P.L. Patrick Rau (Ed.)

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Foreword

The 14th International Conference on Human–Computer Interaction, HCI International 2011, was held in Orlando, Florida, USA, July 9–14, 2011, jointly with the Symposium on Human Interface (Japan) 2011, the 9th International Conference on Engineering Psychology and Cognitive Ergonomics, the 6th International Conference on Universal Access in Human–Computer Interaction, the 4th International Conference on Virtual and Mixed Reality, the 4th International Conference on Internationalization, Design and Global Development, the 4th International Conference on Online Communities and Social Computing, the 6th International Conference on Augmented Cognition, the Third International Conference on Digital Human Modeling, the Second International Conference on Human-Centered Design, and the First International Conference on Design, User Experience, and Usability.

A total of 4,039 individuals from academia, research institutes, industry and governmental agencies from 67 countries submitted contributions, and 1,318 papers that were judged to be of high scientific quality were included in the program. These papers address the latest research and development efforts and highlight the human aspects of design and use of computing systems. The papers accepted for presentation thoroughly cover the entire field of human–computer interaction, addressing major advances in knowledge and effective use of computers in a variety of application areas.

This volume, edited by P.L. Patrick Rau, contains papers in the thematic area of internationalization, design and global development (IDGD), addressing the following major topics:

- Cultural and cross-cultural design
- Culture and usability
- Design, emotion, trust and aesthetics
- Cultural issues in business and industry
- Culture, communication and society

The remaining volumes of the HCI International 2011 Proceedings are:

- Volume 1, LNCS 6761, Human–Computer Interaction—Design and Development Approaches (Part I), edited by Julie A. Jacko
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- Volume 21, LNAI 6781, Engineering Psychology and Cognitive Ergonomics, edited by Don Harris
- Volume 22, CCIS 173, HCI International 2011 Posters Proceedings (Part I), edited by Constantine Stephanidis
- Volume 23, CCIS 174, HCI International 2011 Posters Proceedings (Part II), edited by Constantine Stephanidis

I would like to thank the Program Chairs and the members of the Program Boards of all Thematic Areas, listed herein, for their contribution to the highest scientific quality and the overall success of the HCI International 2011 Conference.

In addition to the members of the Program Boards, I also wish to thank the following volunteer external reviewers: Roman Vilimek from Germany, Ramalingam Ponnusamy from India, Si Jung "Jun" Kim from the USA, and Ilia Adami, Iosif Klironomos, Vassilis Kouroumalis, George Margetis, and Stavroula Ntoa from Greece.

This conference would not have been possible without the continuous support and advice of the Conference Scientific Advisor, Gavriel Salvendy, as well as the dedicated work and outstanding efforts of the Communications and Exhibition Chair and Editor of HCI International News, Abbas Moallem.

I would also like to thank for their contribution toward the organization of the HCI International 2011 Conference the members of the Human–Computer Interaction Laboratory of ICS-FORTH, and in particular Margherita Antona, George Paparoulis, Maria Pitsoulaki, Stavroula Ntoa, Maria Bouhli and George Kapnas.

July 2011 Constantine Stephanidis

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HCI International 2013

The 15th International Conference on Human–Computer Interaction, HCI International 2013, will be held jointly with the affiliated conferences in the summer of 2013. It will cover a broad spectrum of themes related to human–computer interaction (HCI), including theoretical issues, methods, tools, processes and case studies in HCI design, as well as novel interaction techniques, interfaces and applications. The proceedings will be published by Springer. More information about the topics, as well as the venue and dates of the conference, will be announced through the HCI International Conference series website: http://www.hci-international.org/

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Part I
Cultural and Cross-Cultural Design

A Study on the Application of Cultural Elements in Product Design

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Abstract. In recent years, there has been a trend of using Chinese/ Taiwanese cultural elements in consumer electronics (CE) products. This innovative design method has resulted in many works that won significant awards in Taiwan and international design competitions. The award-winning works included mass-produced products and conceptual design works, and the great appraisals have proven that this kind of design method could create added-value for a product. Therefore, "how to use design elements with cultural meanings" has become an important issue. This research has studied cases that used Chinese/Taiwanese cultural elements in product design, including five cases in Taiwan's electronics industry and 15 award-winning works in international design competitions. The purpose was to compare how the design methods used in mass-produced products are different from the ones used in conceptual design works. The results revealed that: 1) The mass-produced products utilized Chinese calligraphy and paintings as the main cultural elements, while the conceptual design works used Chinese calligraphy and paintings in not only artifacts and daily-use items, but also in the expression of custom and behavior, aesthetics, religion rituals, or even Chinese philosophy. 2) The mass-produced products made direct use of Chinese/Taiwanese cultural elements. Namely, some Chinese calligraphy and painting totems were copied on the products, thus presenting Chinese-style appearances. On the contrary, the award-winning works selected and translated the cultural elements more skillfully. The application of cultural elements was used in product appearances and functions. The designers were expressing their interpretation and deeper meanings of Chinese culture by their unique renovation. If the industrial designers could learn from these award-winning works and use the same kind of design method in CE products, new industrial opportunities could be created.

Keywords: Design competition, cultural elements, consumer electronics industry.

1 Introduction

China/Taiwan possesses cultural traditions with a long history. Nowadays, people are keen to study Chinese-style aesthetics, and the cultural heritage has become the new resource of design ideas. The precious cultural elements, including Chinese calligraphy, paintings, literature, utensils, and philosophy, have brought vitality to

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Taiwan's design industry. In view of this, the Industrial Development Bureau, Ministry of Economic Affairs, once entrusted the academic community to research on the styling design in Taiwan. The project collected 1,500 pieces of Taiwan's artifacts, and there were 30 cases of which further studies were done (Wei, et al., 2006).

Under the trends of globalization and knowledge-based economy, the low-cost manufacturing industries of the past can hardly survive in today's international market due to the fierce competition. Faced with international manufacturers and their brands, Taiwan's industries have known how to use the advantages of creativity and design ability and develop high value-added products with unique aesthetics. In this way, brand competitiveness could be increased. Currently, this is also the crucial developed part in the knowledge-based economy of the countries all over the world. In 2005, Jun-Liang Chen's work, Round Sky & Square Ground Ceramics Tableware, won the most influential Design Award in Asia. It has brought a big inspiration to Taiwan's design community. Also, it has shown that the method of using Chinese cultural elements in product design would give Taiwan an opportunity to be on the international stage. The design work skillfully mingled tradition and culture with modern utensils, and its unique aesthetics were indeed thrilling.

Besides, in recent years Taiwan's manufacturers have actively promoted the products of nostalgic styles, emphasizing cultural images. For example, BenQ once launched some CE products with limited supply (BenQ5250C Scanner, Joybook8000 Notebook, and fp785 Notebook). In these products, "Chinese culture" was the main design theme, and they had brilliant sales performance. Because the company received great appraisal in the market, an excellent brand image was established. Another phenomenon that is worthy to be mentioned is that there has been an annual increase on the works that used cultural elements as their design themes to win awards. This was observed in several important design competitions, including the Lite-On Creative Design Awards, Gigabyte Great Design Contest, IF Design Awards, and the Asia Design Awards. This indicated that cultural design has become the main stream of conceptual design, and it has been gradually accepted by the public.

This research discussed the current situation of Taiwan's electronics industries and how they have used Chinese cultural elements in product design. By comparing the differences between the mass-produced products and the award-winning works, the temptation was to find out a set of rules for Taiwan's industrial design, especially on the application of cultural elements and design methods. This research hoped to bring the most benefits to Taiwan's industrial design, thus increasing the competitiveness of Taiwan's products.

2 The Cultural Elements of a Product

Encyclopedia Britannica (1990) mentioned that the term "culture" originated from the Latin word "cultura", meaning the cultivation of a land or some plants. Afterwards, it meant the cultivation of a human being's body and spirit. Webster's Dictionary (2002) said that the meaning of "cultural awareness" should be a human being's psychological process of understanding his survival, lifestyle, and various activities of spiritual and physical realms. In 1871, Taylor proposed that "culture" is the

combination of knowledge, beliefs, art, morals, laws, customs, and other abilities and habits being created and inherited through history (Su, 2005). Therefore, the context of a culture becomes people's attitudes in life, and it is interpreted in people's memory. By the way of understanding and experiencing a culture, People would self-interpret and have extensive perspectives toward things.

In Chinese ancient books, culture means the achievements in culture and education. Ruth Benedict (1976) proposed that "cultural behaviors" are regional, artificial, and with great diversities. A culture would have a trend of being united, and it is like a human being with a set of ideology and behavior model. Chen (1996) indicated that the Frankfurt School gave "culture" the most general definition: all the laboring results of human beings could be considered as the products of the culture, and all of the human activities could be regarded as cultural activities.

In summary, "culture" could be defined as the symbol of human behaviors, and its purpose is to express viewpoints. Therefore, "cultural elements" would appear differently in various levels of people's social lives, and cultural elements would give meanings and possibilities to a culture. When conducting product design, the designer could select the appropriate cultural elements and use them on a new product. The product should be able to arouse certain people's association with that culture, thus stimulating people's nostalgic or immersive feelings and leaving people with a good impression about the product.

In the book Cultural Anthropology, Keesing explained the term "culture". It means a community's life style, meaning the activities that would occur repetitively and regularly. "Culture" indicates an organized system of knowledge and beliefs. By that system an ethnic group could establish their experience and perception, setting standards for their behaviors and choices (Chang, 1989). Therefore, briefly speaking, culture is "the life style of the entire society", and it includes the various social activities.

A Culture is consisted of multi-levels. Stephan (2004) believed that it could be divided into the visible and the invisible. Schein (1999) and Lee (2004) proposed that cultural characterization could be interpreted by three levels: basic assumptions, values, and artifacts. Furthermore, Hampden-Turner, Trompenaars (1997), and Spencer-Oatey (2000) divided culture into 4 levels: 1) basic assumptions and values, 2) beliefs, attitudes and conventions, 3) systems and institutions, 4) artifacts, products, rituals and behaviors.

Xu (2004) utilized Leong's theory "spatial perspective of culture" (2003), and matched the spatial structure of a culture and the three cultural levels. Concerning the design factors, the design attributes of cultural products were distinguished according to different cultural levels. The three spatial attributes of a culture are: 1) The outer "tangible" level, including colors, texture, shapes, surface ornamentation, lines, details, and components. 2) The Mid "behavioral" level, including functions, operation methods, ease of use, security, and the combinations. 3) The inner "intangible" level, including products with special meanings, stories, affections, and cultural features.

3 Research Methods

This research collected five of mass-produced products that used cultural elements in product design, including Transcend JetFlash, A-DATA MyFlash, BenQ 5250C Scanner, Joy book 8000 Notebook, and BenQ Fp785 Monitor. These products produced by Taiwan's manufacturers were designed to have cultural themes. In addition, 15 award-winning works (2002-2006) were selected, including works in Lite-On Awards, Gigabyte Great Design Contest, Asia Design Awards, IF Design Awards, Taiwan International Design Competition, and Intel PC Creative Stylist Competition. The selecting principle was that the works had to be with Chinese-originated cultural elements in their design theme.

2001-2006 mass-produced electronics products manufactured in Taiwan and the 15 award-winning works selected in this research were analyzed in aspects of design features, cultural meanings, cultural elements, and design techniques as in Table 1.

Table 1. The cultural attributes and design techniques of product samples

		Cultural elements					**Product representation**					**Design techniques**				
		Chinese Calligraphy	Chinese brush paintings	Utensils	Religion	Philosophy	External images	Comprehensive impression of theme	Detailed decorations	Operation methods	Functional symbols	Simile	Metaphor	Metonymy	Making direct use of cultural elements	Making indirect use of cultural elements
Mass-produced Products	BenQ Digital Scanne	ˇ					›						›		›	
	A-DATA USB Flash Drive	›	›				›								›	
	Transcend USB Flash Drive		ˇ				›								›	
	BenQ Notebook	›	›				›						›		›	
	BenQ Monitor		ˇ	›			›	›		›		›			›	
	Total: 5 pieces	**3**	**4**	1			**5**	1		1		1	2		**5**	
Awa	German IF Digital Scale			›				›		›	›	›				›
	CD Stereo			›				›	›					›		›

Table 1. (*continued*)

CD Player				ˇ	ˇ		ˇ			ˇ			ˇ	ˇ	
Intel Personal Computer	ˇ				ˇ		ˇ				ˇ	ˇ			ˇ
Lite-On Answering Machine			ˇ	ˇ			ˇ	ˇ	ˇ	ˇ	ˇ				ˇ
Lite-On Music Player					ˇ		ˇ			ˇ			ˇ		ˇ
GIGABYTE Conceptual E-Schoolbag			ˇ				ˇ	ˇ	ˇ	ˇ	ˇ				ˇ
Lite-On Conceptual Stereo			ˇ				ˇ			ˇ			ˇ		ˇ
Lite-On Digital Amulet			ˇ	ˇ			ˇ			ˇ			ˇ		ˇ
Lite-On Media Player			ˇ				ˇ	ˇ					ˇ	ˇ	
Lite-On Conceptual Keyboard			ˇ				ˇ		ˇ	ˇ			ˇ		ˇ
Lite-On Remote Control			ˇ				ˇ		ˇ	ˇ		ˇ			ˇ
Lite-On Conceptual E-book			ˇ				ˇ			ˇ					ˇ
GIGABYTE Media Player			ˇ				ˇ	ˇ					ˇ	ˇ	
GIGABYTE Photo Frame				ˇ	ˇ	ˇ	ˇ		ˇ				ˇ		ˇ
Total: 15 pieces	1		**11**	4	4	1	**15**	5	6	**10**	4	2	**9**	3	**12**

4 Analysis and Discussion

Table 1 shows that among the five mass-produced electronics products, there were three of them using Chinese Calligraphy as the main cultural elements, and four using Chinese paintings. Only one of them used both Chinese Calligraphy and paintings, and that one utilized the images of daily utensils. As to the 15 award-winning conceptual works, the application of cultural elements included Chinese Calligraphy,

artifacts, daily utensils, behaviors, aesthetics, religion, rituals, and even Chinese ideology and philosophy. Utensil images were the most popular application in product design, while religion and philosophy was used in four of the design works. Analyzed from the perspective of cultural levels, most of current mass-produced products used the elements in the "material level", and the decoration of Chinese Calligraphy and paintings could create obvious images of Chinese culture. Although most of award-winning conceptual works used the elements in the "material level" as well, they selected functional utensils to present cultural meanings. Some works even tried to explore the cultural and the metaphysical levels, including contents like religion, beliefs, rituals, behaviors, aesthetic ideology, or philosophy.

In terms of product representation, all of the five mass-produced electronics products were "external-image-oriented". There was one piece of work presenting the comprehensive impression of theme, while another one presenting the product's operation methods. On the contrary, all of the 15 conceptual works presented their comprehensive impression of themes, and 10 of them expressed design ideas through functional symbols. There were five pieces of works having the attribute of "detailed decoration", while six of them having the attribute of "operation methods". Only one piece of work had the attribute of "external image". The attributes that these conceptual works had were very different from the mass-produced products.

In terms of design techniques, all of the five mass-produced electronics products made direct use of images on the products. One of the five used the simile technique, while two of the five used metaphors. What was different from the abovementioned mass-produced products was that there were 12 of the award-winning works making indirect use of cultural elements, and nine of the 15 were using metonymies. Some of the work pieces made direct use of images like the way mass-produced products used. In the conceptual works, there were four using similes, while there were two using metaphors. The above analysis revealed that although mass-produced products would use similes or metaphors to develop design ideas and convey messages, in fact they did not go beyond the direct use of cultural elements. Decorations of Chinese Calligraphy (characters) and Chinese paintings (totems) were copied on the products to display Chinese styles. Therefore, there was no need for the designers to go through any symbol translation process, and they just directly presented the cultural elements on the product surfaces, without any modifications. As to award-winning conceptual works, most designers used metonymies, making indirect use of cultural elements in order to present deeper cultural meanings. Hence, the design procedures were very different from the ones of the "material level". The designers needed to explore the cultural and the metaphysical levels and transform the possible design elements through observation and re-interpretation. Afterwards, the new product could be developed according to the traditional design steps.

5 Conclusion and Suggestions

The purpose of this research was to compare the cultural attributes, design elements, product features, and other design techniques of the abovementioned creative cultural products. Through analysis and integration, the data of product differences and

correlations were known, hoping to serve as a future reference for the industry and the design community. The research results were as follows:

(1) The mass-produced products used Chinese Calligraphy and paintings as the main cultural elements, while the conceptual design works used various elements such as Chinese Calligraphy, Chinese brush paintings, artifacts, daily utensils, behaviors, aesthetics, religion, rituals, and even Chinese philosophy. In other words, not only the images of daily use items and utensils were used, but also the custom, affection, religion, and art were included. From the perspective of cultural levels, mass-produced products were having less application of cultural elements, especially in lack of the elements in the cultural and the metaphysical levels. Therefore, most of the mass-produced products were in the material (utensil culture) level, using outward cultural factors to present products' features. However, the conceptual design works covers cultural elements of the cultural (living life) and the metaphysical (spiritual life) levels, using inward elements to display cultural features. This phenomenon might be due to the fact that mass-produced products have more pressure on the manufacturing costs and functional limitations, thus having more restriction on the selection and translation of cultural elements.
(2) The mass-produced products made direct use of Chinese/ Taiwanese cultural elements, coping Chinese Calligraphy and paintings on the product surfaces in order to display Chinese styles. On the contrary, the award-winning works more skillfully selected and translated the cultural elements, using the cultural images or partial of the proto-type on the product forms or functions in order to present deeper Chinese/ Taiwanese cultural meanings.

From the way the award-winning works used Chinese cultural elements, Taiwan industrial designers could apply the similar design methods to the domestic CE products in order to develop the international market and business for Taiwan's enterprises. Nevertheless, the international market acceptance was surely one of the reasons why the mass-produced products were using cultural elements in "the material" level instead of "the metaphysical" level. Therefore, strategically speaking, in order to truly and effectively use Chinese/ Taiwanese cultural elements in product design, the cultural elements in the lower level should be tested and experienced first, and then the ones in the middle and the higher levels could gradually be applied in product design.

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Mobile Research: Benefits, Applications, and Outlooks

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Abstract. With the growth of the Internet, online surveys have enabled researchers to shorten the data collection and analysis cycle. While online survey is well-suited for collecting structured data and identifying relationships between variables, it's limited in providing immediacy and context. The prevalence of smartphones is enabling researchers to capture more context and minimize time lag between customer experience and data collection. This paper will discuss the merits, limitations, and application of mobile research, using a BlackBerry apps study as an example. Applications for different industries will also be discussed.

Keywords: Mobile, research, methodology, smartphone, user experience, design, contextual, longitudinal.

1 Introduction

The increasing prevalence of smartphones signifies an important evolution of how companies reach out to their customers. In particular, smartphones present an opportunity for companies to catch their customers during, or immediately after they have experienced a product or service. This often cannot be accomplished via current research methods, such as face-to-face/phone interviews, online surveys and analytics. Mobile research places companies closer to their customers, and hence enables them to gain a deeper understanding of the customer experience.

2 Literature

Online surveys often lack immediacy. This presents challenges when evaluating effectiveness of a product or service. Online surveys are often fielded to collect customer feedback weeks or months after they have experienced a product or service. Customers often cannot recall their experiences accurately or provide detailed feedback after the time delay, thereby reducing the usefulness of the data.

Also, online survey does not capture the context of the customers (e.g., customers' location and time point), making it difficult to understand the underlying motivations of the customers. Kaplan and Duchon noted that "The stripping of context...buys 'objectivity' and testability at the cost of a deeper understanding of what actually is occurring" [1]. Gable wrote “survey approach provides only a ‘snap-shot’ of the situation at a certain point in time, yielding little information on the underlying meaning of the data.” [2]. Lazarsfeld pointed out many research techniques are

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developed to ascertain the meaning of respondents' answers in the absence of contextual grounds. [3]

Research using mobile device complements online surveys to collect customer feedback with immediacy and context.

3 Study Overview

A recent study of BlackBerry apps will be used as an example[1]. The goal of the study was to reveal user experiences issues with a variety of BlackBerry apps and to capture the issues immediately after users have used the apps. BlackBerry users throughout the US were invited to download a mobile survey app. Over a period of a week and a half, after the respondents have used an app, they were asked to answer a small set of questions about their experiences. The survey app enabled the researchers to ask different questions at different time points of the study. In this case, we had a different set of questions at the beginning, middle, and the end of the study. At any time of the study, respondents can choose to discontinue their participation.

Mobile research can be conducted in a number of tools: SMS-based, web-based, app-based. The focus of this paper is app-based mobile research. All tools share similar benefits, but this paper will illustrate the added benefits of app-based mobile research. The benefits outlined are applicable to both quantitative and qualitative mobile research.

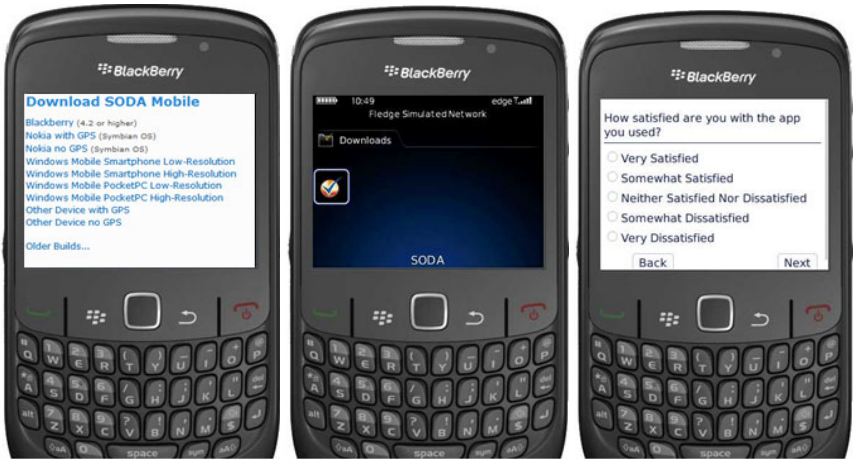

Fig. 1. App-based mobile study interface

4 Benefits of Mobile Research

4.1 Immediate

Mobile research is a powerful way to catch customers "in-the-moment". Customers are asked to provide feedback during or right after they experience a product or

[1] Blackberry Apps Mobile Study: June 16-21, 2010, N=1248.

service. In the Blackberry apps study, users filled out a short survey immediately after they have used an app. Since it's still fresh in their memory, they were able to describe the specific problems experienced (e.g., a social networking app crashed repeatedly when uploading pictures), and the capabilities they desired.

In particular, compared with web-based mobile survey, app-based mobile surveys minimize the time delay between the customers' experience and the feedback. App-based mobile surveys allow users to take a survey with one click on the app, rather than requiring users to open a browser/e-mail, navigate to the survey, and click on the link, as with web-based mobile survey. This is especially useful when researchers wish to gather feedback from the same customer via multiple surveys.

In general, mobile research often uncovers issues that may not have been revealed by online surveys, because the data are fresh, and more accurate.

4.2 Longitudinal

Mobile is also a great enabler of longitudinal research. With the prevalence of mobile devices, professionals and consumers alike now carry their phones almost anytime, anywhere. This provides an opportunity for researchers to understand how customer behaviors change over time. In the Blackberry apps study, mobile research enabled us to capture users' different queries over a period of one week. Hence, we were able to tie the reported issues to their pertinent queries. For new features and services, researchers can analyze customers' learning curves, and how their interaction with a product/service changes over time.

4.3 Captures Customers' Context

Understanding customers' context has always been a challenge. Where customers are, when they are using a product/service, and their intention have important impact on perceptions of a product or service. Yet it has been very difficult to capture, especially with remote research methods, such as online surveys and analytics. Because customers can provide feedback wherever they have their smartphones, mobile research helps put together additional "pieces of the puzzle" by capturing customers' locations and time points. For example, makers of mobile search apps can gain a richer understanding of a customer by asking about their locations (e.g., in the car, in a store etc.) App-based mobile surveys also allow researchers to serve timed-based questions. For instance, a retailer may pose different questions to its customers on weekends vs. weekdays. This would be difficult to achieve in a web-based mobile survey or online survey. Mobile research is a great tool to help put together the puzzle for customers' context.

4.4 Complements Existing Qualitative, Quantitative, and Data Analytics Methods

Despite the benefits of mobile research, it's not meant to replace any existing research methods. Rather, with its capability to capture immediate, longitudinal, and contextual customer feedback, mobile research adds an additional touch point to help paint a more complete picture of the customers.

