	.549	.204	-.113	.419
Predicable Output	.087	-.010	-.067	.807	.027	.101
Error Recovery	-.073	.382	.219	.765	.113	.123
Error Prevention	.076	.270	.172	.687	.084	-.200
No Time Pressure	.448	.143	.175	.522	-.037	.068
Real-Time Help Instruction	.076	.236	-.026	.022	.790	-.184
Maintaining Privacy	.143	.228	.196	.076	.753	.042
Flexibility	.074	-.219	.558	.153	.574	.226
Elegant Design	.111	.107	.153	.072	-.067	.849
Eigenvalues	6.094	2.632	1.724	1.567	1.262	1.185
% of Variance	30.468	13.161	8.621	7.836	6.310	5.926
Cumulative %	30.468	43.629	52.250	60.086	66.396	72.322

Table 5. Features of friendly user interfaces

Factor Level	Feature Level	Applicable to User Input or System Output
Ease of Use	Low Mental Workload	Input and Output
	Low Physical Workload	Input
	Informative Feedback	Output
Reliability	Sense-of-Achievement Experience	Input and Output
	Robustness	Input and Output
	Ease of Navigation	Input and Output
	Intuitive and Natural Control	Input
	Safety	Input and Output
Inclusiveness	Appropriate Notification	Output
	Adaptivity	Input and Output
	Accessibility	Input and Output
	Pleasurable Experience	Input and Output

Table 5. (continued)

Tolerance	Predicable Output	Output
	Error Recovery	Input
	Error Prevention	Input
	No Time Pressure	Input
Considerateness	Real-Time Help Instruction	Output
	Maintaining Privacy	Input and Output
	Flexibility	Input and Output
Attractiveness	Elegant Design	Input and Output

serve as a checklist to guide design. The checklist is expected to help designers to develop a user interface that invokes positive emotion responses and reduces the possibility of causing negative emotions. Compared to the existing principles and rules listed in the literature, the terms at the factor level are easy to understand. In addition, the notions such as “Maintaining Privacy” and “Sense-of-Achievement Experience” at the feature level were never mentioned in previous literature that focused on usability. These requirements offer a chance for designers to address the needs of friendly user interfaces from emotional perspectives.

5 Case Study

Furthermore, the checklist was applied to a case study, in which a bar table prototype with a multi-touch screen was evaluated by a focus group with one experienced designer, one professor, and one university staff without professional training in design. They all had more than ten years of working experiences. This interactive table was initially designed to provide the service of drink ordering and entertainment in bars. The surface of the touch screen was made by silicone, which was surrounded by two arrays of infrared light sources. There was an infrared camera mounted in the chamber of the table. This chamber included a computer, a projector, and a glass to reflect the image coming out from the projector. People could use mugs or bottles with different numbers of contact points at the bottom to trigger corresponding digital contents. In addition, users could interact with the digital contents with gestures applied on the surface. Figure 1 demonstrated the experiments of system functions in



Fig. 1. System operating state of the multi-touch table



Fig. 2. Maintenance state of the multi-touch table

a design exhibition. The equipments of the system and the maintenance situation were shown in Figure 2. Taking the comments collected from the participants of the experiments as the initial data, the focus group evaluated the prototype again with the checklist and summarized the requirements of design improvement in Table 6. With these requirements, designers could further improve the table systematically.

Table 6. The requirements of improvement for the multi-touch table

Categories	Requirements of design improvement	
Ease of Use	(1)	Low Mental Workload: Enlarge the graphic icons and text for senior users; Reduce the cases of using short term memory while operating the system;
	(2)	Low Physical Workload: Improve the UI for maintaining the equipments under the table; Provide the shot-cut UI on the cover so that people can calibrate the system conveniently from outside;
	(3)	Informative Feedback: Provide distinguishable sounds and animations while touching different elements on the screen;
	(4)	Sense-of-Achievement Experience: Provide the UI to dynamically display the rank of customers based on the degree of contributions to the club or to the other members;
Reliability	(5)	Robustness: Water-proof touch screen; Ensure stable response of digital contents when many users are interacting with the system at the same time;
	(6)	Ease of Navigation: Limit the structure of menus into two levels of hierarchy; Group the items based on familiar categories and list them alphabetically;
	(7)	Intuitive and Natural Control: Ensure natural mapping among gestures and state changes of the contents;
	(8)	Safety: Prevent customers from contacting the heated air emitted from the projector under the table;
Inclusiveness	(9)	Appropriate Notification: Provide the ingredient immediately at the moment of ordering drinks;
	(10)	Adaptivity: Maintain the personal profile of favorite drinks for quick ordering;

Table 6. (continued)

Tolerance	(11)	Accessibility: Provide the voice control and auditory feedback for visually impaired people;
	(12)	Pleasurable Experience: Provide entertainment games to facilitate social interactions among customers;
	(13)	Predicable Output: Ensure the contact points of mugs or bottles trigger the correct digital content every time;
	(14)	Error Recovery: Provide the return button to get back to previous steps;
	(15)	Error Prevention: Provide the confirmation page for order summary before submit it; Adjust the sensitivity of touch to ensure stable inputs;
	(16)	No Time Pressure: User-controlled paces; No time limit if no one is waiting for using it;
Considerateness	(17)	Real-Time Help Instruction: Provide the help for recommending drinks based on the collaborative filtering of popularity and special tastes;
	(18)	Maintaining Privacy: Need password to access personal accounts of club members;
	(19)	Flexibility: Provide the short-cut for experienced customers and step-to-step procedures for novices;
Attractiveness	(20)	Elegant Design: Enhance the appearance of menu icons with animations;

6 Conclusions and Recommendations for Future Work

In this research, a checklist with features that contribute to friendly user interfaces was identified. This checklist was then applied to the evaluation of a bar table prototype with a multi-touch screen. The result showed that the requirements of design improvement could be determined systematically with the help of such a checklist.

Although the objective of identified the features is achieved, there are several research issues deserving further study. First, twenty features may be not exhausted enough to cover all design conditions. For example, more features that are specific to web applications, mobile applications, or ubiquitous computing could possibly be found. Second, when a checklist is already available, a new survey instrument with quantitative evaluation method may be developed based on the structure of the checklist. Once the answers of some questions are found, “user friendly” will no longer be a vague term. Instead, designers are able to create an innovative user interface and guarantee its user friendliness by a systematic method.

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