5 Methodological Considerations

5.1 Sample

The sample may not always be representative. Even though smartphone users no longer consist of only early adopters, when interpreting the data, practitioners should note that respondents of mobile research tend to be relatively more sophisticated with technology.

5.2 Completion Rate

Completion rates with mobile research are generally good. Even with app-based mobile research, in which respondents are asked to download and install an app in order to provide feedback, in our experience, the completion rate is generally around 6%. (ie. Respondents that accept a study invitation, successfully download the app, and complete the study). Overall, the completion rate mostly ranges from 3% to 7%. Factors such as convenience and novelty will continue to increase or decrease completion rate, which should be continuously monitored, as mobile research methods evolve.

5.3 Level of Interactivity

Compared to personal computers, smartphone's smaller screen size and reduced functionalities limit the level of interactivity with the respondents. Even though stimuli can still be shown as on personal computers, interactive features such as drag and drop are mostly not supported. That said, increased level of interactivity of mobile research will likely be available in the foreseeable future.

5.4 Extent of Context

While mobile research is helpful in capturing customers' context, it's worth noting that as with most remote research methods, the context captured won't be as rich as face-to-face research.

6 Best Practices

Do…

Keep the questionnaire short. Respondents' expectation for time spent on smartphones for each task is short. Compared to online, telephone, or face to face methods, mobile research questionnaires need to be short.

Keep the list short. Smartphone screen sizes tend to be smaller than personal computers. To minimize scrolling, keep the response choices lists short.

Be very selective but don't underestimate the power of verbatim questions in mobile research. Contrary to the assumption that customers don't take time to provide thoughtful verbatim, in our experience, verbatim feedback from mobile

research has been very insightful. This may be due to mobile users being used to texting and messaging via their devices. That said, as with most remote research methods, keep the number of verbatim questions at a minimum.

Minimalist UI. Screen real estate is limited on smartphones. Consider foregoing widgets such as progress bar, and cosmetic elements, to minimize scrolling, especially on smartphones.

7 Applications of Mobile Research

Mobile research's strength in immediacy lends itself to products/services where collecting feedback immediately after customers have experienced them is important. In our experience working with clients, sectors that benefit from mobile research include:

7.1 Mobile Device/App Makers

Besides the benefit of gathering user feedback immediately after they have used a device or an app, as outline in our example, mobile device or app makers can benefit from app-based mobile research's capability to gather longitudinal feedback. This is especially useful for features or apps that have high repeated usage, such as search, social networking, and map tools, where users may revisit the tools multiple times a day, and often for different purposes.

7.2 Event/Conference Organizers

Soliciting feedback about an event/conference can be challenging. After the event, attendees return to their daily routines and may not take the time to respond to online surveys. For those that do, recalling their experience at the event is often not easy. Mobile research allows event/conference organizers to reach out to the attendees immediately after an event, or a specific program of an event (e.g., a workshop at a conference), collect feedback while attendees' memory are fresh, and store the data electronically (as opposed to paper-based research, which requires data entry before analysis can begin).

7.3 Hospitality Industry

Similar to event/conference organizers, hospitality industry (e.g., hotels, restaurants) can also leverage mobile research to collect feedback about their service immediately after customers have experienced it, rather than after the customers have left their proximity.

7.4 Merchandising/Advertising

App-based mobile research is also a great tool to measure the effectiveness of merchandising/advertising. Geo-targeting capabilities will enable retailers and merchandisers to collect feedback about advertisements and items while shoppers are

exposed to them in stores. Feedback is collected during the shopping process, rather than after.

7.5 Media/Content Provider

Media and content providers (e.g., network/cable channels) can also leverage app-based mobile research to understand viewers' perception of their content. App-based mobile research is time-based. This enables content providers to pose questions specific to a show/program at the beginning, during, and after the show/program. The immediate, fresh feedback from viewers allows content providers to not only measure viewership, but also to understand viewer perceptions and identify issues almost real-time, rather than days after the show/program has been shown.

8 Upcoming Advancements and Conclusion

As technology evolves, mobile research will evolve with increasing sophistication. For example, location-based triggers will enable researchers to pose different questions to customers, depending on their locations (e.g., at a particular store, restaurant). The advancement in technology will continuously augment mobile research's capabilities to capture immediate, contextual, and longitudinal data at large scale.

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Discussion of Design and Experiential Marketing in Ming-Show Pottery Cultural Creative Product

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Abstract. In the present day, the government of Taiwan is tiring to promote the policy of Cultural Creative Industries (TCCI), as well as to industrialize the cultural products with creation; thus, marketing is the major factor in industrial operation; furthermore, the exterior environment, competition between the same industries, promotion and sales of the distribution and the interior creative ability become the important points for the industry. This study was focused on the case study which discussed about the interior and exterior marketing strategy analysis of Ming-Show Pottery. The relevant information was obtained from domestic and foreign literatures, which also included interviews to understand the actual operating situation deeper for the industry by interview; meanwhile the SWOT analysis was also adopted in this study to understand the poisoning, external opportunities and threats and the internal advantages and disadvantages of target markets. The study results are obtained as follow (1) The model of Experiential Strategy consists of five factors: Sense, Emotions, Thoughts, Action and Connection; so that the customer will interest in the product and culture by stimulating those five factors; ;(2) The applied strategies in the future which including brand marketing, selling spots expansion, experiential marketing ways and different industrial collaboration were made via SWOT analysis as the foundational references to the industry; and (3) Establishing the model of experiential marketing strategy applications can improve the competitive ability of marketing promotion for the industry in terms of interactional marketing.

Keywords: Ming-Show Pottery, Lazurite, Cultural Creation, Marketing Strategy, SWOT.

1 Introduction: The Background and Motivation of the Study

As the progress of technology and the convenience of information transmission, the cultural industry of Taiwan has turned to the TCCI in present by the promotion of government. Culture means life of past, and the industry can be more creative if it can combine with innovation. As a result, how to promote cultural creative products to more consumers and allow them to get involved into consumptive experience besides to

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preserve and continue the culture of the industry will be the main point. "Cultural Industries" refers to contents of creation, production and the business, and the essence of it is the intangible assets and with cultural concept, and is usually protected by the intellectual property rights and presented by the forms of product and service (UNESCO, 2008). Therefore, the industry those take creative style as the core value will have highest added value by design; it combines not only culture, creation and uniqueness of product, but bring the infinite opportunities and growing space for economy.

As the reasons above, this study focused on the case study which discussed about the interior and exterior marketing strategy analysis of Ming-Show Pottery, as well as to introduce the concept of "experiential marketing". The relevant information was obtained from domestic and foreign literatures, which also included interviews to understand the actual operating situation deeper for the industry by field study. The research purposes can be inducted as following four points:

1. The foundation of the study theory was through the discussion of literatures to understand the implications of experiential marketing.
2. To understand the design and develop process and the general operating situation of Ming-Show Pottery by field study.
3. To consider the problems that the industry may face and the solvents it may adopt by SWOT analysis in terms of design marketing.
4. Finally, to construct the experiential marketing strategies for the industry to be the reference in their future operation.

2 Literature Review

2.1 The Discussion of Experiential Marketing

What is Experiential Marketing? Experience is not only defined as the product's concept or the evolution after purchased by customer, but all activities that could influence customer's purchasing decision can be called experience. In brief, experience refers to the value of consciousness, emotion, cognition, behavior and connection to replace the value of product's functions. Such as, the ridding probation project of automobile industry which allow customer to replace the value of the product itself with the trial experience. Therefore, Amould et al (2002) had divided experience into four stages:

1. **The Pre-consumption Experience:** Including search, plan, dream, predict and guess to the experience.
2. **The Purchase Experience:** Derive from the interaction between selection, payment, packaging, service and environment.
3. **The Core Consumption Experience:** Including consciousness, sense of repletion, satisfaction or discontent, discomfort or comfort and transformation.
4. **The Remembered Consumption Experience and the Nostalgia Experience:** It can help the photograph to be alive and allow people to feel old experience through storytelling, and discuss about past with friends; it can be helpful to memory classification as well.

Experiential Marketing: The experience marketing refers to a product or service, which selects some methods to provide the sensational, creative or emotional

experience to create extra experience value for the consumer. Therefore, Schmitt (1999) pointed out the "experience medium" includes communication, identification, product, brand establishment, environment, websites, human and so on. These experience media may create sense, emotion, thinking, action and connection. Customer will stimulate their needs by these factors to obtain the preference for product. Such as in automobile industry, aviation industry or the food industry enable the customer to have tries by themselves to urge customer interested in the product then increase the consumptive desires.

Fig. 1 Strategy experiential mold are composed of five factors- Sense, Emotion, Thinking, Action and Connection.

1. **Sense Marketing:** Composed of vision, hearing, taste, smell and touch to stimulate customer's sense experience and increase extra value to product. For example: The decoration of Ming-Show Pottery's store can attract the customer's visual feeling by the aborigine's totems, pictures or the traditional clothing.
2. **Emotion Marketing:** Emphasizes on customer's interior emotion, and creates connection with product by their own experience. Such as customer's consumptive behavior created by having the emotion with the product.
3. **Thinking Marketing:** It can initiate customer to create the experience of reorganization and problems solving via curious, interest so as to excite creative thinking from customers.
4. **Action Marketing:** It is used to create the customer experience which relates to the behavior mode and life style, including the experience occurred by interacting with others to change the consumptive habits.
5. **Connection Marketing:** It consists of sense, emotion, thinking and action marketing, and the major point in connection marketing is the right specific group and choice with demand; moreover, it can bring more experiences to customer by those factors. Thus, Ming-Show Pottery can stimulate experience on the five senses through their products to customers so as to make them interest in cultural cognition and comprehension to the products.

Fig. 1. The Model of Experiential Marketing (Schmitt, 1999)

2.2 Ming-Show Pottery

Colored glaze bead is the symbol of Paiwan culture, it also stands for the symbol of human's specific ideas; each colored glaze bead has different myth legend and denomination by the different color, pattern/motif. Ming-Show Pottery adopts the pith of the culture and applies on the creation and design to create cultural products which are different from in traditional aboriginal culture'. The products combine with other materials so as to make them to have more creation and customization on design. The brief introduction about the entrepreneur as shown in Table 1, and the Table 2 is the product design of colored glaze bead.

Table 1. The introduction of Ming-Show Pottery

Entrepreneur	Ming-Show Pottery
Set up time	June,15th, 2003
Person in charge	Ming- Zhi Li, Xiu-Uha Wu
Telephone	07-6101933
Address	82647 No.200, Lane 263, Jhanbao Rd., Zihguan Dist., Kaohsiung City 82647, Taiwan (R.O.C.)
Brief introduction	Ming-Show Pottery was named by the founder's name by the meaning of crating the culture art career together; they specialized in the handicraft article of aboriginal colored glaze bead and aboriginal related works. The products of Ming-Show Pottery have been selected as gifts for foreign guests by the chair man of Tourism Bureau unexpectedly, and thus being popular in Korea and Japan. The shop is looking forward to being one of cultural industries to be more exquisitely and art at present.
Product development	hanging ornament, jewelry, necklace, hand lace, hairpin, hat…etc.

Table 2. The characteristic of cultural creative product (organized by the author)

Product type	**Product picture**	**Product feature/ cultural story**
Necklace		**"Bead of Dexterity"** Legend: Papilio is famous by it's straighten fly. It symbolizes a person who works agile and quick in the movement so it's a suitable gift for an athlete and pragmatic worker.
Hand lace		**" Bead of Brave"** Legend: The person who has the outstanding distribution to the tribe or heroic performance in the battlefield can be given the bead. It can help to increase intelligent and brave. It symbolizes protection and security, advance bravely and extraordinary achievement.
Hairpin		" **Bead of Woman Weaver" (also called bead of virginity)** Legend: The old will donate the Palic necklace or hairpin to the daughter who is waiting to be married and it is suitable to be used in nubile age. It symbolizes the treasure, chastity and high technique, and is suitable to be worn by damsel and artist.
Hanging ornament		「**Bead of Sun** 」 Legend: It is said that there was a chieftain who always wears a sad face due to the hard transmission of information in the secluded mountain where he lives; then the celestial old man showed up who was willing to be the representative for the chieftain to make contract with the sun, and the sun promised him to call his people by the light. It symbolizes eternal pledge and unchangeable promise.
Compound material		「**Bead of the Pottery Pot** 」 Legend: The pottery pot in Paiwan is considered to noble's heirloom. And the boar tooth bracelet is considered as the man who has the heroic deeds in killing the wild boar, which is also distributed to the society. It consist of two materials to create another meaning for cultural product, and was designated to be the souvenirs in the 2009 World Games in Kaohsiung

Fig. 2. Products of colored glaze bead

2.3 The Relationship between Product and Experiential Marketing

There are many industries have connected products to experiential marketing in present day, such as the Starbucks which provides a temporary conference room, workroom, reading room with pictures and music to create certain kinds of phenomenon. Furthermore, IKEA sales the product by the form of family market to build the situation of living room, kitchen, and bedroom which allow customers to experience the phenomenon personally. In meanwhile, it will increase its exposure rate via the experiential media to promote the public relations so as to update the product value; thus, the experiential value can be improved by the explanation and promotion of the business owners. Therefore, the relations between products and experiential marketing can be strengthen by allowing consumers to experience the making process of colored glaze bead to produce their unique product by themselves. Moreover, it can use aboriginal situations, storytelling by the business owner and network to attract general customers to improve the relations as well.

3 Methodology and Procedures

3.1 Research Object

This study took Ming-Show Pottery as the object.

3.2 Methodology

1. SWOT analysis: It consists of advantage, disadvantage, opportunity and threat; the basis profit can be found by using advantages and opportunities to improve the disadvantages and threats. This study analyzes the advantages and opportunities of Ming-Show Pottery then to improve he disadvantage and threat by the establishment of the experiential marketing strategy.
2. Sample analysis: Analyzes the information from collection literatures, which can be the pictures, literatures, data or concrete object as well as to integrate the factors from the samples. This study had collected the first information via interviewing the Ming-Show Pottery to analyze the cultural products so as to understand the implications of product creation.
3. Case study: It can be adapted to progress in-depth study in order to determine the factors that can result in certain states or behaviors from individuals groups or institutions, or the relations between various factors (Wun-ko Wang, 2002). This study focused on cultural products of Ming-Show Pottery case to draw up the experiential marketing strategies which can be the operating reference for the business owner.

3.3 Research Procedures

This study can be divided into three steps, first step was the establishment of study object and purpose, then discussed the literature review to establish the base for the study theory; step two was to carry on the work of interview and record on Dec., 2010 by field study; after the analysis of the interview records, the last step was to make experiential marketing strategy to Ming-Show Pottery via marketing strategy manner.

4 Results and Discussion

4.1 The Analysis of Cultural Creative Product

According to the Ming- Show's actual development of the culture creative product, the classification of the products can be divided into five types which are the necklace, bracelet, anklet, hairpin, hanging ornament, key chain, compound materials design via the field investigation and interview to the founder; the attribute of the products is shown as table 2:

4.2 Investigation and Analysis of Industrial Operation Interview

This study had adopted in-depth field study to understand the details of the present operational situation to the business owners in January 2011; the subjects of the interview were divided into four parts: (1) Upstream- Creative research and development (2) Midstream- production and process (3) Downstream- selling situation and (4) Comprehensive discussion. The relevant subjects were detailed divided into other factors for discussion so as to record and establish the firsthand data as the basis for analyze. The analyze process of the information arrangement is shown as Table 3.

4.3 SWOT Analysis

This study has integrated the information about the present developing situation of Ming-Show Pottery, and has analyzed the design features of cultural product as well as to record the local field study to organize the factors of advantages, disadvantages, opportunities and threats for the shop's operation as shown in Table 4.

In Table 4 we can know how to hold the opportunities by the advantages when facing the future strategies of the industrial development; excepting to enhance the local cultural image and to promote the fame and competitive ability for the industry, developing local cultural products can bring to the development of business opportunities and promotion of cultural features so as to attract more visitors. Moreover, the disadvantages and threats can be improved by ways of different industrial cooperation to work with other art and cultural business owners, as well as to improve the design and develop ability of cultural products, enhance marketing strategy, expanding selling spots; the methods above are the essential factors to the industry in future operation.

Table 3. The analysis of industrial operation general situation (compiled by the author)

Upstream- Creative research and development	Creative elements	(1) needs of cultural transition(2) needs of life(3) needs of educational meaning(4)needs of market (5)different material combination (6) infinite extending development of Lazurite Art works (7) cultural combination and development of aboriginal populations
	Creation source	(1) to develop and produce a sample product according to the needs of market (2) tailor-make for customer's need (3) old products re-seek for new materials (4) remix traditional and modern design style (5) stories and legends of aboriginal culture
	Creation predicament	(1) fund (2) technological upgrading (3) human resource management (4)advertisement and marketing channel (5) display channel (6) recognition to product from market
	Production method	To make with extra care by handmade
	Cultural features of the industry	To spread and inherit aboriginal culture of Paiwan so as to expend the new market for cultural creative industries.
Midstream- production & process	Applied material of product	(1) pottery (2) wood (3) ore (4) fabric (5) rock (6) silver (7) agate (8) dzi beads (9) turquoise (10) soapberry (11) crystal (12) animal teeth
	Product variety	Relevant Lazurite necklace, bracelet, anklet, chatelaine, hair pin, clothing and so on.
	Creation series	(1) pearl of sun (2) pearl of noble (3) pearl of woman weaver (4) pearl of brave warrior (5) pearl of land (6) pearl of peacock (7) pearl of tactician (8) butterfly series
	Production mechanism	All products are produced and developed by the shop itself.
	Production predicament	(1) fund research and development (2) mass production for customization (3) market channel (4) recognition to product from market
Downstream- selling	General situation of market	Buyers: are divided into official and civil individual. The market depends on official, governmental and general public buyers in present.
	Major selling market	(1) government gift (2) cultural market(3) creative market (4) teaching market (5) activity market
	Present marketing strategies	(1) stands of creative market (2) street artists(3) Internet selling (4) introduced by friends
	Future marketing strategies	(1) industry-university cooperative research project (2) attending national contests to increase fame (3) to be selected in the certification of craft house
Comprehensive discussion	Product plan	The technologic instruction of product package design, marketing design and management, science and technologic fabrication or craft design can make art works into products, as well as to apply the aboriginal cultural features to the Lazurite works in order to design unique products by industry-university cooperative research project.
	Product production plan	Introducing design esthetics and cultural design implications, as well as to make the product to be sophisticate, artistic, living and characteristic style design. Moreover, mass-production can improve the output value for the workroom.
	Future development plan	Establishing Paiwan aboriginal culture museum to attract more visitors and to increase operating income.

Table 4. SWOT analysis of Ming-Show Pottery

Strength	**Weakness**
1. It has abundant aboriginal cultural stories and legends. 2. The selling spots is in the prosperous city where can attract more people to notice their products. 3. The products combine with and apply other natural materials to create diverse product values. 4. The products can be designed and produced at home. 5. Cultural products have their own brands; this can helps to be easy recognized and different with others. 6. It has own designers and selling stuffs to lower human resource cost. 7. The shop can be reserved for visiting which can help to reach the purpose of experiential marketing.	1. Lazurite has to be produced by mass human resource; it's hard by mechanical mass production. 2. The culture of aborigine is hard to be accepted by Han people; therefore many consumers are not familiar with the features of the industry. 3. It lacks of marketing channels, so it's hard to expend the scale of the industry. 4. It lacks of professional managers and marketing staffs. 5. The abilities of innovative develop and design has to be improved. 6. It lacks of well package design. 7. It has greater cost for production.
Opportunity	**Threat**
1. It can join the industry - university cooperative research project to improve the industrial competitive ability. 2. To go deep into the basic levels of population to promote the Lazurite culture through activities. 3. To accept the assist policies which help to promote art and cultural industries by government? 4. To work with local governments so as to develop the gifts for the local regions. 5. To contact with mediums more actively so as to increase the measures of placement marketing. 6. To attend national competitions or apply to the fine works' and craft house's certifications so as to increase the fame for the industry. 7. The attribute of the industry can be listed as the sightseeing factory, or to build the Paiwan aboriginal cultural museum so as to expand the strategy of experiential marketing to attract more visitors and incomes.	1. There are more same business operators with the same industrial attribute in the market; as a result the environment of the industry has great competition. 2. The business owners of art and cultural industry can corporate with cross-industrial union mechanism to increase the added value. 3. The business owners of art and cultural industry have various marketing platform, and the workroom of the industry combines with experiential marketing strategy to promote and increase output value and income. 4. The product of the same attribute have lower unit price in general due to the mass production and development. 5. The beneficial result can be increased due to the speed of mass production. 6. The cultural products of art and cultural industry can be customization in mass production.

4.4 Ming-Show Pottery–Experiential Marketing Strategy

Ming-Show Pottery shows that the shop can bring customers five senses experience by crating experiential phenomena; it also use experiential media to allow consumers in-depth understand the cultural story which introduces the implication of Lazurite. Furthermore, the shop allows consumers to make their own Lazurite by themselves so as to increase their interests on the products and to promote the selling rate. Table 5 is the experiential marketing strategy made for Ming-Show Pottery by this study; it applied the strategic experience module and five senses elements as well as to combine aboriginal cultural factors to show the experiential marketing process.

Table 5. Experiential marketing strategy of Ming-Show Pottery

Strategy experience module	Five senses	Applying factors	Experiential process
Sensational marketing	vision hearing touch	Aboriginal totem and symbol aboriginal music experiential DIY of Lazurite	Customers can hear the aboriginal music, and appreciate the phenomenon which is created by aboriginal cultural graphics and decorations when they step into the store; moreover, they can experience Lazurite DIY by themselves as well.
Emotional marketing	vision hearing	Cultural and story film narration, staff explanation, film introduction	Staff explanation or film narration can help customers to develop emotion and recognition in Lazurite culture as well as to understand the implication of aboriginal culture.
Thinking marketing	vision hearing touch	Film introduction aboriginal music Lazurite DIY experience	Allowing customers to produce curiosity and provide more creative ideas through the music and film introduction by staffs.
Action marketing	vision hearing touch	Aboriginal traditional dance Lazurite story exhibition	Holding aboriginal dance activities or playing aboriginal cultural drama can develop well interaction between customers and business owners.
Connected marketing	vision hearing	Introducing relevant information by e-media or web sites.	Combining sense organs, emotions, thinking and action marketing to specific population or demand. In addition, allowing customers to know about the cultural implications of Lazurite deeper by experiential media.

5 Conclusions

This study was focused on the case study which discussed about the interior and exterior marketing strategy analysis of Ming-Show Pottery, as well as to introduce the concept of "experiential marketing" to the industry. The relevant information was obtained from domestic and foreign literatures, SWOT analysis and interviews to understand the actual operating situation deeper for the industry by field study, as well as to establish experiential marketing strategic mode by strategic experiential module and experiential media. The study results are obtained as follow:

1. The model of Experiential Strategy consists of five factors: sense, emotions, thinking, action and connection, so that the customer will interest in the product and culture if Ming-Show Pottery can stimulate those five factors.
2. The applied strategies in the future which including brand marketing, selling spots expansion, experiential marketing ways and different industrial collaboration were made via SWOT analysis as the foundational references to the industry.
3. Establishing the model of experiential marketing strategy applications can improve the competitive ability of marketing promotion for the industry, as well as to improve the interaction relations between customers, firms and products in terms of interactional marketing.

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Friendly Design and Interaction Relationship Study on Sitou Tea-Sipping Design of Cultural Product

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Abstract. Cultural products contain external and internal implications. The distinctive implications of products and the interactive relationship with users are the foundation for cultural creative products. Based on this, the conversion of friendly design in cultural products is investigated through the study of the relationship between friendly design and interactive relationship in cultural product, literature review and case analysis with the application of converting Sitou local cultural characteristics to the design development of cultural creative products, for the purpose of promoting product value. Thus, three conclusions are proposed as follow : (1) the three major elements of "emotional arousal", "emotional association" and "emotional communication" can be taken into account when discussing the conversion of product friendliness to help designers' product style design and the emotional communication; (2) with the added-value of converting Sitou's local cultural characteristics, the tea-sipping products studied show the unique elements of local Sitou culture and the style differentiation of delicate products; and (3) friendly design in products is able to serve as a medium to convey the emotions for enhancing the interaction between people.

Keywords: Cultural Creative Product, Friendliness, Design, Interaction.

1 Introduction

The cultural products of cultural creative industry or creative industry are the production of the conversion between life style and consumption patterns. The necessity of cultural creative products is relative but not absolute. According to the description in terms of cultural and artistic products in post-modernism, personal feelings and emotional judgment have gradually replaced objective judgment of single values. [5] Indicates that the value of cultural products is equivalent to "implications". While the "use value", according to the rule of experiences, is the meaning visible from the appearance of the products (external), the symbolic value is the meaning behind the products (internal). The implications of the cultural products is considered an application of converting cultural use value to cultural symbolic value and even to symbols of value for creating indefinite business opportunities [6, 10, 7, 3]. The unique implications of products and interactive friendliness between users and product as a result are the internal foundation of cultural products design.

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Apart from creating individual product language showing the uniqueness of products, it enhances product's friendly interactive value.

Based on the ideas, the friendly design and interactive relationship between cultural products are studied through collecting cultural product samples in the market; it can be used to analyze the case for friendliness conversion form by discussing the design elements from the interaction and communication between products and users. In addition, the design and development of creative tea-sipping culture products with Sitou local cultural elements are introduced to verify the evaluation of the friendly design and interactive relationship in cultural products. The interactive value between cultural products and the users could be promoted and the results could be the references for sellers and relevant researchers when conducting cultural products design. The study aims at achieving the following three goals based on the background and motives above, which are:

1. Generalizing the conversion elements for friendly design products by discussing the cases of cultural product.
2. Conducting the developmental design of innovating tea-sipping products by discussing Sitou's local cultural symbols and implications, and turning them into design elements to produce innovative value for the products.
3. Recording the evaluation of the interaction between users and products to generalize the elements of friendly design in cultural products.

2 Literature Review

In order to study the theoretical basis of friendly design and interactive relationship in cultural products further, the following are the review discussions for relevant theories aiming at friendly design products and Sitou cultural image.

2.1 Friendly Design in Cultural Products

Interactive Design and Communication. In daily life, no matter what activity an individual is engaging in, he/she continuously transmits personal ideas to others and also gets the other information from other people or media Such behaviors are the elements of communications. Generally speaking, there are two ways of communication, namely the verbal and non-verbal communication [8]. In view of design, product or visual communication design is associated with two participants, presented participants (the description in the process) and interactive participants (those whom communicating with each others through certain media, such as producers and viewers). In the course of such communication, interaction in some conditions is directly and immediately. For example, practically designers communicate with viewers by showing various designed graphs.

Furthermore, there are some differences between the natures of communication in designers and viewers. The former allow the "message" to be "delivered" and "receipted" actively, while the latter is to "receive" the "message" passively. As a result, what it takes to be the complete design drawings and products is essential. Products and design drawings are the objective knowledge that could be learnt from objective experiment and this depends on mutual participation from designers and viewers to further figure out the best module with more types of interactive

conversion for passing the messages behind products and the association between designers and users.

The Conversion Types of Friendly Design in Products. From the theories of communication mentioned above, cultural product itself also has much deeper emotional elements. Emotion is the origin of design and creation, and has been widely used in product design in addition to arts. Subjective self-expression and objective cultural image can be considered in the course of designing cultural products. Adopting multiple essences and understanding cultural implications when expressing friendly emotions help products transmit or arouse the nature of emotions.

The conversion of friendly design product in the research mainly refers to the concept of using emotions in design as proposed by Donald A. Norman in "Emotional Design" [4]. The following three levels are indicated aiming at emotions in design thinking:

1. Instinctively level: the original effects of product including product presentation, perceptional impact and feeling
2. Behavioral level: the experiences which can produce influence on product function and use to users.
3. Reflective level: the feeling, recognition, emotion and memory which can influent the conscious and high-level part. The interactive influence between thoughts and emotions can only be felt at this level which may have change due to the difference in various cultures, experiences and growing process.

After combining these three levels and the representing skills of emotional friendly design, three major essences, "emotional arousal", "emotional association" and "emotional communication" are taken into account when discussing the conversion of friendly design in products. In the level of "emotional arousal", the instinct reflection is arose by the primitive instinct in the natural environment; in the level of "emotional association", designer's motive is arose by emotion and association is used for situational imagination; in the level of "emotional communication", the attraction of product is the "feedback" in design rule to serve as a communication bridge for the communications between human beings and matters. The conversion association is showed in figure 1.

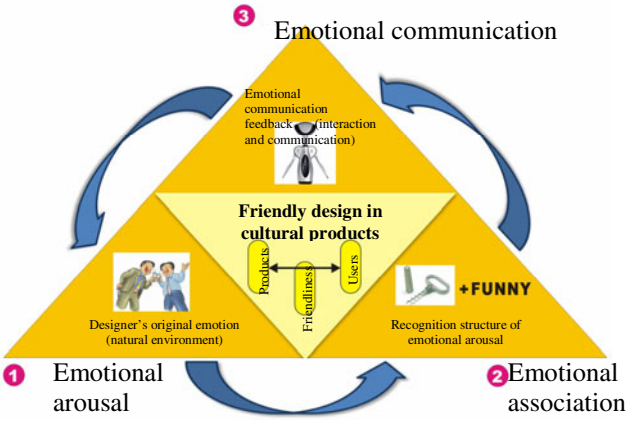

Fig. 1. Conversion of friendly design in cultural products

2.2 Sitou Cultural Image

Sitou Forest Park of National Taiwan University's experimental forest lies in central Taiwan and administratively belongs to Luku Township in Nantou County. It covers about 2,500 hectares with the altitude ranging from 700 to 2,000 meters. The climate is mild and the mountain outlook is magnificent. Not only is it abundant in natural resources but also in plant species and wildlife resources. In addition to offer an excellent environment for eco tourism, it is a veritable treasure house for academic research applications from various university departments and graduate institutes in biology sciences. Furthermore, it also provides us with a place for ecological education [1]. Under the forest management in recent years, the Sky Walk is designed as a place for ecological observation that enriches the forest park's worth for visits and becomes a famous scenic spot in Taiwan.

The data of research questionnaires show that the top five elements with the most Sitou Forest Park cultural image are the Giant Tree, Sky Walk, Bamboo House, Ginkgo The Grandfather tree and the Landmark of Sitou –University Pond [2].Random sampling was conducted to select the ginkgo tree and the university pond as the major subjects for cultural image conversion to carry out the cultural product design development.

In addition, Chinese firs, cypresses, red cypresses, ginkgo trees and bamboos are widely planted in the park. Among the plants, cryptomeria japonica and bamboo forests are the most famous. Local materials are also selected for the production manufacturing in the hope of combining creative tea-sipping culture product design with unique natural resources and cultural landscape of Sitou Forest Park to develop cultural products with good quality and raise the added-value of domestic materials.

3 Methodology and Procedures

3.1 Research Subject

The research subjects are the ginkgo and the university pond representing local cultural image in Sitou forest park at Luku Township, Nanto County.

3.2 Methodology

1. Literature review: Literature review is one of the methods for historical research that emphasizes on describing literature content and re-chronicling the literature for better understanding. The conversion module theory of design communication and friendly design products are studied by collecting and analyzing the literature data.
2. Case study: case study is the in-depth study to determine the relationship between the factors from the status, and behaviors of the individuals, groups and institutions. The research aims at discussing the distinctive cultural images of Sitou Forest Park, analyzing the data of cultural products in the market and converting cultural image design to cultural product of tea-sipping.
3. Field study: the techniques of "interview" and "record" are adopted in the research. Interviews were conducted and the processes were recorded for users of tea-sipping cultural products in terms of their using assessment in the hope of collecting more object and real data.

3.3 Research Procedures

There are three stages for the research: the research subject and purpose are determined for further literature review to establish the theory foundation in the first stage; the product design is developed and sample is produced in the second stage; the filed interview is conducted in the last stage with the proceeding of users' evaluation interviews and records in May, 2010. The collected data was also analyzed to establish the module.

4 Results and Discussion

4.1 The Case Study of Friendly Design in Cultural Product

There are too many kinds of cultural creative products in the present market; however, this study focuses on the deeper investigation of the relationship between design thinking and friendly design in cultural products when designers are in the development process. The table 1 shows the study case of cultural creative products in the market; two of them have the functionality as well as the combination of the cultural design elements. This is to sum up the design elements for conversion of friendly design in product by discussing "emotional arousal", "emotional association" and "emotional communication" for understanding the use of designer's elements such as symbolic cultural symbols, conversion of product function and friendly emotion.

Table 1. Case study of friendly design in cultural product

Product/Photo	 (Dragon-shaped chopsticks stand/bottle opener)	 (styled Salad mixer)
Emotional Arousal	You are drinking with friends, and y standard bottle opener; the scenario is with a dull, ordinary bottle opener in h when you are drinking delightedly	You are dining at a restaurant with a cold, lifeless salad mixer in hand. There is nothing special about this mixer except that it is a salad mixer.
Emotional Association	I will be more willing to use it if it looks funny.	If a salad mixer is given a cultural meaning (combined with the shape of an ancient weapon) and fun, as well as emotionally bonded with the users, would it be helpful to increase the joy when using it?
Emotional Communication	The use of reification on the product design to conveys the pleasure of drinking. When friends see the bottle opener, more joy would be added out of the curiosity.	The product design applied reification and combined with composite materials, to allow cease the image of cold, lifeless product it used to be. This may help to increase the deli feeling to the user except the functionality of product itself.
Friendliness Conversion	To increase pleasure of drinking for the interaction.	To increase delight feeling for users.

Note: the photo is taken from https://www.npmeshop.com/

As shown in the case study of cultural creative products above, the conclusion and analysis of emotional design can help designers to focus on the style design and conversion of emotional communication. A product with emotions makes people feel more decent. It is no longer concerns with the changes in terms of appearance and form of an object only, but to make the receiver to feel the internal awareness of an object through the emotional presentation of it.

4.2 Design of Innovative Tea-Sipping Cultural Product

From the perspective of innovative development design, the Sitou landscapes culture and the tea-sipping product design are selected as the development objective, in the attempt to integrate new structures and styles into the creation of cultural image, as well as to investigate the evaluation of the friendly interaction between products and users. Tea drinking culture in Taiwan is a relaxing and pleasing activity that friends can enhance their friendship through enjoying tea together while talking and chatting. However, how do people in the busy modern life make a good pot of tea easily? Also, the traditional tea wares are more complicated in the ways of use and cleaning for the modern life which are not suitable for people nowadays. These factors are the purposes for the research. The design issue analysis and the initial improvement are shown in the table 2 after collecting the data and studying the advantages / disadvantages of the existed tea-sipping products with the integration of innovative ideas in the study.

Table 2. Design issue analysis of tea-sipping product design

	Design issues	Initial improvement
1	The tea tray on the market is poor in creative design and not able to break the constraint of traditional design.	Design the innovative elements and the change of the types.
2	Tea ware and tea tray are usually separately placed that occupy too much space.	Include the convenience of tidying up function that it can be used for placing tea-making facility when not being used.
3	When making tea, extra cups placed on the tray cause the waste of space and inconvenience for use.	The design of placing all cups in certain areas.
4	Tea tray in recent years has the designs of water sink and drain hole, but it will quickly fills up after several uses due to capacity.	Drain hole needs to have a tube which is cumbersome and therefore not suitable for the design elements. Water sink volume should be increased.
5	Product styles are highly repetitive and similar to other products without any design innovation.	A historic and cultural implication may be added to the design, and bionic design, zen presentation, modern essence and aesthetics can be some of the ideas for evaluation and analysis.

After analyzing the design issues, table 3 is made to indicate the design guidelines and orientations. Figure 2 is the draft of innovative idea, Figure 3 shows the 3D module construction and Figure 4 indicates the completion of product mock-up.

Table 3. Design guidelines

	Design Highlights	Design Orientation
1	Specialty	The simple combination appearance and human-based interface design allows easy portability and assembly.
2	Material	Wood (80%) + metal components (20%)
3	Cultural image	The design for images of Sitou gingko trees and the university pond
4	Size	W500 x H85 x D300 (mm)
5	Style	Uniqueness of human, natural and artistic elements
6	Sustainable design	Primary concern of manufacture is easy-to-assemble/disassemble parts for mass production.

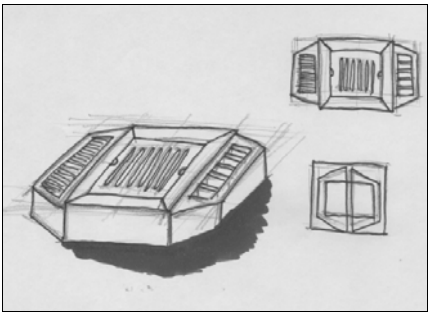

Fig. 2. Draft of innovative idea

Fig. 3. 3D module construction

The innovative tea-sipping cultural product in light of this study is named "Ginkgo Happiness Tea Tray" which combines the forms of ginkgo and bamboo and turns tea-making tray into a product two cultures. The design of tea cup and cup drain on left and right sides of the tray displays the consideration to the convenience for not only tea-making but also tidying up; this can help to save time for complicated tea-making preparation for modern people.

Fig. 4. Completion of product mock-up (Designers: Cheng-Dar Jan, Producer: Yong-Chang Zhang, Instructor: Chi-Hsiung Chen)

4.3 Design Evaluation

After the innovative tea-sipping cultural product design was developed, an interview for users' evaluation was conducted in May 2010. The following are the design evaluation analysis from the results of five users' experiences in terms of friendly design and interactive relationship in cultural product. The design evaluation analysis and the information of the users are as follow:

1. The basic data of the users
2. Design Evaluation

A. Tea-sipping product is also the artistic product with value of collection and display. The study has received widely positive feedback by creating innovative tea-sipping products with the use of conversion of Sitou local cultural elements. One of the users mentioned that "… the product not only has the function of traditional tea-making but also serves as a household decoration with its unique exterior style when not being used". From the results, while the appearance designs of traditional tea ware on the market are more typical and lacking of differentiation, the products with Sitou cultural image design not only enhance the product design value but also show the life and meaning of the culture.

B. Human-Oriented Design— Pleasure of Interaction. To adapt the modern life and improve the disadvantages of traditional tea ware, the focuses of the human-oriented tea-sipping product design are on the convenience and simplicity of the use. In addition to product's basic functions, users' tea-making habits are also considered to make users feel the interaction from tea-sipping for maintaining the friendliness and conveying the warm feeling to others.

C. Friendly Design — medium for emotional communication. Cultural products does not require too much decoration, instead, its simplicity is also able to convey the implications. The friendly design and user interactive relationship are verified by the tea-sipping cultural product in this study. Three of the users in this study all agreed that the product is able to not only advance the tea-making pleasure but enhance the product use frequency as well as increase the joy. It can be regarded as the greatest communication activity and the medium for emotional communication to shorten the distance between human beings and matters with the friendly design.

Table 4. The basic data of the users

User	Age	Occupation	Tea-sipping Experience (year)
A	45	House wife	10
B	53	Teacher	20
C	35	Bank Accountant	8
D	48	Designer	12
E	50	House wife	15

5 Conclusion

The conversion of friendly design in products and the interactive relationship are investigated to increase value for products by the study of literature reviews and case studies, which applied Sitou's local cultural characteristics to the design and development of cultural creative products. Three conclusions have been made from the study as follow:

1. The friendly design of cultural products is investigated as the conversion of product friendliness through the introduction of "emotional arousal", "emotional association" and "emotional communication". This helps designers to focus on the style design and the conversion from emotional communication to design ideas.
2. A new style cultural tea-sipping products is developed by the combination of the Sitou local cultural elements through this study; it helps to show the uniqueness of the local culture there which may create delicate products that distinguishes itself from others.
3. The friendly design in product is considered as a medium for emotional communication which helps to shorten the distance of interaction between human beings and matters. The focus of cultural products, compared to general product designs in terms of attributes, are gradually diverted into the improvement of symbolic values from the functional orientation; it shows the unique identity and differentiation for the products, and that is the central purpose of the cultural product design and development.

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Creating Effective Personas for Product Design: Insights from a Case Study

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Abstract. Personas are a popular tool for product design professionals. However, controversy exists in the product design community in terms of its validity and applicability as a vehicle for client insights. Based on persona development work we have performed for a financial services company, we propose best practices that could help create more useful personas in support of product design.

Keywords: Web design, product management, persona, client insights, user experience, user research.

1 Introduction

A popular design tool, personas are useful in helping product design professionals adopt a user-centered design approach. However, effective personas can be more difficult to develop and apply than other types of client research insights, such as UI design recommendations based on usability studies and wireframe evaluations. In this paper we will present analyses and recommendations for how to avoid common pitfalls and improve the way personas are developed and leveraged through the entire product design cycle – from developing business requirements, product concepts, functional specifications and web content to creating the interaction and visual design of the user interface. We will illustrate our points through a case-study approach, drawing upon our extensive experience with persona creation in software, eCommerce and financial services industries and, in particular, learnings from a persona project that we completed for a major financial services company.

1.1 Background and Our Research Approach

A few years back, when one of the authors joined a financial services company to start the web market research function for its fund business, there had been little insight into how their clients interacted with the website fund family website. The site provides product information, education, and market insights to financial professionals and individual investors who are interested in the company's investment products. The authors worked to establish user research as a foundation to inform the strategy and design of the website, conducting a number of usability studies and wireframe

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evaluations for various website design projects. However, it became clear that we still lacked a baseline understanding of the key target audience: financial advisors who use the company's products as part of their client portfolios. The usability studies we conducted shed light on key UI design improvements needed for specific web pages and web-based applications, but they did not provide a fundamental picture of how the advisors think, what role the site plays in their overall business process, and what motivates them to come to the site instead of competitor sites. Against that background, we started considering research that would fill this gap.

After discussing the organizational needs with internal business stakeholders, we decided to utilize personas, fictional characters representing user archetypes, as the research deliverable in which we would package the insights. Each persona was to include a summarized description of the character's personality, motivation, and behavior. Our decision was based on the notion that the personas would help designers and product managers to obtain a user-centered perspective [1]. In contrast to conventional client research reports that contain lengthy details, personas contain vivid descriptions of users that help product design professionals develop an intimate and internalized understanding of the target audience, making it easier to design specifically for that user.

Often, when developing personas, a team will begin by performing an ethnographic study with a reasonably large sample size in order to provide an in-depth understanding of users in a contextually meaningful manner [2]. Due to cost-benefit considerations and access to a large amount of pre-existing ethnographic research on the same user base, we decided to employ a two-step approach that combined leveraging existing client insights and conducting user interviews. First, we reviewed the existing web user research the firm had produced over the previous three years to develop hypotheses regarding our financial advisor users' core behaviors, motivations and attitudes in relation to the website. This research included a previously conducted ethnographic study for the business and a number of usability studies we had conducted for the web site. In addition, a number of personas had already been created as part of the previous ethnographic research for the financial advisor clients – these personas were not developed for the web, but could still serve as a good starting point for our work. After developing our hypotheses based on the existing research and identifying gaps in our understanding, we conducted one-on-one interviews with ten advisors in which we explored their daily activities, organizational composition of their firms, job-related pain points, tasks, a day in the life, and so on. Based on the findings from these interviews we developed two distinct personas.

1.2 Components of the Web Personas We Created

In developing the personas, we took into consideration the professional nature of the users we were representing. It was clear that our personas needed to emphasize business-related elements such as online and offline tasks, business processes, organizational structure, measures of success, and so on. At the same time, we wanted to provide a window into the user's psychological world, exposing the motivations and personal beliefs that drive their overt behavior. Based on these considerations, we included the following components when constructing the personas:

Primary goal, background, key motivations. We started each persona by including a picture of a randomly selected professional. Then we included a *primary goal*, which states in one sentence the primary objective the persona wants to achieve relative to his/her job. Next we included a *background* paragraph, which highlights the professional background of the persona. We then included his/her *key motivations* for visiting the web site and why he/she visits other financial websites. These components create a picture of how this type of user thinks and behaves, and describe their primary motivation relative to their investment advising business.

Mindset, objectives/needs related to mindset, and behavior to meet objectives/needs. In this section we provided more detailed information about the personas, focusing on their psychology and behavior. In doing so, we included three components: *mindset*, *objectives/needs*, and *behavior to meet objectives/needs*. *Mindset* refers to high-level categories in which the users organize and think about their core activities. We uncovered four distinct mindsets through the research synthesis and user interviews for the financial advisors relative to their web behavior: *research*, *building investment strategy*, *servicing and prospecting clients*, and *maintaining expertise*. Mindset in itself describes at a very high level how users think and what activities they group together in their minds. In order to describe in more detail what the user tries to achieve within the mindsets, we included a number of *objectives and needs* associated with each. For instance, when an advisor is in the research mindset, he or she could have a number of specific needs such a need to track the overall stock market, a need to understand the performance of a client's portfolios, a need to compile useful information to pass to clients, and so on.

Mindset and objectives/needs describe the psychological aspects of the personas. In order for the persona to generate actionable product ideas that effectively support user tasks, there is a need to provide an account of *user behavior*. This is accomplished in the "behavior to meet objectives/needs" component. Here, we described the types of tasks and activities that advisors are engaged in to meet their objectives and needs. Some examples include going to Yahoo! Finance to obtain market news, using a financial tool to conduct finance-related analysis, going to a fund provider website to get detailed fund information for funds belonging to that fund provider, and so on.

Priority scale. Different personas have different sets of priorities. For example, a financial advisor who focuses on constructing winning portfolios for his clients will place high priority on research and low priority on communicating with clients; for a financial advisor who focuses on communicating with clients, the priority is the other way around. Listing out priorities for personas helps us prioritize web projects to be consistent with user needs, and helps us to understand which persona a given project is most likely to appeal to. In order to give readers a quick overview of such priorities, we included a priority scale for each persona we developed. Below is an example that illustrates how this is done for one of the personas that we created:

Fig. 1. An illustration of Priority Scale as shown in the Persona document. The priority scale helps product professionals have a quick view of the relative priorities of a persona.

1.3 Web Personas Uncovered

Through the research, which consisted of a synthesis of previous internal research and interviews with ten financial advisors, we uncovered two major web personas for the advisor web site users. One persona, called Thomas in this paper, focuses on creating winning portfolios for his client, and the other, called Lindsey in this paper, focuses on building a bigger client base to drive business success. Thomas, in support of his key goal of creating quality client portfolios, places emphasis on conducting research and building robust investment strategy. His typical web behavior includes conducting in-depth portfolio analysis, using specific analytic tools such as spreadsheets and financial software, following the commentary of a few trusted industry experts, and so on. Lindsey's key goal, on the other hand, is growing business by expanding her client base. She places a greater focus on building client relationship, and consequently her typical behavior supports a client-focused mentality. She stays on top of world events in order to answer clients' questions, gathers investment information to share with clients, updates her investment expertise to appear confident and capable when interacting with clients, and so on. While both personas perform similar web-related tasks at a first glance, the ways that they perform those tasks differ due to their different underlying motivations. Thomas seeks quality, depth and accuracy in information and analysis, whereas Lindsey seeks higher-level information and conducts investment analysis that can benefit her conversations with clients.

2 An In-Depth Look at the Persona: It's Not What You Think It Is

Personas are a commonly used, yet sometimes controversial design tool. Within the design community, one can find different opinions about what belongs in a persona, how personas should be created, how personas should be used and what value personas offer. While the authors had extensive experience creating and using personas prior to this project, we gained many additional insights regarding how to best leverage this tool. We will point out common pitfalls we have seen in using personas and suggest best practices based on our learnings.

2.1 Personas Describe a Mentality and Behavior, Not an Actual Person

A common practice in using personas is to treat the persona as corresponding to a particular person. For instance, in an eCommerce context, hypothetically we might identify two personas, one called Impulsive Shopper and the other Cautious Shopper, and are tempted to classify actual web visitors to eCommerce sites as either Impulsive Shoppers or Cautious Shoppers. While this approach is a convenient way of applying personas, it can create serious issues. A given user may or may not assume one persona all the time – he or she might behave in a way consistent with one persona in some occasions and with another persona under other circumstances. For instance, a particular shopper might be an Impulsive Shopper when it comes to small purchases and Cautious Shopper when it comes to big-ticket purchases.

Let us take eBay shopping for another example. Considering eBay's business model, one might assume, in a highly simplified manner, that eBay has two primary personas, conveniently called Auction Shopper and Fixed-Price Shopper. Auction Shopper likes to participate in auctions because of the great deals available there and the excitement associated with the bidding process. Fixed-Price Shopper on the other hand enjoys the convenience of buying items with a fixed price. Any given user who shops on eBay.com could assume both personas under different circumstances. For instance, when shopping for collectibles, where great deals can be had through auctions, the user tends to assume the Auction Shopper persona and behave accordingly, employing auction tactics to get better pricing, checking price updates once every 20 minutes, and so on. Yet when shopping for new-in-season items, where auctions do not provide great deals, the user might assume the Fixed-Price Shopper persona and behave more like a typical online consumer, looking up merchandise, adding it to a shopping cart, and making payment immediately.

Based on the above observations, we can define web persona as an "archetype" comprised of the characteristics, goals, motivations, and activities of real web users. Defined as such, a web persona reflects a contextually valid representation of a user in a particular part of their online activity, rather than a real person, who may assume one web persona in one situation and a different persona in another situation.

2.2 Persona Does Not Equate to Market Segmentation

The above discussion points to a rather important distinction between personas and market segments. Whereas both attempt to describe the different types of clients for a particular business and they might look rather similar at a first glance, they are quite different as vehicles of client insights. Market segmentation tries to classify clients into a few categories based on similar attributes and also identify the distribution of these segments within the entire client population. For instance, a retail business might have a number of segments such as 10% top shoppers, 70% regular shoppers, 10% occasional shoppers, and 10% rare shoppers, based on the dollar amount spent. These market segments are different from personas in that they try to identify quantifiable traits of shoppers rather than capture hard-to-observe psychological dimensions. Therefore each client can be classified as belonging to a particular segment, and the size of these segments can be readily determined. Market segmentation helps business decision makers identify business opportunities of the

different sectors of the client base. On the other hand, personas are used to help design professionals in generating ideas and solutions based on in-depth knowledge of user attitudes and behaviors. Instead of emphasizing quantifiable qualities such as age, educational level, and purchase behavior, personas typically focus on creating a summary of the different types of attitudes and associated behavior in an easy to digest format. Therefore personas may or may not have one-to-one correspondence with market segments. As such, we advise practitioners to use personas as a tool to absorb client insights and generate product ideas rather than a way to determine the sizes of client segments.

2.3 Avoid Being Too "Fluffy" and Stay Relevant and Accurate

As mentioned above, personas are not without limitations as a design tool. Central to the controversies surrounding personas is the perception that personas are too "fluffy" because they often include details about users' personal life that are irrelevant to product design. For instance, a typical persona might contain descriptions such as "Nancy came from a small town and moved to San Francisco 10 years ago. She is a mother of three boys, one in high school and two still in kindergarten. She likes movies, hiking, golfing, and is a good cook, and she is also a member of a book club." This demonstrates a common practice of persona development – adding a lot of personal detail to make the persona appear more like a real person. This practice does let people resonate with the personas at a personal level. However, in most cases such details offer no recognizable value to the design team and are generally not supported by research. For instance, unless we are designing a product related to sporting goods, knowing that the persona likes hiking and golfing probably does not help generate actionable product or interaction ideas. Furthermore, by including too many personal-life details, the persona might begin to misrepresent actual users. For instance, most of the users probably do not come from a small town, have multiple kids, like golfing, or attend book clubs. Making design decisions based on these non-representative details could result in products or interactions that are irrelevant to user needs.

Here is one way in which we can improve the Nancy persona. If the intention here is to convey that our users move from elsewhere to a large city in seeking better opportunities, instead of saying "Nancy came from a small town and moved to San Francisco 10 years ago", we can rephrase by saying "In seeking better job opportunities, Nancy came to San Francisco after graduate school and took a number of professional jobs." This way we remove fluffy and irrelevant information and replace them with content relevant to a key point that we want to convey: *Nancy is a career-driven professional with a good education*.

2.4 Attitude vs. Behavior

A persona should consist of both attitudinal (e.g., motivations, beliefs, desires) and behavioral (e.g., tasks performed, information sought, websites visited, web tools used) traits of users in order to drive product decisions. However, we've found that many personas are created in a way that puts more emphasis on attitude than behavior. This probably has something to do with how personas have traditionally been used in the web design field: helping designers develop a user-centered

perspective through empathy created by vivid and believable description of users. Many personas do include information about user behavior, but they treat such information in a cursory manner and do not incorporate enough detail or accuracy. Such emphasis on describing personality rather than behavior can create problems when people are trying to apply the personas: while we might be very familiar with a persona's personality and background and feel comfortable referring to her when designing the product, we still lack details about exactly what such a person would do and what kinds of information they look for. Including a balanced mix of attitudinal and behavioral information about users in the personas not only helps professionals empathize with users, but also lets them develop product features that provide robust support for user tasks.

2.5 Personas Should Be Developed for a Particular Purpose

A commonly accepted best practice states that effective personas are developed as part of a well-defined objective, which specifies the context in which the personas will be used and the user population they represent [1, 2, 3]. Our experience with this persona project supports this thinking. The work we performed was aimed at creating a better experience for online financial advisor users; therefore our personas were developed based on financial advisors' online behavior, and contained details specific to their online behavior and contextually relevant behavior. We identified two distinct sets of motivations and behavior, which form the two personas that we produced. It is possible that in relation to the offline world, these two personas no longer apply or there might be additional personas emerging. By defining the domain in which the intended persona work applies, we can create personas that directly impact product decisions related to that space. And in order to support additional projects that are related to a different space, new persona work needs to be performed. For example, if we want to develop a mobile experience, we should not assume that the web personas apply as is. It is likely that different types of personas with different priorities and tasks would emerge from a mobile usage angle. Interviewing users relative to their mobile usage to come up with mobile-specific personas is recommended for this particular purpose.

3 Application

We have discussed the process of creating financial advisor personas for a fund family website and best practice insights gained through the process. In this section, we will turn to the application of personas. We think the most valuable way of leveraging personas is to get product design professionals and business decision makers to adopt a *user-centered* approach towards planning and design. Because they provide a clear view into the end user's needs and perspective in an easy to digest format, personas can help to inform any decision that we make about the products used by the personas' representative users. Below we will explain how a client-centered product design approach can be driven by personas in relation to developing product requirements and designing user interface.

3.1 Inform Product Requirements Using Personas

Before starting to design a product, we need to have a product vision and associated product requirements in place. This is the phase in which product managers and business analysts work on the overall concept and functional specifications of the product, before the actual interaction and visual design takes off. In this phase we need to understand who will be using the product, for what purposes and under what circumstances – and how that would increase the bottom line for the business. Below are some key areas where personas can help with creating product requirements.

Exploring and evaluating product opportunities. Before we even determine which product we should develop, it is a good practice to explore and evaluate product opportunities based on business and user needs, and then narrow down to a particular product that the business would like to move forward with. At this stage, personas can be a handy tool for guiding exploration and evaluation based on what users want. For instance, by comparing the behavior and needs of the personas to what the website is currently offering, we can easily identify places where users could use more help and then come up with a product solution that fills the gap. In the hypothetical eBay persona examples mentioned above, the Auction Shopper likes to be constantly updated about the bidding process in order to win the auction. Based on such information, great opportunities exist for eBay to come up with a mobile app that sets auction-progress alerts on mobile devices. Please note that whereas coming up with product ideas based on user needs is nothing new, leveraging personas for this purpose can make this exercise much easier because there is no need to dig up information about users – the personas already contain all of that in a summary form.

Prioritizing product for the right target users. When designing a product, personas can help to prioritize the product for the right audience. Consider the personas that we created. If we plan to launch a new web-based advisor tool for helping advisors conduct various investment analyses, product managers can think about the target audience by having a conversation about which persona the product should support: Thomas, Lindsey, or both? It we are thinking about a tool intended to provide cutting-edge investment analysis, then it should be optimized for Thomas, who focuses on constructing winning portfolios for his clients. If we are thinking about a tool intended to provide comparisons across different mutual funds and exchange traded funds, then it should support the needs of both Thomas and Lindsey. It would support Thomas because fund comparison is an integral part of constructing winning portfolios, and it would also support Lindsey because effectively comparing various funds adds great value to client communication, which is one of Lindsey's primary motivations. By having a conversation around priorities, leveraging the insights provided by the personas, we can help bring clarity about the types of users the product should be optimized for.

Defining functions and content. After determining the primary personas the product should support, product managers can use the tasks and activities details contained in the personas to help define the functions and content that should go with the product. For instance, in the above advisor web tool design context, they can look up the data points that the target persona looks for and include those in the tool, and also include functions that support the various tasks that the target persona performs. They could

also leverage the priority scale mentioned above as a guide to prioritize functions and content based on what is important to the personas.

3.2 Inform Design Using Personas

Once the product vision and requirements are in place, we are in the phase of creating the design. Using personas has had great popularity among designers because personas provide an easy-to-digest portrayal of users that facilitates user-centered design. While personas do not provide designers with answers to all their design questions, they do assist designers in focusing on the core user goals and supply them with relevant information and insights to help them produce a solution that supports those goals.

There are many ways of leveraging personas in improving design. We will focus on illustrating a few specific areas that we think could greatly benefit from the use of personas.

Designing information architecture and navigation. Coming up with sensible information architecture and navigation is typically the first step of the design phase. Information architecture speaks to how a website or web application is structured, and navigation is about how users travel from one place to another on the site or application. An effective information architecture structures content in a way that maps to the way users think about and interact with that content. Similarly, an effective navigation scheme supports the user in easily finding a path through the site or application that allows them to accomplish their goals. This can be relatively easy for a simple site or application, or very challenging for a site or application that supports a large number of goals for many different user groups. In either case, personas are a valuable tool in designing and cognitively testing proposed solutions.

The authors will often begin the process by describing in scenario form each of the core use cases for each persona, and sketching architectural and navigation solutions that meet the needs of each scenario effectively. This is an iterative process in which each scenario contributes more information, possibly driving changes to the proposed architecture and navigation. By the end of the process, the design team will have performed a cognitive walkthrough of each core use case for each persona, and created a solution that appears to effectively support them.

Organizing content and functionality. When laying out content and features on a webpage that supports multiple audiences, we can leverage personas in informing how these elements should be grouped. The idea is that each persona is focused on a unique set of tasks and information, and therefore locating content for each persona in close proximity should help users easily find content related to their primary objectives and thus help them accomplish their specific tasks. For example, if a webpage supports both Thomas and Lindsey, the two personas that we developed, then content that supports Lindsey's goal of better advisor communication with clients can be placed in one content container (e.g., a table) whereas content that supports Thomas's need for advanced analytics can be placed in another content container on the same page.

Designing task flows. Well-developed personas should contain information about the flows or sequences of how users engage in various activities, and such information

can be used to improve the design to make it easier for users to accomplish their tasks. For example, in the Thomas persona mentioned above, we outlined the sequence of how Thomas conducts investment research. He starts by viewing generic financial sites and forming investment ideas based on the information reviewed, then he views a specific fund provider site to do more in-depth research, and finally he uses the proprietary software application provided by his own firm to synthesize all the information to develop his investment analysis. This understanding can help designers think about how pages on the website should be sequenced and what kinds of actions should be available on each page to better support users' tasks.

Optimizing marketing messaging. Another important way of leveraging personas is to determine the right messages for the target users. First, consideration should be given to what persona a message is intended for. Then the message can be refined by leveraging information about the persona's motivations and background. For instance, if a message is created to promote a financial analysis tool intended for the Thomas persona, we need to highlight the fact that the tool has robust functions and can support in-depth investment analysis. On the other hand, if the tool is intended for Lindsey, then the associated message should emphasize that the tool can be used to create presentations to facilitate an advisor's conversation with her clients.

3.3 Where Personas End and Additional Client Research Begins

When we look at the entire product design and research cycle, persona development is typically done at a very early stage to provide baseline and highly summarized insights about users and their behavior. This helps to inform the overall product direction and design approach. As the design process evolves and we require more specific insights, such as how to improve usability and visual design, the information contained in personas is no longer sufficient to inform design decisions, and additional user research such as wireframe evaluations and usability studies should be conducted. That said, personas can be valuable in keeping a user focus and encourage us to align all design efforts with user goals throughout the entire design process.

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Decision Support System for Industrial Designer Based on Kansei Engineering

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Abstract. A combination of the traditional methodology of Kansei Engineering with the up-to-date Decision Support System (DSS) is developed in this paper. The users who have a little knowledge of information technology can achieve the Kansei Engineering optimal design in a short period of time by using the DSS, which is composed of a friendly human-computer interface, a database management module and a model management section. The introduction of the structure of the DSS is made first and a case study on the flat-panel handset is followed. Through the use of morphological analysis and semantic differential method, many designed samples and Kansei words are stored in the pre-determined database module. Some more consumers' information is required to get the evaluations of the automatic-formed models. Then a combination of BP artificial networks and GA is used to get the final results. The system is developed by the PHP language to make sure that it runs smoothly in a web environment. Finally, a matrix of physical parameters is attained according to the output of the system. A decoding procedure is done to get the real physical design elements of the optimal model of handset, followed by a prototyping method using other software such as UG. The optimal design is shown at last.

Keywords: Kansei Engineering, Decision Support System, flat-panel handset.

1 Introduction

The market is changing so fiercely that it has transformed from the traditional product-oriented one to one where we put more focus on the meeting of the customers' needs, of course, with no except to the handsets market. The product design, which directly or indirectly determines the final purchase behavior, lies in many different factors such as consumer preference [1], texture [2] and interfaces [3]. Recent study has shown that it's really more and more important to consider the inner preference of the customers within the competitive market. How to grasp the authentic preference of the public has become the core tactic of the manufacturing corporation. As a newly emerging methodology of design, Kansei Engineering is described as a useful tool to help the product designer to transform the feelings into the real design elements in physics.

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Kansei Engineering technology can be classified into three types, Type I, Type II and Type III. Type I is a category classification on the new product towards an identification of the design elements. Type II utilizes the current computer technologies such as expert system, neural network model and genetic algorithm. Type III is a modeling using a mathematical structure [4]. We focus our study on Type II in this paper. According to some references, there are usually two types of Kansei Engineering systems, which are developed separately to consumers and designers.

Here lists some articles talking about the consumers'. Nomura, J. details a virtual space decision support system employing Kansei Engineering which is applied for production and sales mainly in the kitchen business [5]. Sato, N. et al extract the features of a movie using factor analysis from data of a Semantic Differential Gauge questionnaire, and then link the viewer's Kansei with the features using multiple linear regression analysis [6].

Some systems on the designers are: Ishihara, S. et al present ART1.5-SSS, a modified version of ART1.5 (Adaptive Resonance Theory) for small sample size clustering. The network used for automatic rule building in our Kansei engineering expert system, instead of statistical analysis [7]. Relevant study has made some progress in the automatic computation of the mental-physical relationship. Ishihara, S et al developed an automatic semantic structure analyzer and a Kansei expert systems builder using self-organizing neural networks [8].

The rapid developing computers with great calculating ability have made it possible to get the conceivable results in a few seconds. Decision Support System, as one of the most powerful tools to solve unstructured or semi-structured problems, has been progressing so rapidly from its born. So many systems dealing with the Kansei Engineering have been developed.

There is some study into the automatic way of implementing Kansei Engineering. But as a useful tool in aiding the evaluator to make decisions, DSS has drawn a lot of attention. The integrated study of KS and DSS is rare. The system in this paper is developed in the web language PHP so that it can make the process of data collecting more smoothly. Many useful mathematical models are provided, with which the potential designers can select freely. A friendly human-computer interface is developed according to the human factors principles. They can help both the consumers and designers to fulfill their tasks well. Finally the optimal design parameters are screened and a decoding operation is made in relevant CAD software such as UG.

In this paper, we develop the logical model of the decision support system for KE design, which consists of tripartite components. A friendly human-computer interface, a database storing the fundamental information of the data flows and a model management component which provides the powerful tools such as BP artificial networks and GA algorithm together make great contributions to the whole system.

In the following case study, the optimization of a flat-panel handset is given. Morphological analysis is used to determine the physical design size. Several semantic words are picked and a Semantic differential method is applied to quantize the feelings of the potential customers. Finally the BP artificial neural network [9] and

genetic algorithm, which simulates the cognitive process of the human brain and the natural evolution of the species well, are combined to attain the final solutions.

2 The Basic Structure of the DSS

There seems to be a consensus that a DSS is composed of three interrelated parts: a data management component, a model management component, and a dialogue management [10]. There is no except to the one in this paper. The logical structure of the decision support system which we have developed is shown in Fig.1. The abbreviations are as follows: Inner refers to the datasets stored in the hard disks of the system, while the outer has the opposite meaning, which needs the inputting of the preliminary data, taking the semantic ratings of the Kansei words as an example. DMC and MMC, which respectively represent the data base and model management component, are the most two important components of the DDS. The latter consists of the problem solving tools such as K-means clustering numerical algorithm for the grouping of the representative sample points and Multi-dimension Analysis. Also, it cannot do without GA and BP algorithm.

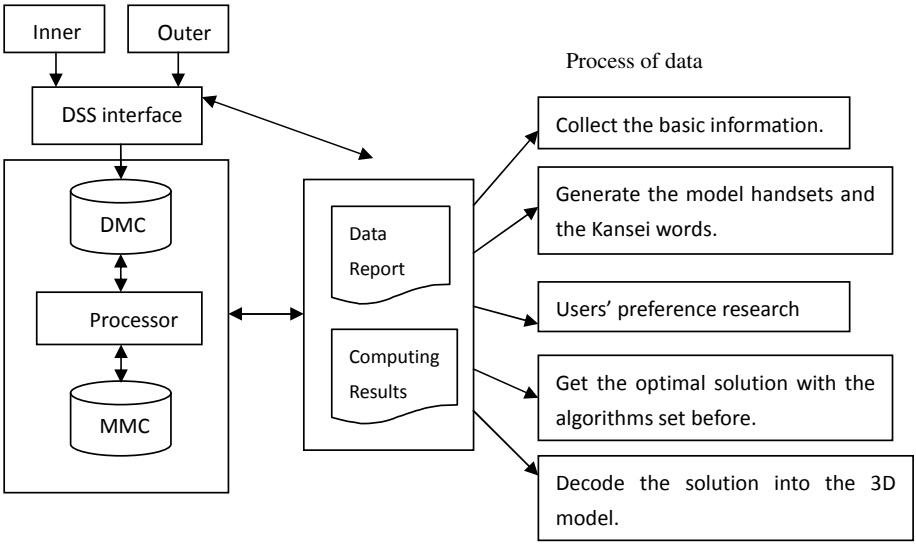

Fig. 1. Basic Structure of the DSS

2.1 Inner and Outer Data flows

As one of the main sources of the datasets, the Inner refers to the ones storing in the hardware of the system originally. It consists of selected primal models varying according to the graduation of the physical variables. Adversely, the Outer, which

comes out from the exterior source, gathers the evaluations from the potential consumers. The results are made of two parts. The former comes from the groupings of the primal models, while the latter gathers the rating of the selected handsets after clustering method.

2.2 DSS Interface

The human-computer interface is what enables the learner to communicate with the computer and the computer to communicate with the learner [11]. The interface which provides a smooth channel between the human and the machine is so important that many usability problems occur if not taken seriously. Different traditional products such as the ovens or TVs which have an instruction solve the problems well. The software interface lacks this function. In this way, the interface of the DSS shows a significant role in supporting the users to achieve the goal.

2.3 Data Management Component (DMC)

Constitute of the database part and the management component, which runs its role of both reading and writing the data flows, the DMC acts an important part in pulling the job off. A special data structure is designed to memory different kinds of records such as numerical values and sample pictures. It provides the consumers who are requested to rate the phone model with the inner data and make a copy of the feedback. Without the DMC, it's like to draw a triangle with two sides left, which does not make sense.

2.4 Model Management Component (MMC)

As same as the DMC shown above, it is also composed of two distinguishing parts, which are the model base and the module of the data processing. Model base is dissimilar based on the problem you facing with. In this paper, some multivariate statistical models are added to the model base so that it can show the special characteristics of the datasets collected. Many other instruments including MLP, BP artificial neural network and GA are provided for the solution of the problem. In this system, a combination method of BP and GA is used to get the best design which in some way attracts the largest number of the consumers. It's a more advanced when compared to the previous study which only take the simple assembly of the design elements into consideration.

2.5 Processor

Being a linkage between DMC and MMC, processor makes the running of the data flow of the system more smoothly. Data is processed in batch to get the reports which will be shown on the screen. Some computations of the mathematical models with the

original data are running here. It saves lots of time and money because an integrated and repetitive calculating is made. Human's brain can be liberated from the dull computing to produce more creative work.

2.6 Data Report and Results

Actually, it's a part of the human-computer interface. The final results and medium-term reports are shown within it. The status whether the computer is working now is clear at a glance. A good feedback relationship is built with the support of the data report and results part. We can decide what to do next after reading the system status and statistical results. The final results which include the optimal physical design parameters are shown in the data report. Some further operations which can convert the physical factors into the real appearance of the product can be attained in other CAD software such as UG.

3 Case Study

The consumers' preference is changing so fiercely that Kansei Engineering is put more and more attention. In a high competitive market such as mobile phones, the product designers need to provide the consumers with various styles of products [12]. The product image plays an important role in the consumers' preference and choice of the product [13]. In this paper, we choose the flat-panel handsets to be the expected item for the decision support system. The explicit methods are listed below.

Step 1: Determine the physical design variables of the handsets through morphological analysis methods in industrial design. Therefore, 21 continuous variables and 5 discrete ones are picked out to represent the whole design. The basic data and original formation of the mobile phones come from a lot of famous handset manufacturer such Nokia and Samsung Corporation.

Step 2: Consolidated the linguistic variables which can represent the consumers' needs. About 100 descriptive words are picked out from relevant magazines and TV programs. Then a sketch survey was done to analyze the main Kansei words with the method of factor analysis. There are 14 image words left, which includes one entry referring to preference. In this step, a fundamental Kansei Engineering method and the basic statistics method are used.

Step 3: With the principle of gradation, 40 typical cells were picked out. 22 potential consumers were asked to participate in the Multidimensional Scaling Analysis (MDS) part. In this study, a 6-dimensinal coordinate system is built according the selection requirements which ask a younger pressure coefficient less than 0.1 and RSQ more than 0.8. Then a K-mean cluster analysis is applied to get the representative samples from the 40 ones. Based on the results of the analysis, 12 representative models get out of the

ruck after using the cluster analysis. In the traditional KE study, it's common to deal with the discrete variables. While in this one a combination of both continuous and discrete variables are made.

Step 4: 120 undergraduates (aged from 22-26) were randomly chosen according to their student numbers from the business administration of the Northeastern University to take part in the assessing part. Faced with the computers which we provided for the evaluation, they gave their attitudes on the typical handsets model with a 7 degree Likert Scale (-3-3) under the name of the Kansei words. The preference data is then stored in the Outer source of the database. The human-computer interface is put on display in Fig 2.

Step 5: So many data are collected that it's the high time the data analyze system played a role. Data is extracted from the data management component and corresponding method is elected according to the evaluator's personnel attitude. Of course, several means can be used to get the most precise solution. Because the model base is so powerful that it can support nearly all the numerical algorithms. In this paper a simple combination of BP artificial network and GA are used to ensure the exact results. An optimal was in front with the algorithm pre-compiled.

Step 6: Decode these combinations of categories and display them using 3D imagine and rapid phototyping models. In this study, a method based on the rapid 3D image formation is used. The final design model is listed in Fig 3. Because of some technology problems, the plug-in module of the automatic phototyping has not been set in the system. Further study is going on to solve this problem.

Fig. 2. A Human-computer Interface

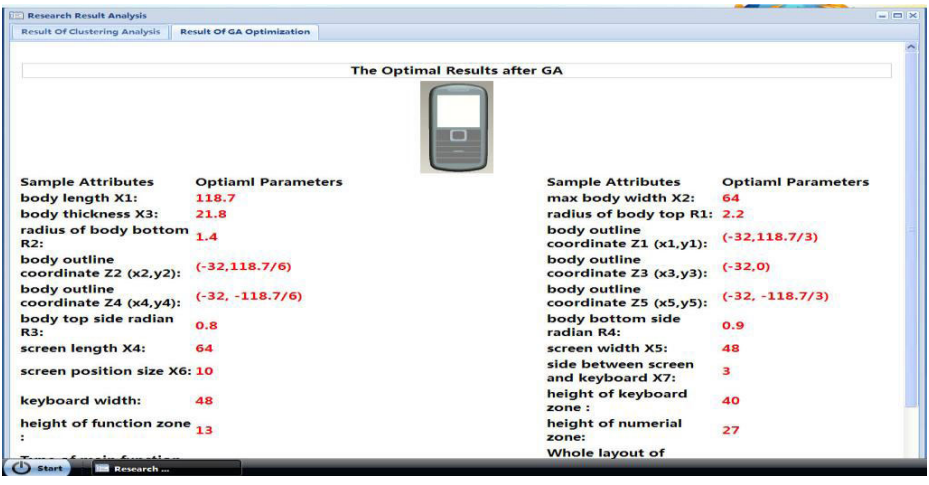

Fig. 3. Optimal Physical Results

4 Discussion

The rapid developing market calls for a higher standard for the design industry. Customers' preference is becoming more and more important under the presumption that there is no obvious difference between two products whose price is much of a size. The one, who can transfer the masses' predilection into the design elements, will beyond no doubts to be the winner in the competitive business world. In this paper, we give a brief introduction to the DSS which is used for the optimization of the physical design sizes of a flat-panel handset. Further study should go on to get more precise result: (1) a larger number of potential consumers should be investigated to assure the precision of the results. (2) Some more mathematical models shall be added to the model base module. Consequently, the evaluator has more choice to determine the analysis of the datasets. (3) The results are decoded into the physical design model in the PROE software. How to have the automatic phototyping module embedded in to the DSS is the biggest problem in the long run.

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A Study of Framework and Process Development for Cultural Product Design

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Abstract. The style of product design for a country or a nationality is influenced by its essential traditional cultures and lifestyles. Recently, the importance of studying Taiwanese cultures has been shown repeatedly in several studies in design field. Despite the recognized importance of product design in cultural and creative industries, they lack a systematic approach to it. Therefore, the main purpose of this paper is to build a design framework and process for cultural product design. The approach includes two phases. First, the design framework and process for product development is constituted by the cultural attributive analyses and design concepts table, design principles, literature review and expert opinions. In the second phase, we undertake design practices based on the design framework and process in order to prove the effect.

Keywords: Cultural product, design framework, Taiwan aboriginal culture.

1 Introduction

With the changes of customers' needs and perceptions, the consumer market is evolving simultaneously conducted by customer-orientation and consequentially design processes are much focused on the diversity and cultural features of product specifications. The product attributes of geographic and ethic features are influenced by its essential local cultures and lifestyle. In recent years, the wave of modern Chinese style is seen in different design applications, even in the movie industry. It is obvious that the Chinese culture has caught global attention. The various tribal cultures and passions of the Taiwanese are deemed as well-known characteristics of Taiwan by other countries.

In this age of aesthetic economy, every country focuses on promoting cultural applications as the main step of economic development. For example, the manufacturers of pewter in the UK through its alliances with crafts-based designers, have transformed its learning capabilities in order to add value to its products and create new organizational knowledge [21]. Furthermore, after the recession of the traditional sugar industry, Fiji in the south Pacific has increased the income of tourism to support national economic by holding folk cultural art-festivals [17]. At this point, the field of

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design has played an important role in embedding the cultural elements into products and in increasing the cultural value in the global competitive product market. Therefore, designing a product with local features in order to emphasis its cultural value has become a critical issue in the design process [12], [19].

While the cultural and creative industries are the main strategy of global economic development, the influence of cultural features on the products needs to be discussed. However, there is insufficient investigation in this field and lack of a systematic approach for processing it. Therefore, two phases are included in this study. In the first, the design framework and process for product development are formed by the cultural attributive analyses and design concepts table resulting from literature review and expert opinions. In the second phase, design practices are undertaken in order to prove the effectiveness of the proposed design framework and process, and also act as a reference for the following studies.

2 Culture Features and Product Design

In the early 20th century when users thought about "design", "form follows function" often came to mind. Nevertheless, along with technology progress, designing "feeling" into products to present the emotional communication of user experiences became a design trend in the 21st century [6]. Product design in addition to function analysis and market research, also needs to consider the product's meaning and delivery to satisfy user needs. Leong and Clark [9] believe that cultural-based knowledge can provide new ways of thinking and designing which may be able to save us from contemporary ethical dilemmas.

2.1 Three Cultural Levels

Culture generally refers to styles of human activity and the symbolic structures. Moreover, culture has been described as the evolutionary process that involves language, customs, religion, arts, thought and behavior. From the design point of view, Lee [7] proposed a culture structure with multi-layers including 'artifact', 'value', and 'basic assumptions' which identified key design attributes such as 'functional', 'aesthetic', and 'symbolic'. Leong and Clark [9] developed a framework for studying cultural objects distinguished by three special levels: the outer 'tangible' level, the mid 'behavioral' level, and the inner 'intangible' level.

Based on previous studies [4], [9], [12], [13], a framework for studying cultural objects is summarized in Fig. 1. As shown in Fig. 1, culture can be classified into three layers: (1) Physical or material culture, including food, garments, and transportation related objects, (2) Social or behavioral culture, including human relationships and social organization, and (3) Spiritual or ideal culture, including art and religion. These three culture layers can be fitted into Leong's three culture levels given above. Since cultural objects can be incorporated into cultural design, three design features can be identified as follows: (1) the inner level containing special content such as stories, emotion, and cultural features, (2) the mid level containing function, operational concerns, usability, and safety, and (3) the outer level dealing with colors, texture, form, decoration, surface pattern, line quality, and details.

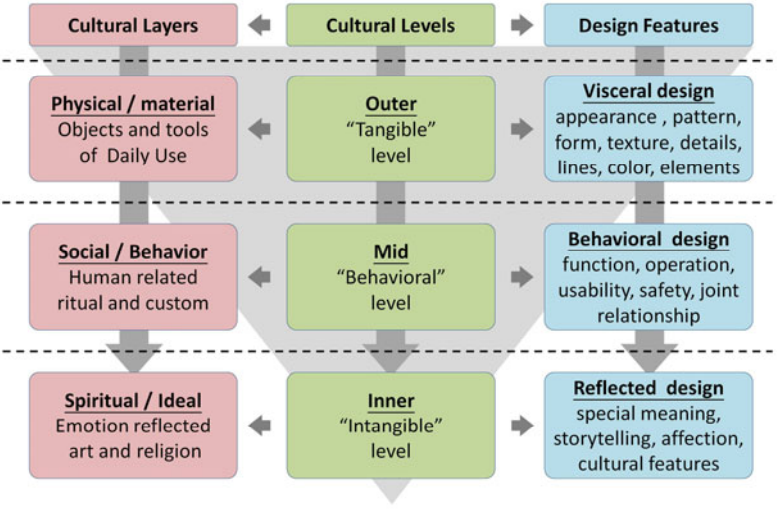


Fig. 1. Three layers and levels of cultural objects and design features (Lin, 2005; 2006)

2.2 Fundamental Cultural Resources of Taiwan

Enhancing the quality and adding extra value to the product is necessary for the improvement of product performance. Taiwan has a strong potential to develop significant cultural products. Three fundamental resources for the development of a culture product in design are as follows: (1) the Taiwan Aboriginal culture, (2) the Chinese Southern Civilization originating roughly four hundred years ago, and (3) the Chinese Antiques civilization, with displays in the National Palace Museum, originating around four thousand years ago [18]. Among these three resources, Taiwan Aboriginal culture indeed has a unique and great inspiration with its primitive arts and craft designs. Therefore, increase the value of investigating Taiwan aboriginal culture.

Taiwan Aborigines have different customs and material cultures from one tribe to the other, due particularly to the geographical environment. For instance, the culture of tribes located near the ocean reflects their fishing based living, while mountain tribe culture develops from a dependence on hunting [8], [16]. However, in general, traditional tribes have self-sufficient societies which are dependent on agriculture, fishing, hunting and animal husbandry. Taiwan aboriginal material culture can be classified into four main aspects: foods, garments, living, and craft [8], [10], [16]. With their beautiful and ancestral visual arts and crafts, Taiwan aboriginal cultures should have great potential for enhancing product design value thus increasing its recognition in the global market. Hsu, Lin, and Chiu [5] have designed a questionnaire on the cognition of consumers toward aboriginal culture in product design. The results of the questionnaire provide guidelines for product design with aboriginal culture features. The conclusions are as follows:

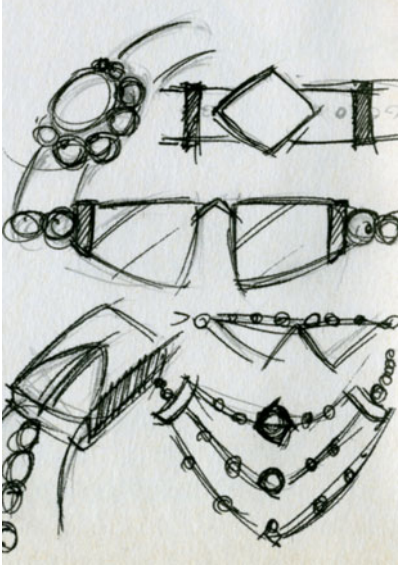
1. Subjects responding to attitudes toward aboriginal culture believe that products with aboriginal culture designs have the potential to promote the positive qualities and extra value in life and increase the value of the product in a competitive market.
2. Subjects responding to the most significant features in aboriginal culture agree that the following in order of significance: ornament, woodcarving, webbing, totem, stone carving, and garment design add a unique style to contemporary product design.
3. Subjects responding to the appropriate types of products in relation to aboriginal culture believe that fashion ornament, package design, furniture, handcrafts, appliances, kitchenware, stationary gifts and lighting fixtures would be enhanced by the unique style and the contemporary design.
4. Subjects responding to the users' demand for aboriginal culture in design place the following in order of significance: special meaning, cultural features, texture, form, storytelling, and color.

2.3 Design Theories Relevant to Cultural Products

More and more modern products are combined with local culture features to improve their identity. The investigation of design method and cultural feature is shown repeatedly in several studies in design field. Despite the recognized importance of product design in cultural and creative industries, they nevertheless lack a systematic approach to it. Therefore, Lin [14] provided four steps to design a cultural product, namely, investigation, interaction, development, and implementation using scenario and story-telling approaches. The scenario is described from the user point of view and may include social background, resource constraints and background information. Central to most scenario based design is a textual description or narrative of a use episode. It may describe a currently occurring use, or a potential use that is being designed.

Cultural features are considered to be unique characteristics that can be embedded into a product both for the enhancement of its identity in the global market and individual consumer experience [2], [20], [21]. They could trigger a cultural reflection of consumers through design. In general, the common discussion of cultural applications to the product is the theory of product semantics. For example, Lin and Huang [11] classify the logic of figurative designs whose forms are based on some reasonable visual connections. It defines visual connections such as metaphor, simile, allegory, metonymy, and analogy borrowed from linguistics, and then systematically analyses these elaborate relationships between products and the signs. In addition, Butter [1] suggested that the design process can be seen as somewhat linear with clearly distinguishable phases and suggested eight steps for the systematic generation of semantically relevant design concepts. Based on this literature, an approach was undertaken to integrate the design theories and provide assistance for cultural product design.

Table 1. Example of a cultural attributive analyses and design concepts table

Analysis of Cultural Attributes		Interpretation of Culture	Features of Product	Category of Products
Tribe	Taiwan Aboriginal –Paiwan and Rukai	Wear, status symbol, decorative, arrangement also followed special rules, symmetrical	shading effects, decorative, extension of personal particularity	glasses, sunglasses, watch, furniture
Object	Necklace by Lazurite beads			
Type	Ornament			
Image				
Material	glass beads•shell pieces			
Color	The solid colored beads in orange, yellow, green, white and black. The shell pieces are white.			
Characteristic	They were precious things passed down in the family by chiefs or used in a dowry. The number of beads on the neckwear represented the wealth, social class, position, and gender of the wearer.	Sketch of Design Concept as Metaphor, Analogy. Features of Product: extension of personal particularity, wear, decorative		
Operation	The manifold beads were often used together, such as in multiple-strand ornaments. Single-strand ornaments were worn at the chest or around the neck.			
Pattern	Each type of traditional bead had a different name, sex and associated legend.			
Form grammar	The order of arrangement also followed special rules.			
Form construct	The bottom part features large multi-colored beads, and this is the most precious and unique part of whole item. The two sides are symmetrical and decorated with shell pieces and orange, green and yellow medium- and small-sized beads.			
Formation	This neckwear is a hemp band with five branches to which colored large beads and small single color beads and shells are attached.			
Using scenario	This kind of neckwear would only be worn in the once every five year festival or when a chief married.			
Cultural content	They would be used as wedding gift to the bride when chiefs married. In addition, they were used to treat illness, in fortune telling, and also were believed to bring luck.			
Resource	Lee [8], Lin [10], Liu [16], [22]			

3 Cultural Attributive Analyses and Design Concepts Table

In Taiwan, cultural awareness has caught the attention of the design research society followed by regional and governmental promotions. Hence, Taiwan aboriginal crafts, products, and activities have increasingly been studied in market and academic research. The studies show positive results. The uniqueness of Taiwanese aboriginal culture is valuable and worth incorporating into existing products in daily life via new design.

Most cultural literatures provide extensive descriptions, which were difficult to apply to the product design. Wu, Hsu, and Lin [19] suggested focusing on data collection from the culture in terms of physical, material, customs, ceremonies, and spirituality among the objects. The collected data was then matched to the different items, based on tribe, name of object, type, image, material, color, feature, function, pattern, form grammar, form construct, formation, inner content, cultural significance, and resource. These items covered three levels of cultural characteristics and basic information such as image, tribe, and name. Further combination with the emphases on product semantics, would construct a cultural attributive analyses and design concepts table, which will be useful in design concept of developing [15]. We suggest that this information will serve as a reference for designers during the product design phase. Table 1 shows an example of attributes of cultural features.

4 Design Framework and Process

Culture plays an important role in the field of design, and cultural design will become a key point in design evaluation in the future. Incorporating cultural features into the product design process will become a new design trend in the global market. Apparently, we need a better understanding of cultural communications not only for taking part in the global market, but also for developing local design.

The cultural product design is a process of rethinking or reviewing the cultural features and then redefining them in order to design a new product to fit into society and satisfy consumers through culture and esthetic [3]. Designing new products by adding unique cultural features would not only benefit economic growth, but also promote unique local culture in the global market. Therefore, transforming cultural features into a cultural product becomes a critical issue. In order to facilitate the understanding of the cultural product design process, the design framework and process are proposed for combining consumer attitudes, cultural levels, cultural attributes, transformation, product semantics and design features as shown in Fig. 2.

A good understanding of the cultural attributes will benefit articulating the context between the culture and product design and therefore accelerate concept development. Based on the cultural product design framework and process, the cultural product is designed using scenario and semantics approaches. In a practical design process four phases are used to design a cultural product, namely: identification (telling a situation), investigation (setting an objective), interaction (writing an analysis), and implementation (designing a product) as shown in Fig. 2. And according to the literature review and expert opinions, design guidelines are developed based on the research of consumers' needs, cultural content and design theories.

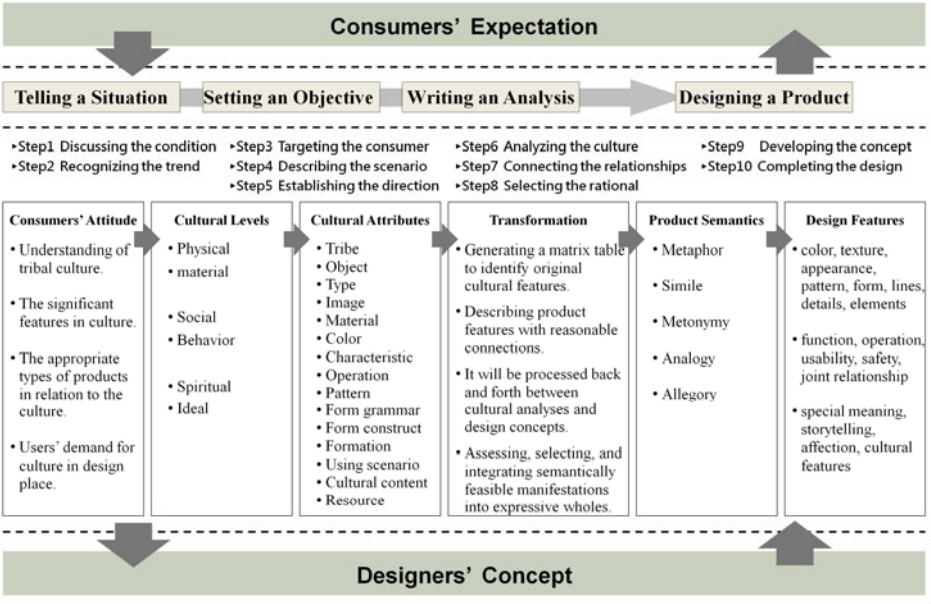


Fig. 2. Design framework and process for cultural products

Ten steps of design procedure would provide designers or students a systematic method to designing a cultural product. The four phases and ten steps of the cultural product design process are further described accordingly as follows:

1. Identification/ telling a situation:
   - (1) Discussing the condition: understanding cultural products through discussions. Designers should have explicit understanding of design aspirations and develop a preliminary prioritized attributes hierarchy.
   - (2) Recognizing the trend: based on the cultural attributes, observe, compare and incorporate related issues such as economic developments, social trends, technological applications, and related existing products into the new product design.
2. Investigation/ setting an objective:
   - (3) Targeting the consumer: make a good observation of customer needs and explore the consumer society in order to define a product image with meaning and style derived from culture features concerns.
   - (4) Describing the scenario: this step allows designers to describe scenarios of users who have a preference for a particular style and identify with the features, meaning, category, and appropriateness of the product.
   - (5) Establishing the direction: this step establishes a design specification, which will identify the goal, function, target group, and limitation of the design. All of these concerns should match attitudes of consumers.
3. Interaction/ writing an analysis:
   - (6) Analyzing the culture: based on cultural layers, generate a matrix table as shown in Table 1 to identify original cultural features including tribe,

object, type, image, material, color, characteristic, operation, pattern, form grammar, form construct, formation, using scenario, cultural content, and resource.

(7) Connecting the relationships: based on reasonable connections such as product semantics, describe product features and develop a product with these cultural attributes. The analysis and synthesis will be processed back and forth between cultural analyses and design concepts as shown in Table 1.

(8) Selecting the rational: assessing, selecting, and integrating semantically feasible manifestations into expressive wholes. In addition, describe the product performance and sketch the preliminary design image.

4. Implementation/ designing a product:

(9) Developing the concept: this step is the concept development and design realization by figurative product semantics (e.g. metaphor, simile, metonymy, analogy, and allegory), in order to transform the cultural meaning into a logically correct cultural product.

(10) Completing the design: examining the details and integrity of the cultural product as product features, supply cultural attributes to transform them reasonably into the product performance.

5 Design Practices

Based on the foregoing study phase, we specifically propose a design framework and process for cultural product design, proving the effectiveness of this systemic approach by the following design examples. The design practices in this study are the result of integration of literature reviews, design concepts from aboriginal culture in Taiwan, and the category of products related to life products. There are many different aboriginal tribes in Taiwan. Each tribe has dissimilarities in their respective features. However, some applications of utensils for daily using are similar, such as among the Paiwan and the Rukai which both use the flagstone to build residences and make furniture. In addition, some aboriginal tribes were using bamboo tubes or dry gourds as containers, the Hakka or Hoklo people in Taiwan also have similar customs. Moreover, these are characteristic features for demonstrating their application in products which could be easy recognized by consumers.

Through the design framework and process for implementing design practices, the material culture chosen was recorded in the cultural attributive analyses and design concepts table (Table 1), and developed the design concept of the products. From the above-mentioned background, we undertook the concept of the detail design and sought out the appropriate presentation of the products. Finally the practices were completed with computer models to simulate the actual product presentation.

As shown in Fig. 3, Lazurite beads of Paiwan were precious items passed down in the family by chiefs or used as wedding gifts. The number of beads on the neckwear represented the wealth, social class, position, and gender of the wearer. The sunglasses using the design practice of analogy revealed the extended personal characteristic and practicability. In addition, the designed concepts shown in Fig. 4 were developed based on the functional container of water, analogizing the function of container into the desk

light. The shape and texture of the concept reveals the natural hard-shell shape of bamboo, and analogized the motion of pulling out the bamboo to the switch. According to the design framework and process, modern products were developed using the culture features as examples to explore the feasibility of the design reference from the cultural features. Therefore, it provides designers a valuable reference for designing successful cultural products.

Fig. 3. Sunglasses, the design concept is from Lazurite beads

Fig. 4. Desk light, the design concept is from bamboo tubes

6 Conclusion

Over time, Taiwan gradually developed its own distinctive culture. The variety and distinction of Taiwan culture offers potential application in the field of design. By enhancing the original meaning and images of cultures and taking advantage of new production technology, Taiwan aboriginal material cultures will have great potential for enhancing product design value thus increasing Taiwan product recognition in the global market. The design framework and process for product development is constructed by the cultural attributive analyses and design concepts table, design principles, literature review and expert opinions. Through the integration of all this information, we provided a different way of thinking about interactive experiences between cultural attributes and product features, notably, the importance of a product with cultural attributes in order to enhance the product's value and satisfy user needs.

The traditional life of aboriginals is original and natural, i.e. the function of material culture is simple. Therefore, the investigation of the consumer's ideal product always results as the objects and tools of daily use. The concepts of design practices follow it as well. However, it's the transformation of material culture into only tangible objectives in which the endeavor of design based on ritual and spiritual customs is still in need.

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Exploration of the Cultural Product Design of the National Palace Museum from a Qualia Viewpoint

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Abstract. This research is focused on the cultural product design of the National Palace Museum (NPM) from a "Qualia" viewpoint. Because of the rapid rise in cultural product design in recent years, the Taiwanese government has led industrial development in emphasizing "Qualia," the emotional value or sense of quality goods. The NPM is being used as the flagship to create national policies for the cultural product design industry. The researchers have chosen the most well-known collection at the NPM - Jadeite Cabbage - as the subject of the research and to which to apply this cultural product design concept. The subjects for this study are products from the NPM's gift shop and online store. Content analysis and literature review were the methods chosen to explore the style and quality of the cultural products of the NPM. The findings and some suggestions for improving product design and administrative measures are presented.

Keywords: qualia, cultural product design, museum, National Palace Museum.

1 Introduction

Because of the impact of economic globalization, development of product design is facing a conflict between localization and globalization. Seeking a kind of compromise has become the competitive strategy. The government in Taiwan develops the cultural and creative industries actively, having incorporated six new industries and set forth the National Development Plan, but also energetically promoting measures to assist industries in upgrading. [1] It is a significant issue to study the manner of enhancing industrial competitiveness through the improvement of value-added product design.

Moreover, with the development of Perceptual Engineering, accentuating the "Qualia Concept" of the emotional value of products has become important to product design styles and trends. SONY in Japan introduced the idea of a quality-oriented program called "Qualia-Project". In recent years, the Corporate Synergy Development Center in Taiwan has been expecting to increase value-added products and services as well as shape corporate style to enhance overall industrial competitiveness through the

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promotion of the “Plan of Qualia Advance for Small and Medium Enterprise”. At the Ministry of Economic Affairs, this guidance is anticipated “to create a new feature with quality, to construct style with competitiveness.” Consequently, cultivation of a sensual quality needs to be clarified. [2] On the other hand, the National Palace Museum is internationally known for the precious cultural Chinese Imperial Palace, the exquisite aesthetic image representative of Taiwanese culture. It is the largest and most well known museum in Taiwan with a collection of over 67 million Chinese cultural relics.[3] In accord with the fact that cultural product design shows uneven qualities, it is necessary to research the NPM products because of their leading role.

Therefore, this study is from a qualia viewpoint to explore the cultural product design of the NPM. For the specimen, the researcher adopted the most famous piece at the NPM – "Jadeite Cabbage". For the area of study, the researcher chose the products of the NPM to research, both those at the gift shop and online, through the methods of analysis, picture and literature, hoping to advise and offer recommendations and references to the NPM to enhance the product quality.

2 The Derivative Product of the Greatest Treasure in the NPM - “Jadeite Cabbage”

Of the 67 million pieces of the NPM 's cultural relics[4], Jadeite Cabbage" is the most well known, and from which the largest number of products are developed and designed. Hence, concerning the exploration of “Jadeite Cabbage” culture and its derivative products, we must first discuss the heritage itself.

2.1 An Analysis of the Form of "Jadeite Cabbage"

In terms of shape and color, “Jadeite Cabbage” is a realistic creation. White and green in color, the height is 18.7 cm, smaller than real cabbages in Taiwan. Gray leaf stems and green leaves account for about half of its entirety. (Figure 1) There are two insects on the leaves. The dark green insect, which scholars call a katydid, has the larger body of the two. The Northern Chinese called this insect a Guoguo because of the sound, while it is also called a grasshopper. The posture is that of a katydid ready to spring into action. (Figure 2). According to research its sound is a mating call to the female. [4]

The insect on the other side is a locust, green in color and smaller. (Figure 3). With regard to texture and materials, Jadeite Cabbage is semi-translucent. It belongs to a Jadeite type produced in the mountains of Yunnan to Myanmar: the colors are pure white, from the sodium aluminum silicate mineral, and green, because it contains chromium. Furthermore, if the jade color is rich with red, it may contain iron and is commonly known as “Fei.” [5]

“Jadeite Cabbage” is a refined quality creation. It is labor-intensive and costly to refine jade into a piece of artwork, therefore it is necessary to consider how to save labor and materials. [6] With this in mind "Jadeite Cabbage' is an ingenious sculpture, a realistic creation, which was released from naturally colored jade. [7]

Fig. 1. Jadeite Cabbage Length 18.7 cm, Width 9.1 cm, Thick 5.07 cm, Photo by National Palace Museum

Fig. 2. The katydid on Jadeite Cabbage, Photo by National Palace Museum

Fig. 3. The locusts on Jadeite Cabbage , Photo by National Palace Museum

2.2 The Interpretation and Meaning of Qing Jadeite Cabbage

This work originally was placed in the Forbidden City's Yung-ho Palace, which was the residence of Emperor Kuang-hsü's (1875-1908) Consort Chin. For this reason, some have surmised that this piece was a dowry gift for Consort Chin to symbolize her purity and offer blessings for bearing many children.

There are two insects that have alighted on the vegetable leaves. They are a locust and katydid, which are traditional metaphors for having numerous children. Study reveals that the female katydids lay 13-152 eggs, grasshoppers lay 200-440 eggs, and locusts lay approximately 128-1500 eggs. [8] “Zhou Nan, China generations” Book chapter V, Katydid" said that katydids represented “ the blessing of giving numerous children” Consequently, Jadeite Cabbage represents the blessings of married women, "bringing numerous children".

2.3 The Overall Evaluation of the Qing Jadeite Cabbage

For the form of shape it displays, it consists of a popular subject matter of life, modeling realistic exquisite workmanship and precious materials. The later connotation, given the warmth of its auspicious meaning and allusions, greatly improved the value of the Jadeite Cabbage, and enhanced the public's impression as well. Overall, the "Qing Jadeite Cabbage" is an excellent creation. However, with the museum's strong promotion, Jadeite Cabbage has become famous as a top attraction of the NPM.

3 The Derivative Product Design of Qing Jadeite Cabbage

By Dec. 2009, there were 198 different products using the design of Qing Jadeite Cabbage. Most of the products are co-produced through the "Brand Authorized License Project" and the "Open Invitation Derivative Product Partners Project." In addition,

these products are the fruits of labor of special development and competitive production of special projects design working together.

3.1 Brand Authorized Licensing Project

Brand Licensing refers to an open way to seek and accept its own brand business. The company agrees with the proposal for the NPM series products of the enterprise cooperation. There are now namely 7 companies and the development and design of related products is up to 94. The category includes replicas of artifacts, food, stationeries, and life products [9]. Besides, the NPM accepts mostly private companies to apply to cooperate for designing the cultural products. But the NPM alone holds the right of authorization of the products. By Dec. 2009, there were 104 pieces of cooperative products of Qing Jadeite Cabbage, including stationery, jewelry and household items. (Figure 4-6) [10] The cooperative items of Qing Jadeite Cabbage are listed in the following table.

Table 1. The list of Cultural Goods derived from Qing Jadeite Cabbage

Source	Category	Item	Quantity	Total
Brand Authorized	Cultural Reproduction	Ceramics, Gold, Glass	94	198
	Foods	Chocolate, jelly, cake, pineapple cake, chocolate cake		
	Stationary	Pencil boxes, magnets, key chains, ornaments, stickers, folders, plates, mugs, mouse pads, dolls, stationery, note paper, pens, pencils, notebooks		
	Commodities	Badges, glasses case, passport holder, key ring, strap, stickers, folders, wallets, handbags and so on.		
Cooperation Development	Stationary	Paper, memo book town, name card box, gift set, notebooks, journals, letters demolition?, bookmarks, clip, pen, stamp pad, mouse pads, stationery, folders, memo clip, magnetic, magnets, postcards	104	

Note: Finished by Me-Hsien, Huang, 2009

Fig. 4. Derivatives of Qing Jadeite Cabbage -- Stationery and Commodities (Photo by Mei-Hsien, Huang)

Fig. 5. Derivatives of Qing Jadeite Cabbage -- Cultural reproduction and Foods (Photo by Mei-Hsien, Huang)

Fig. 6. Sample Pictures of derivative products of Jadeite Cabbage (Photo from https://www.npmeshop.com/ct_search.aspx 2010/11/01)

4 The Idea of Qualia Conceptual Cultivation

The word, qualia, derived from Latin, is close to the English word 'quality'. Qualia is based on a person's internal subjective experiences and how those experiences made that person feel. In general, the meaning of “quality” trends the function; “qualia” trends “feeling” and “emotion”. A “Qualia product” means a product that can heighten customer experience through touched mind or joyful feeling, such as a beauty, creativity, humor, giving customers additional motives to buy beyond that of practical function.

Nobuyuki Idei, the former chairman In the SONY Corporation in Japan, offered this idea of "qualia" in 2004. He believed that although quality is what enterprises paid attention to in the past, talking about quality is not enough; we must also take advantage of creating emotional life experiences for different levels. He suggests "the economic charm of qualia." [11] Afterward, there were some related sayings raised. Here are three important sayings as fellows.

4.1 Function to Human Feeling - The Development of Product Design

In his history of product design and development, Lin (2009) pointed out that the development of 20th century product design should be divided into five stages in the following order: design for function, design for friendliness, design for fun, design for elegance, and lastly, design for feeling. [12] This refers to 21st Century human design, which emphasizes the inherent humanity of the unique aesthetic and psychological needs of feelings. It is significantly different from the early 20th century, which emphasized the practical and physiological needs of a "functional" design. As a result, the sense of the quality designed product is not only getting increased popularity but also tends toward the personalized, a taste of the culture and so on. The intangible emotional value of goods is gradually surpassing the useful value of commodities. This is the "sense of qualia".

4.2 Attractive Quality

Japanese scholar Noriaki Kano looked from a psychological viewpoint to analyze the internal needs of the customer. He proposed in 1984 that the two-dimensional quality mode coordinates the “useful quality” and "attractive quality". If the product is of good quality, customer satisfaction is high for sure. In contrast, customers will give a negative assessment if the product is bad. With the increase of product quality, customer satisfaction raises exponentially. (Figure 7) [13] Hence, if attractiveness is unexpected by the customer because usefulness is the necessary and basic requirement of product quality, from the Kano mode of view, regardless of how much a product is improved, customer satisfaction is limited.

Afterward, Noriaki (1996) emphasized the importance of “Attractive Quality” and pointed out that Creativity and Engineering are the vital progressions to achieve and create the needs in the customer’s mind. On the other hand, Attractiveness, Beauty and Delicacy are skills to enhance added value of goods by unique style.

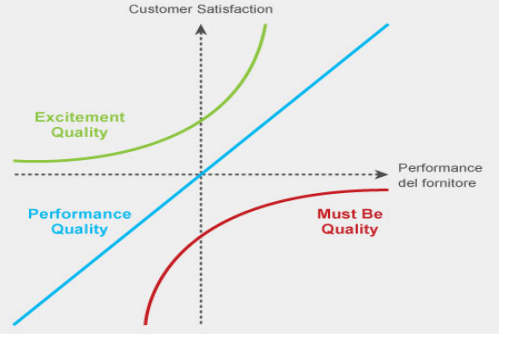

Fig. 7. Kano model of product development and customer satisfaction (Noriaki, 1984) [14]

4.3 Cs and 3 Levels' Cultural and Creative Design

In cultural and creative design, Lin (2009) brings the idea of the 4C's factors that can be characteristics of goods: 1) Cultural: Cultural and creative life is the creation of culture as a starting point. 2) Collective: From the heritage of culture and creativity come selections of representative elements of daily necessities. 3) Cheerful: Cultural and creative work is enjoyable and pleasant. 4) Creativity: This is the synthesis of the creative combined with the cultural life. These 4Cs are the elements.

After Leong (2003) proposed the research architecture of cultural product design into the outer(tangible), mid(behavior), and Inner(intangible) levels of cultural space. [15] Lin (2005) based on this cultural framework space and offered the design attributes: (1) outer or tangible level, inclusive of color, texture, shape, surface ornamentation, component composition and other attributes, (2) mid or behavior levels which includes cover features, interoperability, ease of use, security, integration relationship property, and (3) Inner or intangible levels defining indulgence products as having special meaning, the product being a narrative, the products having feelings, the product of cultural traits and so on. The inner or intangible levels is mort closed to qualia. [16] Lin (2006) moreover points out that from the user-oriented scenario is more in line with cultural context. [17]

From above concepts, qualia is a important aspects of product design. It touches the deepest inner joyful feelings of consumers' hearts and attracted them to buy the product more then only good practical function. Attractiveness, beauty, creativity, delicacy and engineering are the basic elements. This value-added design are valuable for us to concerned.

5 The Exploration of "Jadeite Cabbage" from the Qualia Viewpoint

Qing Jadeite Cabbage is currently one of a considerable growing number of derivative products. The researcher considered that the phenomenon reflects some comments.

5.1 The Good Characteristics of the Derivative Product

There are several characteristics of the Derivative Product of "Jadeite Cabbage" . In the first place, regarding daily life and popular collections, the products designed from museum artifacts purchased by the public are designed in a variety of ways to serve daily necessities as well as for admiration, bringing universal heritage into people's lives. Secondly, since the collection is based on product design, development and production, it stimulates industry and commerce, not only expanding the museum's collection of applications, but also enhancing the museum's economic revenue. Thirdly, by using locally designed and created products, localization is advanced as well as internationalization since the products are sold to an international market. The local market is aided while the spreading of goods into the international market brings more attention to the museum.

5.2 The Defects of the Derivative Product

However, from a qualia viewpoint, an overview of the current culture of the Qing Jadeite Cabbage products reveals there is still much room for improvement. Four points could be considered: (1) The form of product design is conservative. On the layer of the form of product design, the shape of product design of the NPM is certainly used in many life-styles. But most used are relics of the original shape and its pattern of replication, or they are reposted. These designs lack of distortion, transformation, and other sublimations of a substantial design variation, and regarding color, they are rarely objective. (2) The range of product design application is narrow. On the layer of the marketing of product design, the range of product design application is too narrow. Product design is limited to reproduction of the sculpture, food gift boxes, stationeries and small household items. In the context of daily necessities, the applications are still very inadequate. Also, the designed products are geared toward the adult perspective, lacking in market segmentation; children's educational products are too limited. (3) The cultural content of product design is rare. On the layer of the internal aspects of product design, the product is within its own cultural definition. However, most of the emphasis is on the appearance of the design while short in statement understanding and cultural connotation, not considering the depth of the meaning, and neglecting to show expression and active design. (4) The overall style of product design lacks creativity. On the layer of the overall style of product design, the Jadeite Cabbage is rich in high quality elements of the cultural and creative spirit. The product design of the NPM was originally based on the Chinese Palace's degree of beauty and refinement. It had unique advantages and characteristics of life applied to different items. The NPM products in Taiwan have a high degree of culture and creativity, representative of Taiwan in the Central Plains and its unique depth of creativity. However, due to the lack of cultural form and content and conservative interpretation design, government and academic cooperation continues to develop the design. In addition, the cooperation of science and technology still needs to move forward.

6 Conclusion and Recommendations

NPM is the flagship of Taiwan's cultural and creative industry. As pilot for Taiwan's cultural creative image, the quality of its product design collection is of key and essential significance. The NPM is currently active in promoting cultural and creative planning for the park for transacting cultural and creative study, revealing the intentions. The researcher holds an extraordinarily optimistic attitude about the improvement of cultural and creative product design development.

Qing Jadeite Cabbage is the most popular heritage item. The sales of products designed with it in mind are higher and more significant than any other of the NPM cultural goods. Regarding overall style, it has more than just beauty and delicacy. However, the combination of creativity and technology are the weaker points, so the attraction will be relatively limited. Concerning the quality side, the goods of the NPM are representative of popular views, modern elegance and a sense of creativity.

The researcher suggests some recommendations from two aspects. On the product design side, the suggestions are: 1) To strengthen the design of the transformation and deformation, and avoid the negative heritage copy of the designs and patterns, 2) To

expand the cultural heritage by employing product design application according to the needs of different consumers' interests, especially those of children, and 3) To expand the cultural definition of goods.

On the administrative operations side the suggestions are: 1) To expand the company to design, enriching the heritage application design; 2) To combine government with academics and cultivate goods design talent; 3) To enhance design quality and competitiveness, assisting in traditional design services industry; 4) To enhance product design and development partnered with the domestic and international research community; 5) To increase the offering service of more digital pictures of artifacts to provide richer design elements; 6) To promote design education, enhancing the aesthetic quality of the consumer; 7) To expand the scope of cultural relics made to enrich the design elements; 8) To consider lowering the cost of licensing as a strategy to improve the use and design of business.

In summary, the cultural products of the National Palace Museum have multi-dimensional meanings, including Taiwan's localization, target, brand, and international significances. So, it is of great value, through the cooperation of industry, government, and academic, to research the development continually.

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The Impact of Cultural Differences on Instant Messaging Communication in China and Germany

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Abstract. Instant messaging (IM) is a popular real-time communication tool to facilitate cooperation. This study attempts to provide a better understanding of instant messaging communication in China and Germany. The study aims to investigate the effects of individualistic versus collectivistic culture and low- versus high-context communication on the preference of multi-party chat and the level of responsiveness in instant messaging communication. 72 Chinese and 60 Germans participated in the survey. The results revealed that Chinese users significantly preferred multi-party chat, seldom sent messages to offline contacts, and used emoticons more frequently to increase the respond speed than German users. Further implications on designing effective cross-cultural communication tools were discussed.

Keywords: Culture, Instant Messaging, Survey study.

1 Introduction

We are living in the information world, where information technology and internet-based communication tools provide convenient communication across long distances and can help multinational cooperation. However, the cultural barriers greatly impact effective communication and cooperation. Cultural differences may cause misunderstandings, conflicts and consequently affect the cooperation process.

Cultural differences in how information technology is used may provide some insights on designing effective collaborative tools in the workplace and to facilitate multinational cooperation. In this paper, we explore how cultural differences influence the use of one popular information technology – Instant Messaging (IM).

IM as a convenient internet-based communication tool has rapidly being adopted in the workplace. Due to its simplicity, ease of use and relatively high level of synchronicity, IM is now widely used all over the world. Studies have shown that IM can support a variety of informal communication tasks between workgroup members, and it is an important part of many workplace tasks (e.g., [1,2,3]). It is predicted that by the end of 2011, IM will be the communication tool with 95 percent of workers in leading global organizations using it as their primary real-time communications [4].

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In the past two decades, IM researches have been primarily studied from a western perspective. Until recently, several studies examining cultural issues in computer-mediated communication (CMC) provided valuable results to explore how people from other cultures using this information technology and whether western patterns of use behavior can be generalized to other cultures (e.g., [5,6,7,8,9]). Their studies mainly focused on comparing CMC use behaviors between Asians and North Americans. The results supported the contention that CMC use behaviors differ across these cultures. Under increasing globalization of markets and multinational cooperation, it is also important to know the differences between Asians and European people, for instance, comparing instant messaging communication between Chinese and Germans, in order to provide an integrated view on this topic. Although in general, Europeans and North Americans are all called western people, cultural differences still cannot be ignored. Take Americans and Germans for example, cultural differences exist in communication (e.g., [10,11]) and decision making (e.g., [12,13]).

In this paper, we investigated the effects of culture on instant messaging communication in China and Germany. The purpose of this study was to extend the cross-cultural instant messaging studies to a broader area by adding the results from China and Germany. The findings of this study will make contributions on cross-cultural instant messaging researches. The findings will also help practitioners design effective cross-cultural communication tools.

In the remainder of this paper, we first reviewed literatures on culture and its impact on instant messaging communication. We then presented the results of a preliminary study. Based on literatures and the results of the preliminary study, two hypotheses were developed to examine the preference of multi-party chat and the level of responsiveness for Chinese and German IM users. A questionnaire was designed to test the hypotheses, and the results were analyzed. We ended by discussing and providing recommendations for the design of internet-based cross-cultural communication tools.

2 Literature Review

2.1 Culture and Communication

The term culture is used broadly and inclusively to refer to the collective life patterns shared by people in social groups such as national, racial, ethnic, socioeconomic, regional and gender groups. The most prevalent used definition of culture is given by Hofstede [14], who defines culture as “the collective programming of the mind that distinguishes the members of one category of people from those of another”. Through systematically collection of data, Hofstede constructed a commonly acceptable, well-defined, and empirically based terminology to describe culture. Five independent dimensions were concluded [14,15]: (a) power distance; (b) uncertainty avoidance; (c) individualism versus collectivism; (d) masculinity versus femininity; and (e) Confucian dynamism. An evaluation index was also developed, which provided a systematic measurement for different national cultures and allowed comparison between cultures. In this study, we focused on the “individualism versus collectivism”

cultural dimension, trying to investigate how individualistic and collectivistic cultures impact the instant messaging communication.

According to Hofstede [15], individualism is defined as "a situation in which people are supposed to look after themselves and their immediate family only", whereas its opposite pole, collectivism is defined as "a situation in which people belong to in-groups or collectivities which are supposed to look after them in exchange for loyalty". The measurement provided by Hofstede indicated that the value for "individualism versus collectivism" dimension is 20 for China, and is 67 for Germany. The large difference between China and Germany indicates that these two nations lie in the different pole of the individualism-collectivism dimension. China is a typical collectivistic society, and Germany is considered to be stronger as an individualistic society.

Culture and Communication are closely correlated. Communication provides the development of culture, and cultural science could relay to following generations by communication [16]. Hall and Hall [17] classified cultures on different dimensions in terms of communication. One dimension is low- versus high-context communication. Context is defined as the information that surrounds an event. The Chinese, Japanese, the Arabs, and the people from the Mediterranean region are high context cultures, whereas Americans, Germans, Swiss, Scandinavians, and other northern Europeans are low-context cultures [15,18,19].

The high-context communication style is one in which most of the information is already in the person, while very little is in the coded, explicit, transmitted part of the message [17]. In other words, meaning is found in the nature of the situation and relationship in high-context cultures. One of the representatives of high-context culture is China [19]. Chinese people always have closely relationships to the others in their society and tend to have deeply information network around them. The low-context communication style is just the opposite. The information is provided in the explicit code. Low-context people seal their personal relationships and influences from outside off. In comparison to the high-context people, the individuals who belong to low-context culture always need detailed background information each time they communicate with each other. In other words, meaning is found by words in low-context cultures. Germany is a representative of the low-context communication style, as Germans always need to be introduced in detail and require all the background information available.

2.2 Cross-Cultural Studies on Instant Messaging Communication

In recent years, several studies have examined cultural differences on instant messaging communication. They have compared the instant messaging communication behaviors between Asian and North American cultures.

Setlock, Fussel and Neuwirth [8] compared different cultural groups, either as homogeneous American pairs, homogeneous Chinese pairs, or heterogeneous American-Chinese pairs, on face-to-face setting and via instant messaging communication. They found that cultural differences were reduced but not eliminated in instant messaging communication. In addition, the synchronicity of the IM is more important for supporting remote work among members of high-context cultures. Kayan, Fussell, and Setlock [7] examined cultural difference in the use of IM in Asia

and North America. Their results showed that multi-party chat and emoticons were much more popular in Asia than in North America. In a more recent study, Setlock and Fussell [9] conducted in-depth interviews of North American and Asian participants to examine how culture shapes perceptions of the affordances of media and usage of these media in different communicative contexts. They found that the ability for media to support social in addition to task processes was more important for participants from China, Korea and India than for participants from United States.

3 Methodology

In this study, cultural differences between China and Germany in instant messaging communication were investigated. As discussed in the literature review, China is a collectivistic and high-context society, and Germany is an individualistic and low-context society. The cultural differences between these two nations are expected to provide two poles helping gauge the impact on instant messaging communication. In this study, Chinese and German students were selected because younger internet users employ IM in greater number and more ardently than older generations [20].

3.1 Preliminary Study

In-depth interviews with Chinese and German IM users were carried out in order to investigate how they use the IM client software. The participants were students from Tsinghua University in Beijing, P. R. China. The German students were exchange students studying at Tsinghua University. The participants recruited in the interview were experienced users of computer and IM. The interviews were conducted at students' dormitory in order to observe their IM use behaviors. Thus, during the interview, participants were allowed to use IM as usual. The interview lasted about one hour. The questions were mainly about their experience using IM. Sample questions were "what do you use IM for" and "why do you choose to use IM". Three main findings were concluded.

Firstly, it was observed that participants often received incoming instant messages while the interview was conducted. Besides, participants accomplished considerable work using IM during the interview. For instance, they arranged a meeting for their group discussion, made an appointment for lunch, discussed the homework, and even talked about the atmosphere in their dormitories.

Secondly, it was found that the general tenor of IM was casual, informal and friendly with relaxed grammar and spelling. Punctuation characters, such as exclamation and question marks were used multiple sequenced in the IM. The informality of communication in IM imparts the system a kind of intimacy that is missing in other type of computer-mediated communication tools.

Thirdly, participants mentioned that a key reason for them to use IM was its synchronicity to support quick responses. Especially when arranging a meeting, it is important to know the details of other person's schedule. In addition, it was noticeable that Chinese participants tended to respond to incoming messages immediately.

3.2 Development of Hypotheses

Based on the literatures and the interview findings, two hypotheses were developed to investigate the relationship between cultural background and the instant messaging communication.

During the interview, we found that participants frequently used IM to arrange social activities, for example arranging group discussions, making appointments, etc. Most of the IM clients today can provide users to talk with more than one people in the same window at the same time, which is called several-to-several communication. Individualism-collectivism is a key dimension in understanding interpersonal interactions and group communication processes. In an individualist culture, individuals are loosely integrated with others. On the contrary, the individuals from collectivistic culture relate themselves in larger groups. People in collectivistic cultures prefer group discussions and habitually make decisions in group settings rather than individually. Therefore, we assume that people in collectivistic culture, like Chinese, will have stronger preference on using several-to-several communication than people in individualistic culture, like Germans. This leads to the first hypothesis.

Hypothesis 1: the preference of multi-party chat is stronger in collectivistic culture than in individualistic culture.

Generally, the communication in IM can be considered as near-synchronously. However, the level of synchronicity can be adjusted by user's response. IM can be synchronously, near-synchronously, or even asynchronously depending on the responsiveness of the receivers. According to Hall and Hall [17], in high-context culture, the meaning of communication is embedded in the situation. Therefore, they pay more attention to the contextual information and use more contextual-nonverbal cues in communication. On the contrary, situational factors play a minimal role in low-context culture. This leads to the second hypothesis that people in high-context culture, like Chinese, response in instant messaging communication quicker than people in low-context culture, like Germans.

Hypothesis 2: the responsiveness of instant messaging communication is quicker in high-context culture than in low-context culture.

3.3 Questionnaire Design

A questionnaire was designed to test the hypotheses. The questionnaire contained four parts: (a) introductory questions; (b) preference of multi-part chat; (c) responsiveness in instant messaging communication; and (d) demographic profile.

The introductory questions served the purpose of obtaining basic instant messaging communication information of participants, for example, years of experience using IM, duration of connecting time per session, and choice of IM client. Part 2 tested the preference of multi-party chat. This part contained 11 questions using a 5-poing Likert-type scale from 1 (agree) to 5 (disagree). Sample statements were "I often chat with more than one buddy in the same window"; "I like to find the solution of a task on my own before I start a multi-party chat to get some ideas"; "I prefer meetings in a

multi-party chat than to find solutions in a dialogue". Part 3 tested the level of responsiveness in instant messaging communication. This part contained 15 questions using a 5-point Likert-type scale from 1 (very often true) to 5 (seldom true). Sample statements were "I immediate reply to incoming messages"; "Usually I finish what I am doing before I give response"; "If I have to wait for response, I fell immediately angry". The last part dealt with the demographic information, for example participant's gender, nationality, education level, major, etc.

The questionnaire was implemented online. The Chinese data were collected from students studying at Tsinghua University in P. R. China, and the German data were collected from students studying at RWTH Aachen University in Germany. The surveyed students had abundant experience of using at least one of the most popular IM systems: MSN, ICQ, QQ, Skype, etc. They were undergraduate or graduate students majoring at Engineering or Economics. The language used in the questionnaire was English. Pre-tests were conducted to ensure no misunderstandings of the meaning for both Chinese and Germans.

4 Results

4.1 Basic Instant Messaging Use Behavior

Altogether 132 valid samples were obtained, including 72 Chinese samples and 60 German samples. The average age of Chinese students was 23.4, and the average age of the German students was 24.6. The majority of both Chinese and German students had used IM for over 5 years. Nearly half of them connected IM more than 3 hours per session. In addition, about half of the respondents logged in IM client daily.

Chinese and Germans had different preferences on the choice of IM client. Results showed that the most popular client in China was QQ (83.3%), followed by MSN (73.6%) and Skype (38.4%). The most popular client in Germany was ICQ (78.3%), followed by Skype (76.8%) and MSN (36.7%).

4.2 Testing of Hypothesis One

Hypothesis one intended to investigate if the preference of multi-party chat was stronger in collectivistic culture than in individualistic culture. The second part of the questionnaire examined preference of multi-party chat. The internal consistency was 0.66 for the Chinese sample, and was 0.60 for the German sample.

The results showed significant difference ($F[1,130]=21.858$, $p<0.001$) between Chinese users (mean=33.42, SD=5.42) and German users (mean=29.17, SD=4.92) in preference of multi-party chat in instant messaging communication. Hypothesis one was supported. Cultural differences indeed have impact on preference of multi-party chat. People in collectivistic culture have higher preference on multi-party chat than people in the individualistic culture.

4.3 Testing of Hypothesis Two

Hypothesis two intended to investigate if the responsiveness of instant messaging communication was quicker for people in high-context culture than in low-context

culture. The third part of the questionnaire examined the responsiveness in instant messaging communication. The internal consistency was 0.66 for the Chinese sample, and was 0.60 for the German sample.

The results showed no significant difference ($F[1, 130]=2.334$, $p=0.129$) between Chinese users (mean=46.24, SD=7.65) and German users (mean=44.28, SD=6.89) in responsiveness of instant messaging communication. However, further analyses of the questionnaire revealed that Chinese users and German users did differ in two aspects of the responsiveness. Firstly, there was significant difference in how often they leave messages to currently offline contacts ($F[1,130]=4.336$, $p=0.039$). German users were more often to "leave messages to currently offline contacts" than Chinese users. Secondly, significant difference was found in their use of emoticons to increase the speed of response ($F[1,130]=12.401$, $p=0.001$). Chinese users used emoticons more frequently to increase the response speed during instant messaging communication than German users.

5 Discussion

5.1 Theoretical Implications

Overall, the results can be explained well by cultural differences on individualistic versus collectivistic culture and low- versus high-context communication style. People in collectivistic culture had higher preference on multi-party chat than people in individualistic culture. In addition, people in high-context culture seldom sent messages to offline contacts, and more frequently to use emoticons to increase the respond speed during instant messaging communication than people in low-context culture.

Firstly, the preference to communicate by several-to-several IM session is affiliated closely to the collectivistic culture. People living in societies that are characterized by collectivism are from the birth onwards integrated into strong, cohesive in-groups, which throughout people's lifetime. Living in accord with each other is more important and therefore they tend to go along with the decisions of the group. Secondly, the finding that Chinese seldom send messages to currently offline contacts can be explained by the coherent of the high-context culture: meaning is found in the nature of the context. Quicker responsiveness ensures the conveyance of the context information during communication. Thirdly, high-context culture relies more on social cues, facial expressions, vocal tones and situational awareness to communicate effectively. Therefore, people in high-context culture use emoticons more frequently to increase respond speed in instant messaging.

5.2 Practical Implications

Based on the findings of this study, we provide the recommendations on designing internet-based cross-cultural communication tools for practitioners. In recent years, mobile instant messaging (MIM) has become more popular besides personal computer-based IM. The ability to access IM client at any time in any place makes the MIM important for business and cooperation. However, MIM has several characteristics different from personal computer-based IM. In a mobile environment,

the user is constrained by the bandwidth and the user interface (UI). MIM designers must face with the smaller UI to provide sufficient presentations of information on the interface. Thus, in this study, we provide design recommendations for computer-based as well as for mobile based cross-cultural communication tools. Four design recommendations were provided.

Provide group settings for collectivistic culture users. Provide functions of sending and replying messages to the entire group members. Users in collectivistic cultures have higher preference on multi-party chat than users in individualistic cultures. Thus, group function is much more important for them. Besides, the interaction with other group members, for instance, sending and replying to all group members are important for them as well.

For users in high-context cultures, provide online contacts and hide offline contacts by default and support as much as context information for the conversation. For users in low-context cultures, rank the contacts according to the communication frequency. The results of this study showed that users in high-context cultures seldom sent messages to currently offline contacts. Considering the limitation of the user interface for mobile devices, only provide the currently online contacts may be the best way to present useful information in limited mobile user interface. Besides, try to support context information for users in high-context cultures, for instance, providing the easy access to the whole log of previous conversations and showing the detailed time of the offline messages send by senders at the receiver's part.

A rich emoticon set is important for users in high-context cultures. Provide shortcut keys for most used emoticons. Users in high context cultures are more likely to use emoticons during instant messaging communication, thus a rich emoticon set is quite important for them to fully express their opinions and emotions during communication. For mobile device, providing shortcut keys to facilitate fast input of the emoticons can greatly help increase the speed of response which is important for users in high-context cultures.

Pay attention to the consistency of emoticons in different cultures. Provide translations of emoticons to users in low-context cultures when they communicate with users in high-context cultures. Emoticons may have different meanings in different cultures. Even the same meaning may be expressed by different ways. For instance, in China, people usually use emoticons "  " or a simple combination of symbols ":-D" to express laughing out loud; but in western, it usually be expressed by using abbreviations "LOL". Thus, the design of emoticons should pay attention to ensure clear understandings of the meanings in different cultures. Moreover, when users in high-context culture and low-context culture communicate with each other, it is better to provide the translations of corresponding emoticons to users in low-context culture, for instance the translated words or the abbreviations.

5 Conclusions

This study focused on instant messaging, aimed to investigate the impact of cultural difference on instant messaging communication in China and Germany. The study showed significant difference in preference of multi-party chat, sending messages to currently offline contacts, and using of emoticons to increase the respond speed in

instant messaging communication between Chinese and Germans. The differences can be well explained by individualistic versus collectivistic culture and low- versus high-context communication style. The results further supported the contention to consider cultural differences in examining internet-based communication behavior for future research. Suggestions on designing effective cross-cultural communication tool were provided for practitioners. With the proliferation of instant messaging and other emerging communication technologies both in the personal computer setting and mobile device setting, more investigations especially for the mobile setting should be considered in the future.

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Culture-Centered Design: Culture Audit of Screen Designs for Educational Software in Saudi Arabia

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Abstract. This paper describes screen design issues in a culture audit performed on software prior to translation. The authors found that this effort was cost-effective, because, for relatively little money and time, one can identify problematic items that translation services may not uncover, avoiding the end result of translating well what should never have been localized in the first place. In the cultural analysis section, we provide an overview of the wider cultural and social context of the rapid educational reform currently underway in the target country, Saudi Arabia. Because most educated users in the target country have learned to use the Microsoft Office Suite, we recommend that the design of Office be used as a baseline reference for any redesign.

Keywords: audit, business, culture, design, development, software, icons, management, Saudi Arabia, user experience, user interface.

1 Introduction

The authors worked with Client X (anonymity requested), a major software translation and localization firm. Their own client (Client Y) was in the process of converting educational software that serves more than 100,000 schools and universities throughout the United States and 165 countries worldwide. In 2009 Client X partnered with AM+A to provide a culture-oriented evaluation of the software's usability, usefulness, and appeal for the Saudi Arabian market (with eventual adaptation for the Gulf and Levantine regions), focusing on the visual design and use of icons and imagery. For this project, AM+A conducted a culture audit, examining icons, graphics, concepts, and terminology. In addition, a small sample of Saudi students studying in North America was recruited to review parts of the interface and to discuss customization.

2 Cultural Analysis

2.1 Educational Change

In considering the user-interface requirements for an Arab version of the library management application, it is important to understand the influence of the central

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government on the adoption of software and the training of academics to use new educational technologies.

Saudi Arabia is engaged in a major spending program to combat the global recession and maintain its economy. Much of this spending ($32.6B, or 25% of the total) is aimed at education and training. More than 1500 new schools are scheduled to be built and more than 2000 renovated [1]. New private colleges and the two new elite universities have introduced educational reforms. King Abdullah has emphasized the need for the Kingdom to embrace higher education, for women as well as men, to diversify its economy, reduce dependence on oil exports, and employ its graduates.

The *General Project for Curriculum Development*, adopted in 2002 by the Ministry of Education, laid the groundwork for the increased use of educational technologies. However, a recent study describes barriers that prevent full use of technology in the schools (M. Al-Abdulkareem, 2008, as cited in [2]):

- Weakness of infrastructure, especially communication infrastructure
- Need for technology specialists
- Lack of technological knowledge and skills among teachers and administrators
- English language barriers (for example, most Web 2.0 tools are in English)
- High cost of technology

The Computer and Information Center in the Ministry of Education has the mission of overcoming these problems and managing the development of educational technology and infrastructure. However, not all schools are computerized and not all schools are connected. The Ministry Website notes that there are 2,300 computer labs (39,100 PCs) in elementary and intermediate schools, 3,000 (51,000 PCs) in secondary schools, and 2,000 Learning Resource Centers (12,000 PCs) [3]. However, there are more than 28,000 schools throughout the country [4].

Boys and girls are educated separately and it is not clear whether education for girls is at the same level of technological adoption. A separate department within the Ministry, the General Presidency of Girl's Education, handles requirements for girls' education. Although King Abdullah promotes female education and expanded career options, religious conservatives continue to restrict opportunities, and many women academics complain that the system is unequal [5]. As a result, a number of private schools exist alongside the public school system, and many (like Dar Al-Fikr Private School in Jeddah) have been sources of curricular and technological innovation [2].

The Ministry's latest ten-year plan (2005) seeks an integrated solution for the application of information and communication technologies by 2014 [6]. In addition there are plans to train 30,000 teachers.

2.2 Cultural Values

Hofstede's 1997 study of cultural values characterized Arab cultures as having high power distance (respect for authority), medium collectivism, and medium masculinity [7]. However, these ratings need to be put in context. Hofstede did his research in the 1970s-1980s; he sampled employees of a Western corporation (IBM); and he

amalgamated the statistics from a number of Arab countries (Egypt, Iraq, Kuwait, Lebanon, Libya, and the United Arab Emirates, as well as Saudi Arabia). As he himself admits, "impressionistically, the Saudis within this region are even more collectivist than some other Arabs like Lebanese or Egyptians" (p. 54). Studies of Saudi Arabia itself describe the country as having extremely high power distance, strong collectivism, and strong masculinity.

These cultural values influence the educational system. Power distance is expressed in a number of ways. Not only is government education centralized, it is standardized and based on religious teachings. Schools follow a curriculum that focuses on instilling Islamic values. Elementary students take nine hours per week of Islamic studies from first to sixth grades; intermediate students take eight hours per week from seventh to ninth grades [8].

Concern with moral values legitimates censorship and public surveillance. Women aren't allowed to buy CDs and DVDs in shops; Internet cafes are required by law to install surveillance cameras; and *Arab News* reported the Saudi Communication and Information Technology Commission asked Research in Motion to allow it to monitor BlackBerry Messenger service or be shut down. [9] Government censors the Internet through its Internet Services Unit; new laws authorize five-year jail sentences for people distributing "pornography or other materials that violate public law, religious values, and social standards of the kingdom" [10]. Saudi Arabia is considered one of the least open countries on the Internet.

Similarly, Saudi Arabia has extremely strong collectivism; national and religious goals are promoted over individual goals in the school systems. Even though King Abdullah's educational reforms are intended to upgrade standards and open new professional opportunities to men and to women, his program is couched in nationalistic and religious terms. The concept of the *ummah*, the community of believers, is central to Islam and used to justify the kingdom's social conservatism.

Lastly, Saudi Arabia practices strict gender segregation and, until recently, restricted women to non-technical jobs. Girls are now being encouraged to consider new occupations, *e.g.*, software engineering and architecture, but all professions remain segregated. For example, only women teach women. If women professors are not available, men lecture women students using video technology and have no other contact with them. Children are educated separately, but girls are not required to cover until they become teenagers.

3 Visual Analysis

3.1 Examples of Websites Considered Sophisticated and Attractive

The students were asked to nominate websites that demonstrated good design. These examples of Saudi Websites were considered particularly sophisticated and attractive.

Fig.1. Saudi Arabian Airlines, left, King Saud University, right Photographic images are also used as buttons on both websites

3.2 Examples of Websites Popular with Young Saudis

While not a universal preference, Saudi young people tended to prefer sites with a simplified appearance overall and a limited number of colors, as shown in the accompanying figures.

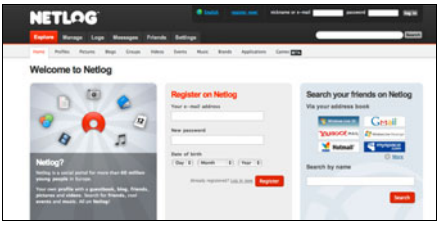

Fig.2. NETLOG is a European equivalent of Facebook that has a wide selection of languages, including Arabic. http://en.netlog.com/

Fig.3. kammelna.com offers card games. Hihi2 has sports news

3.3 Colors Used on Library Sites of Saudi Colleges and Universities

Most Websites for Saudi educational institutions use blue, green and gray palettes. The color green is associated with Islam, but is acceptable for use on secular Websites. (See www.findouter.com/MiddleEast/Saudi_Arabia/Education for more education-related websites,.)

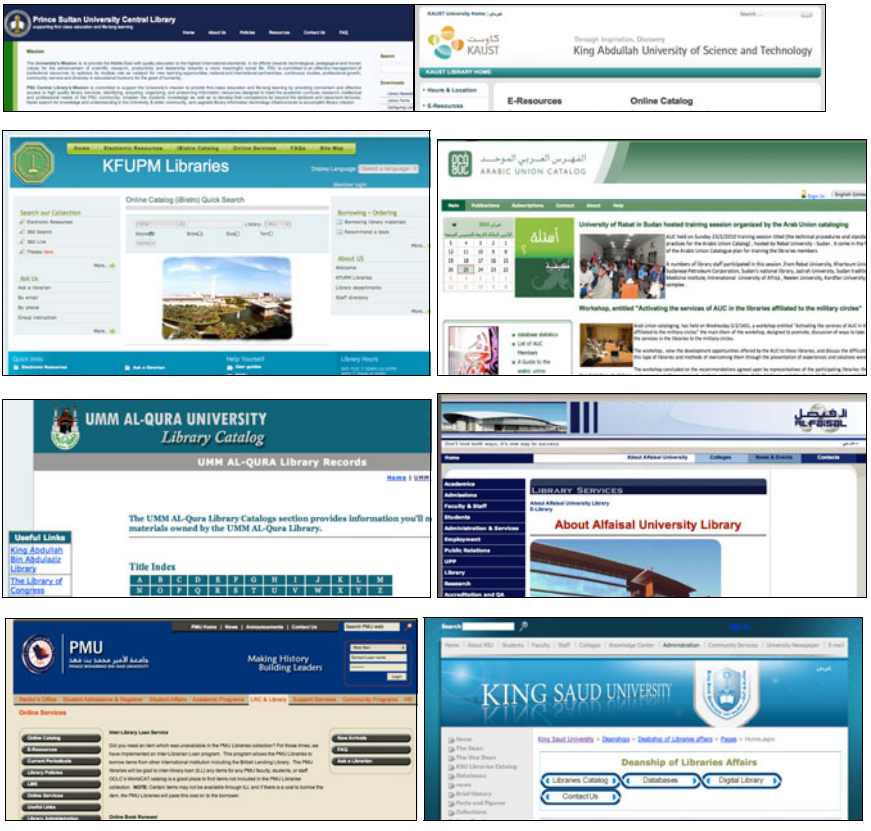

Fig.4. Typical colors in academic and library Saudi Websites

3.4 Microsoft Office Baseline

Most educated Saudis are familiar with the Microsoft Office suite through their introduction to MS Office products during secondary school education. If in doubt about whether an icon is appropriate or meaningful, user-interface designers can safely refer to the equivalent icon in an Office application as a basis for concept and appearance. All of the students had been trained to use MS Office products during secondary school. When asked if they would prefer local software, they said that they preferred to use translated Microsoft products. One conjecture is that Microsoft has come to represent the standard, the "best" product available; another is that students liked the opportunity to switch between the translated Arabic and English interfaces to improve their language skills. However, as Saudi educational standards improve and more graduates begin developing a local software industry, this recommendation may change.

Screenshots from some of Microsoft's localized Middle Eastern applications are shown below.

Fig.5. Microsoft Excel and PowerPoint in Arabic versions

3.5 Icon Usage: General issues

As seen in the reference Websites, most buttons and tabs on Saudi and other Arabic-language Websites contain text only; there is very little use of icons. There does not appear to be any general cultural objection to icons. This trend may be a result of an artistic tradition in which calligraphy is a major art form and figurative painting less valued. Photographs, however, are widely used on nearly every Arabic-language Website and often identify buttons.

On the King Saud University Website, below, buttons usually have text only, but occasionally there are icons in addition to text. (Note that when Websites are available online in both Arabic and English, icon usage is almost always the same in both languages).

Fig.6. King Saud University. Typically buttons, menus, and tabs have text only

3.6 Icons with Specific Cultural or Linguistic Problems

As a general rule, icon design should avoid the use of Roman alphabet or numeric characters, as in the examples below.

There are some exceptions to this rule: where the Roman character is in wide use as an international symbol, it can be used without translation. Many standard icons use characters from the Roman alphabet, but are meaningful because of widespread Internet usage.

Icons which might be associated with other religions, such as a Christian cross, star of David, or a magic wand, should be avoided. Plus signs are acceptable as indicating that something new is being added. However, the vertical line of the plus should not be longer than the horizontal, to avoid any resemblance to a Christian cross. Both witchcraft and sorcery are outlawed in the Kingdom, and a psychic was arrested and sentenced to death as recently as November 2009 [11].

The thumbs-up icon is used by some young Saudis on social networking sites to indicate approval, but it could be misinterpreted by older Saudis. Hand gestures often do not translate well between cultures and should be avoided.

Similarly, icons showing people should be abstract, gender-neutral and well-clothed due to the importance of female modesty in Islamic culture. For example, icons should avoid the suggestion of short sleeves or uncovered hair for young women.

3.7 Visual Themes and Customization of Backgrounds

Respondents told us that they customized their mobile phones with photographs and preferred to put their own photos in backgrounds (appealing images included soccer heroes, beaches, pleasant views, and Angelina Jolie). However, note that the use of personal photographs in social media has been contentious. A recent court case in Saudi Arabia dealt with the possible damage to a young woman's reputation from photos placed on Facebook [9] Most of the images we saw on Saudi Websites were photographs of men in authority (like King Abdullah) or views of modern buildings that reinforce national pride.

3.8 Text Size on Buttons

Graphic designers should be aware that there is a 25% size expansion rate when English is translated into Arabic, if the type size remains the same.[11] Buttons should be sized accordingly to keep type easy to read. In the table below the Arabic text has been reduced in size so it takes less space than the English text, but the type is small and cramped. User testing may be required to ensure that the text is legible.

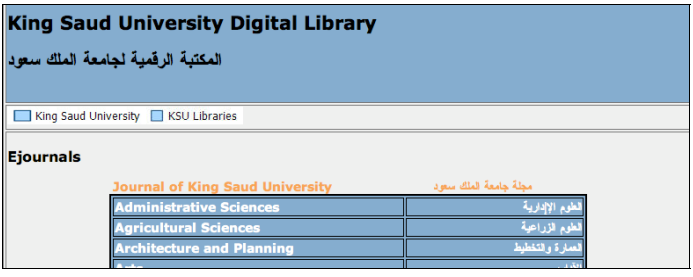

Fig.7. http://digital.library.ksu.edu.sa

3.9 Dual Language Pages

Some Arabic library sites have been designed so that the same page can accommodate English text on the left and Arabic text on the right. This has advantages for bilingual users who need to switch back and forth between languages when searching for materials in both languages.

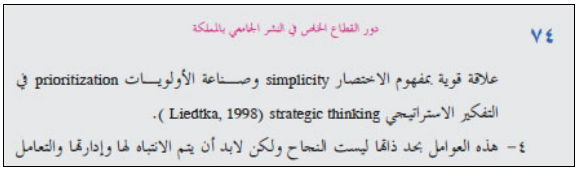

Fig.8. Using two languages on one page is common with Modern Arabic: note the use of Bidirectional Input (Right-to-Left English words and names embedded in Left-to-Right Arabic text). Users switch directions using standardized key combinations.

4 Conclusions

Translating its library software is an excellent first step for Client Y to localize its product for sale in Saudi Arabia. To keep localization expenditure to a minimum, the basic visual design and color palette of the current software could be used with only minor changes. However, it is important to realize that at least two levels of acceptance are involved. Users must feel comfortable with and enjoy the interface but, first, the country's conservative religious and social culture must approve the product for use in schools.

This application could be made more appealing to the Middle Eastern market by making the design resemble some of the more popular Saudi sites with a crisper, cleaner look. Incorporating more blues into the screen design would also bring it more closely in line with Saudi tastes. Further, icons with a more abstract, simplified look would better harmonize with the abstract geometric appearance of Arabic calligraphy.

However, to pass an initial review, library administrative user interfaces may need to accommodate Saudi concerns about access to information. All decisions on purchase and implementation of software for government schools are taken by the national Ministry of Education and many types of books remain restricted.

Nevertheless, this is a unique and exciting time for an American company to engage with the process of educational change. Saudi Arabia is dramatically raising the level of the whole educational system, equalizing opportunities for girls and boys and implementing modern educational technology. As the country builds and equips its new schools, it is negotiating its own path to modernity and its students are finding their own places in the wider world.

As the current (2005) Ten Year Plan notes:

The development and wide spread of unrestricted mass media communication and the reduction of its costs constitute a challenge and a threat to the Kingdom's national identity and culture. This issue requires a balanced approach that will allow students to enjoy the benefits of modern technology (which, in turn, will benefit the community) while maintaining the Kingdom's values and faith, and that is able to protect them from the risks that might harm them as individuals and groups and that might negatively affect Muslim society. [6]

And, as we support the efforts of young people themselves throughout North Africa and the Middle East to bring change, we should provide appropriately localized technology for education and social improvement.

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Using Metaphors to Explore Cultural Perspectives in Cross-Cultural Design

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Abstract. We have proposed five cultural viewpoint metaphors to help designers that wish to encourage and support cross-cultural HCI contacts. In this paper we present the main results of an experiment carried out to assess the potential of these metaphors in designing cross-cultural systems. Six HCI designers, with different cultural backgrounds, were then asked to create re-design alternatives for a real website guided by the metaphors. As a result, the experiment showed the epistemic effect of the metaphors on cross-cultural design, i. e. as a means to build new knowledge and understanding.

Keywords: Cross-cultural design; HCI and Culture; Conceptual metaphors for HCI design.

1 Introduction

Today, one of the challenges for interaction design is the development of systems aiming to attend to the needs and expectations of people with different cultural and social backgrounds. The most widely used perspective adopted in cross-cultural design is internationalization-localization (Int-Loc) [1, 6, 7, 9]. Internationalization is the process of preparing code that separates the core functionality of the system from interface specifics (e.g. text language, measures, etc.) [7]. With localization, the interface is customized for a particular audience (through language translation, cultural markers and even technical features, for instance) [9].

We are, however, interested in another kind of context: one where the design intent is to *expose and explore* cultural diversity, rather than *conceal* it. This is the case, for instance, when the purpose of the designed system is to stimulate the users to make contact with a foreign culture. In this paper we briefly describe five cultural viewpoint metaphors (CVM) [12], a conceptual design tool that can be used when cross-cultural system designers explicitly want to support and promote different levels of contact with cultural diversity. The International Children's Digital Library[1] and the Unesco[2] websites are examples of systems that fall in this category.

[1] http://en.childrenslibrary.org/ last accessed in Feb 3, 2011.
[2] http://www.unesco.org/new/en/unesco/ last accessed in Feb 3, 2011.

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CVM derived from empirical studies applying Semiotic Engineering [5] to analyze and re-design cross-cultural systems interfaces. This theory views human-computer interaction as a computer-mediated human communication process, with three communicating *agents* on stage: designers, users and system. They are brought together at interaction time through metacommunication. In this particular process, through interface content and controls, the designers actually send an interactive message to users, implicitly telling them about who the designers think the users are, what they have learned about the users' needs and expectations, and finally how and why the users can explore communication with the system while aiming to achieve a wide range of envisaged goals.

This paper aims at presenting an empirical experiment carried out to assess the potential of CVM in designing for cross-cultural experience. The main results reveal the epistemic value of CVM on cross-cultural design at helping designers to think of how to expose and communicate the very idea of cultural diversity. They also suggest that this specific approach to culture-sensitive HCI design deserves attention.

The experiment is, actually, part of broader two-step case study. One, which is presented in this paper, assessed how CVM can be used at design time, and the other assessed how CVM can be used at evaluation time. We triangulated results from the case study with results from another experiment with CVM at evaluation time carried out in another domain. The whole case study is presented in [13].

We begin by briefly presenting the cultural viewpoint metaphors in Section 2. In Section 3, we describe and present results from the experiment with CVM at design time. Finally, in Section 4, we discuss the value of our findings for cross-cultural HCI design.

2 Cultural Viewpoint Metaphors as a Top Level Frame for Cross-Cultural Hci Design

The cultural viewpoint metaphors defined in [12] lead designers to conceive of users primarily as **travelers.** Designers can make decisions about if and how it is appropriate to expose the users to content from other cultures while interacting with a cross-cultural system. Like all other conceptual design metaphors, they have been directly influenced by Lakoff and Johnson's view that a metaphor "is a way of conceiving of one thing in terms of another, and its primary function is understanding" [8].

The metaphors express five distinct perspectives on **traveling** through a cross-cultural territory, and can be plotted upon a *continuum* of cultural approximation established with reference to a presumed user's own native culture. They span from cultural isolation (the *domestic traveler* metaphor) to complete cultural immersion (the *foreigner without translator* metaphor). In between these two extremes there are three metaphors marking progressive cultural approximation: the *observer at a distance*, the *guided tour visitor*, and the *foreigner with translator* metaphors (see Fig. 1).

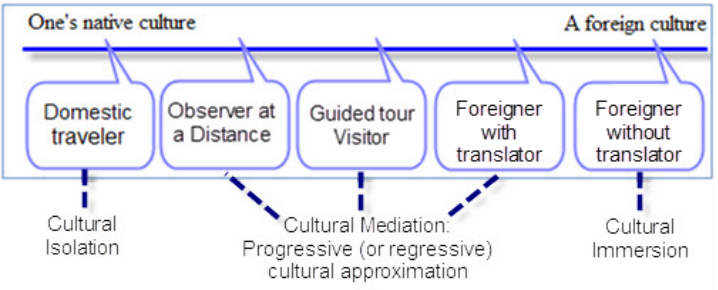

Fig. 1. Progressive cultural viewpoint metaphors

Table 1. Metaphors expression and the effects on organization of Interactive Discourse

Metaphor Expression	Effects on organization of Interactive Discourse		
	Metacommunication features	Cultural variables	
		Language	Cultural Practice
DOMESTIC TRAVELER. No markers from the foreign culture.	Design neutralizes cultural differences and makes the user's culture dominate.	User's	User's
OBSERVER AT A DISTANCE. The cultural markers of another culture are communicated as 'information' (not as an experience the use can 'feel').	Interface elements which represent cultural practices are presented according to the user's culture. Narrative about the foreign culture provides factual information about what is different from one's own culture.	User's	User's
GUIDED TOUR VISITOR. Cultural markers from another culture are 'illustrated' to the user (aspects of cultural issues are exemplified and explained in the user's language).	Design provides contrast between the two cultures. An interpreted view and commentary on the foreign culture mediates the user's approximation and experience with cultural diversity. The user's own culture is dominant and serves as reference.	User's	Foreign
FOREIGNER WITH TRANSLATOR. Cultural markers of another culture can be directly 'experienced' by the user, although in the user's own language.	Communication content is presented in the same way it as to the native users from the foreign culture. Only linguistic translation is done.	User's	Foreign
FOREIGNER WITHOUT TRANSLATOR. Users are addressed as a foreign culture's natives.	The culture of others is offered as it is.	Foreign	Foreign

The adoption of each metaphor entails a different organization of the interactive discourse and different metacommunication features in design (See Table 1). They explicitly correspond to different combinations of values assigned to two global variables: language (the user's or foreign) and cultural practices (with several domain-dependent values: for example, 'driving on the left-hand side of the road', 'reading pages from right to left', etc.). Decisions about how to combine these values (*e. g.* presenting the interface in the user's native language, but addressing the user with a foreign degree of formality) and how much explanation to give regarding *foreign* content selected by the designer, can achieve powerful communicative effects. The intended effect on the expression of design may be one or more of the following:

- Cultural isolation: by design, users are situated exclusively in their own culture, without being exposed to material explicitly referenced to a foreign culture (using the *domestic traveler* metaphor).
- Cultural mediation: by design, users experience different levels of contact with a foreign culture, from strong mediation to weak mediation:
  - Strong mediation: users have only allusive references to a foreign culture, and their own culture dominates the interface signs and interaction forms (using the *observer at a distance* metaphor).
  - Intermediate mediation: users are explicitly guided as they experience selected aspects of a foreign culture through interface signs and interaction forms borrowed from this culture's language(s) and social practices (using the *guided tour visitor* metaphor).
  - Weak Mediation: users directly experience the cultural practices from a foreign culture through interface signs and interaction forms; only the users' native language is retained as a reference to his native culture (using the *foreigner with translator* metaphor).
- Cultural immersion: by design, users are fully exposed to a foreign culture's language and cultural practices, without translation or explanations for foreign interface signs and interaction forms (using the *foreigner without translator* metaphor).

Cross-cultural systems interfaces may be designed using one or more of the proposed metaphors. For instance, it may be desirable to adopt cultural isolation for certain tasks, while intentionally exposing the user to various degrees of *foreignness* in others. Whether the communication of relevant content is going to be expressed through the *observer at a distance*, *guided tour visitor*, *foreigner with translator* or *foreigner without translator* metaphor is a design choice. As a rule, the stronger the mediation, the higher the chances that users will get more and more selective bits of pre-filtered cross-cultural information (selected by design), getting increasingly farther from knowing what roles the information pragmatically plays in the context of the foreign culture involved. For instance, in e-commerce applications, the interface for payment tasks may be designed following the *domestic traveler* metaphor to avoid misunderstandings in transactions involving money. However, users might benefit from knowing that, unlike what happens in their native country, in the foreign country where the purchased goods are going to be delivered customers don't choose to have goods delivered at their homes. They prefer to redeem the goods at specific locations because transportation services cannot be trusted, for instance.

3 Using CVM at Design Time - An Experiment with Avis Website

In order to investigate if and how CVM can support HCI professionals/practitioners at design time, we ran an empirical experiment with the AVIS Rent a Car System© website[3]. It is part of a broader case study to assess how CVM can be used both in design and evaluation activities. Among the larger set of results achieved with the case study [13], this paper discusses the epistemic effect of CVM in a re-design activity.

We chose the AVIS website because it was not elaborated with CVM, and it is clearly a cross-cultural application in the car rental domain that could be re-designed to promote cross-cultural contact. In it, we read that AVIS is "one of the world's leading car rental brands and operates in more than 2,100 locations in the United States, Canada, Australia, New Zealand, Latin America and the Caribbean region" They have a USA-based Global website with more than 50 localized versions for countries around the world such as China, for instance (see Fig. 2).

Fig. 2. – AVIS website in the USA[4] and in China[5]

3.1 Methodology

We adopted non-predictive interpretive methods [4] used in qualitative research. Qualitative methods are especially appropriate for our study, which aims at identifying various meanings that participants have assigned to CVM. Note that, because of this methodological choice, we did not *measure* the extent of epistemic effects achieved by CVM in the process of design (which would require that we chose, *a priori*, which variables could be meaningfully related to epistemic activity in a context that was completely new to participants). Rather, we investigated how participants elaborated and used whatever meanings they associated with CVM while designing metacommunication discourse, and identified recurring elements in this process.

[3] From now on we will refer to it as simply "the AVIS website" (http://www.avis.com/).
[4] http://www.avis.com/, last accessed in Jan 3, 2011.
[5] http://www.avischina.com/, last accessed in Jan 3, 2011.

We recruited six participants and asked them to redesign parts of the AVIS website involved in making a car rental reservation with pick-up location in a foreign country. They should have a different cultural background than the American one expressed in the Avis website, good knowledge of HCI design and reading fluency in English. Participants should also have different cultural experience from one another. We believed that new design alternatives elaborated by people with different cultural backgrounds would create clearer contrast for Avis' USA-centered design choices, thus enriching our research context and results.

3.2 Procedures

First, the participants listened to a tutorial introducing the cultural viewpoint metaphors (with concepts and examples). Then, they generated re-design alternatives for the AVIS website guided by CVM and by a scenario of use and requirements. In the scenario, the participant supposedly works in a re-design Project for AVIS. The company wants to minimize problems that their customers have reported when using a rental car in a foreign country. Problems stem from cultural differences that play a role when driving a car. The participant's task is to propose re-design alternatives to improve cross-cultural contact by communicating cultural diversity guided by CVM. The targeted user is an American residing in the USA, who makes a car reservation on the AVIS website and chooses a foreign country location for car pick-up. This location depended on the participant's cultural experience (see Table 2).

Table 2. Participants' cultural background and corresponding targeted user

Id	**Nationality**	**Participants' Cultural background explored in the experiment scenario**	**Target User:** an American residing in the USA who chooses…
P1.1	Brazilian	Studying and working in England	**London** for car pick-up.
P1.2	Mexican	Living in Mexico	**Mexico City** for car pick-up.
P1.3	Brazilian and Israeli	Studying and working in Israel	**Israel** for car pick-up.
P1.4	Brazilian	Living in Brazil	**Brazil** for car pick-up.
P1.5	Brazilian	Studying and working in Montreal, Canada	**Montreal, Canada** for car pick-up.
P1.6	Brazilian	Studying and working in Toronto, Canada	**Toronto, Canada** for car pick-up.

When finished, they participated in a brief individual post-test interview about the experiment. The interview aimed at collecting discourse evidence regarding the designers' perceptions, comments and explanations about: (i) their design alternatives; (ii) the design process, i.e., how the proposed metaphors helped their decisions and reflection about interaction design; (iii) what they found easy and difficult to do; and, (iv) what they learned with the CVM.

Empirical design evidence (the mockups and the participants' discourse) was analyzed in two steps. First, we inspected the kinds of signs used in mockups. We looked for consistency/inconsistency with CVM concepts, and built a semiotic

reference (*i. e.* a collection of articulated signs proposed for the interface [5]) to compare with the participants' verbal statements, analyzed in the next step.

We should clarify, however, that our aim was *not* to analyze the quality of the final design *products* (*i. e.* the mockups). These depend more heavily on the participants' technical abilities and talent than on the interpretive processes and reflective perceptions that constitute the focus of our interest. It is the participants' *discourse* about the re-design activity, as well as their impressions and opinions expressed during the post-test interview, that mattered most at this stage. This material was analyzed using discourse analysis techniques [11]. The analysis consisted of a systematic and iterative exploration of the participants' discourse in order to find out major meaning categories in it.

3.3 Results

The results of our experiment pointed at three important facts about these participants' first experience with CVM in a design activity. One of them is related to the *form* of CVM (how they were presented, described, and illustrated), whereas the other two are clearly related to how CVM can *function*. The evidence collected suggests that: CVM should be improved to minimize difficulties in understanding the fundamental concepts associated with the approach; CVM achieves considerable epistemic effect on cross-cultural design process; and, CVM helps designers in organizing communication about their intent of promoting intercultural contact.

As already mentioned, this paper focuses only on results regarding the epistemic nature of CVM. By *epistemic* we mean that it can generate new knowledge, not only in factual terms but also at more abstract and conceptual levels. We reached this conclusion based on four specific subcategories of meanings evidenced in the participants' discourse: a mapping of the design space; an exploration of communicative effects achieved by articulating cultural variables with different metaphors; an increased awareness of the designers' own cultural biases and gaps; and, a kind of *mirror effect*, when designers placed themselves in the role of recipients of their own design communication. For lack of space, we cannot present a thick description of qualitative data in this paper. Instead, we selected some of the participants' comments to illustrate the kind of data we used in our analysis.

About the first subcategory, CVM guided the participants throughout the re-design process, helping them to focus on culture and to map out the problem space. See below what some of the participants said, translated into English when originally expressed in Portuguese. The participants' identification precedes the selected statements.

P1.1: "*I was completely guided by the metaphors*". "*When I began to feel lost with this metaphor, I looked at this continuous progression, I* [then] *positioned myself closer to this one*". "*The continuum, the separated layout of metaphors, reminded me of the differences* [among them]*.*"

P1.3: "*I could identify the issues that have to do with culture, and the ones that haven't. The ones that haven't were put aside. So I realized that there were things that had to be eliminated* [from my design]*, and things that had to be added.*"

Second, CVM helped designers to reflect about how to model cultural variables according to each metaphor while elaborating metacommunication. P1.1, for instance, realized that cultural variables generate different levels of difficulty in design:

P1.1: "*The variables of unit of measurement and volume are the most trivial to treat with metaphors. It's a piece of cake! Now, the meaning of the economic car is an important aspect and more difficult than the one I made for the 'foreigner with translator' metaphor, and I used it a lot. And the question about the minimum age to drive a car as a rule of business,* [same with] *the use of the driver's license.*"

P1.2, in turn, realized that the communication about cross-cultural experience may require new forms of representation.

P1.2: "*These experiences involve other kind of senses, so the visual representation could be not so effective* [as] *to hit and impregnate user with the relevant aspects of the cultural values that* [the] *designer wants to communicate*".

Third, difficulties in manipulating cultural variables led participants to face new challenges or problems in cross-cultural design and look for solutions. Here are statements from our participants:

P1.3: "*How can we speak of the Israeli culture within the context of the American practice? Certainly, if I had not heard about these metaphors, I would have had difficulty in doing* [the activity proposed in the scenario] *because I would not have been aware of the problem!*"

P1.4: "*This helped me by informing better that he is closer* [to the other culture]. *And this is very important because the website has to be able to inform all the time where he is, to inform him of the context*."

Cultural gaps experienced by some of the participants actually helped us to confirm the epistemic potential of CVM in bringing out to the participants aspects of their own knowledge and perceptions regarding other cultures. At least two of them (P1.1 and P1.5) decided to seek for knowledge in another website. P1.5, for instance, said:

P1.5: "*Thinking about what would be different for the Canadians, I opened a car rental site from Quebec, which was right there beside that site, to see how they offered their cars for rent, I found their site worse than that of AVIS's. But you can understand a little about the issue with the language. The first language offered by them is English*."

Finally, we collected evidence that CVM led designers to put themselves more clearly in the role of recipients of the metacommunication (the users). P1.2 and P1.3, for instance, explained how CVM put *them* inside the scenario. Suddenly, the target user was not someone far away. Rather, they were thinking of *themselves* as their own users, or of close *friends* they know well.

P1.2: "*Actually, I was considering myself as a "gringo" who's looking for a car rent in Mexico. Yeah, I realize* [that] *the point is how the Mexican culture is presented.*"

P1.3: "*I imagined the scene that you describe. I imagined that a friend was going to Israel and would have to rent a car, I imagined that, then, it would help him to understand the questions and for me to be explanatory and bring curiosities from that country*."

The participants' discourse excerpts presented above show evidence that CVM was not used to generate the answer to the problem right away, but to increase the participants' own understanding of the problem, explore its implications, generate alternative solutions and evaluate them against each other.

4 Conclusions

Cultural differences around the world raise the challenges of good HCI design. For a number of years the HCI community has been investigating alternatives to enhance the design of cross-cultural systems [2, 3, 6, 14]. Our cultural viewpoint metaphors perspective aims at helping designers to think of how to expose and communicate the very idea of cultural diversity. In this paper we presented results from an empirical study carried out to assess the metaphors' potential for informing and improving the design of cross-cultural applications. The epistemic nature of CVM was evidenced by statements about how they guided participants throughout the re-design process, helping them to focus specifically on culture and to map out the problem space. They led the designers to understand, conceptualize and reflect on their design goals and alternatives to achieve them.

The five cultural viewpoint metaphors have the potential to spark innovative features in design. Although we do not predict that this innovation *will* happen in every design instance with CVM, it is a fact that new insights *have been gained* by all participants of the reported experiment. Our approach forces designers to make decisions about strategies to structure communication of intercultural contact opportunities, independently of strategies to recognize and collect culturally-dependent content to be delivered. As a result, they can reason about cultural communication and cultural information at different stages of design. In this respect, CVM can be used in combination with other approaches that focus on cultural content, mainly [6, 10, 14].

Furthermore, evidence collected in this experiment revealed that the application of CVM helps designers gain awareness of their own cultural biases. Through the process of deciding how *they* want to and should communicate cultural differences, designers get in touch with their culturally-determined assumptions that might otherwise go unnoticed in their design choices, affecting the users' experience in unpredicted or undesired ways. Turning cultural differences into a topic of computer-mediated designer-user conversations naturally leads designers to position themselves more explicitly with respect to their own cultural values and beliefs. Reflection about one's own position in the process of designing intercultural systems with the aim of promoting contact with foreign cultures is perhaps the most important finding of this experiment. This is a confirmation of the reflective and epistemic effects of Semiotic Engineering discussed elsewhere [5], from which CVM originates.

The results presented here were validated [13] (as is typical in validation of qualitative research) through an exogenous triangulation [4]. This motivates us to carry out new empirical studies to explore the practical effects of designing cross-cultural systems with CVM on designers and users.

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Cross-Cultural Design of a Groupware Application for Global Virtual Team

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Abstract. The need for supportive and reliable collaborative application is critical; it is also the need for many organizational supports. This paper reports about on-going research on how culture influence should be applied as a requirement when designing a synchronous groupware application as an intercultural collaboration tools aimed for global virtual team which consist of multicultural users. It will try to analyze how culture influences the way users prefer to interact using a groupware. Individuals are conditioned by their culture, therefore in this study we propose to extend Technology Acceptance Model so that we can understand the mechanism by which cultural differences could explain user's behavior toward the acceptance to a groupware application as a remote collaboration tool for global virtual team.

Keywords: Cross-cultural design, groupware, HCI, globalization, global virtual team.

1 Introduction

Computing nowadays has become a global discipline. Many industries are now dealing with the issue of globalization. Globalization extends computing, information, and communication technologies across an increasing number of cultural boundaries, generating a corresponding need for cross-cultural partnerships and due to globalization, global virtual teams are commonplace and the number of virtual teams keeps growing. Global virtual teams with members from different cultures are an emerging trend, although it raises a number of issues variously relating to technology, tasks and people working in their different locations. This raises the issue of cross cultural problems, especially communication conflicts caused by cultural diversity.

Information and communication technology (ICT) plays an important role in supporting international/intercultural collaboration. A tool that can accommodate collaboration and coordination without any barrier to cultural matters is urgently needed and useful. Groupware is a technology explicitly designed to support the work of groups. The importance of understanding culture and the key role it plays in the software industry has substantially increased over the last twenty years [1]. The groupware application and socialization tools that are currently available in the

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market are not sufficient to meet the needs of a number of the above human elements necessary to facilitate users' engagement and development of intercultural competence. In order for the new groupware system to be able adopted by globalized industries around the world, the design and interface of the groupware should be able to be used by all cultures across the world. A great attention should be given for the cultural element in creating products and interfaces that are culture "fit" to its users. This research combines many aspects of different study fields, such as computer supported cooperative work (CSCW), intercultural communication and human-computer interaction (HCI). In designing a groupware application where cultural elements will be used, this research paper will propose to extend the Technology Acceptance Model (TAM) so that we can understand the mechanism by which cultural differences could explain user's behavior toward the acceptance of a groupware as a remote collaboration tool for global virtual team.

2 Research Objective

Research exploring issues related to cross-cultural and user-interface design had quickly spread, where earlier research had shown an increase of scholarly interest on cultural factors affecting Human Computer Interaction [2]. However, there is not much research done on how culture influences user's preference and behavior on groupware application. Most groupware that are available for the society to use does not consider any social aspect in the interface design of the application, such as very few research performed the investigation of the differences in cross-cultural understanding of interface design especially for a groupware application. The different backgrounds of people from different culture may cause them to have different expectations and attitudes towards the usage of the tools and functionalities of an application. The different expectations affect the way they learn to use and understand technology. This research contributes knowledge on how to identify user's need to support collaborative activities among culturally and geographically dispersed global virtual team.

The main research question dealt within this paper is: How can a groupware designed in order to be acceptable for multicultural users from the Human Computer Interaction perspectives? The aim of this research is to develop strategies for groupware developers and designers for greater effectiveness in a global setting, an enhanced sensitivity to cultural differences and a respect for future colleagues and team members across the world. It is expected that the result of this research can stimulate innovative collaborations aimed at improving new groupware applications.

At University Duisburg-Essen Germany, a synchronous groupware named PASSENGER has been developed at the Institute of Computer Engineering throughout the last years. This client-server based groupware application enables student teams to communicate and cooperate via internet, even if the members are located at distributed sites [3]. The system has not applied any social aspect which allow multicultural user to collaborate conveniently using the available tools therefore a new system approach is under development namely PASSENGER 2. It will rely on *user-defined* specification to present optimal environment and configuration during its operation. This research suggests solution on how to support cultural differences in the interface design and tools that support for collaboration among culturally diverse users.

3 Research Framework and Hypotheses

The component of cultural influence on specific design preference has been incorporated in the TAM and serves as an extension to TAM for measuring the acceptance of groupware application. The research model explains the system usage of groupware application for globalised industries. It consists cultural influence on specific design preference, perceived usefulness, perceived ease of use, attitude, intention to use and system usage (see Fig. 2).

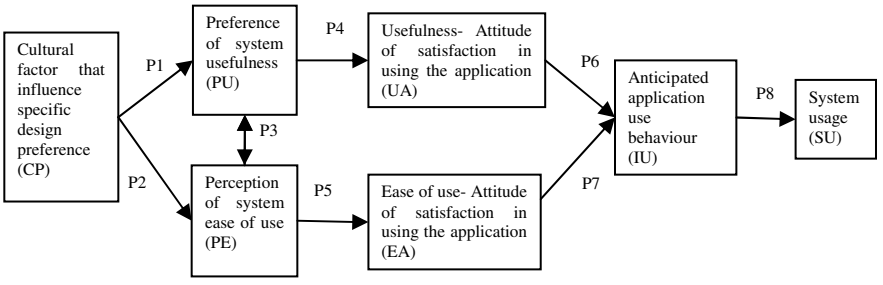

Fig. 1. Research Model

Previous studies have shown that there are various external factors that indirectly influence the acceptance of technology through perceived usefulness and perceived ease of use [4], [5]. In this study, it is expected that cultural preference to be one such external factor affecting the acceptance of groupware application in globalised industries usage, with the hypotheses made as follow:

a. Culturally Specific Design Preference (CP)

This represents what users want the system to look like and what functionality should be included. User's preference in interface design can be expected to be influenced by culture. The term culturally specific design preference was adopted from the previous research conducted by Evers (1997) [2]. As a result, the following hypotheses are proposed:

P1 : Cultural specific design preference influence user's perception on system usefulness while using groupware application
P2 : Cultural specific design preference influence user's perception about system ease of use while using groupware application

b. User's perception about system usefulness (PU)

Previous studies on TAM demonstrated strong empirical support for a positive relationship between perceived ease of use and perceived usefulness [4], [5], [2]. The perceived usefulness for a groupware application is defined as the degree to which user believes that using groupware would enhance his/her daily work performance. This suggests that designers/developers should be able to improve perceived usefulness by adding appropriate features and functional capabilities to the groupware application. The importance of this construct can be derived from Davis' TAM

(1989), in which it is said that perceived usefulness affects attitude and behavior both directly and indirectly. When outcome of using a system is perceived to be valuable to the user, then the user will more like to accept the system. Davis (1989) showed that ease of use had a direct effect on perceived usefulness. As a result, the following hypotheses based on TAM-relationship are proposed:

P3 : Perceive ease of use has a positive effect on the perceived usefulness of a groupware application
P4: User's perception on usefulness influence their attitude of satisfaction in using groupware

c. User's perception about system ease of use (PE)

The perceived ease of use of the groupware application is defined as the degree to which the user believes that using groupware application will be free of effort [6]. Designers and developers of groupware should be able to make the application easier to use by making it easier for users to invoke the functions. As a result, the following hypothesis based on TAM-relationship is proposed:

P5: User's perception on ease of use influence their attitude of satisfaction in using groupware

d. Attitude of Satisfaction in using the groupware application (EA and UA)

The TAM posits that perceived usefulness and perceived ease of use has a direct effect on attitudes towards using a new technology [7]. Attitude is the degree to which the user is interested in specific systems, which has a direct effect on the intention to use those specific systems in the future and the actual usage of the systems [6]. As a result, the following hypotheses based on TAM-relationship are proposed:

P6: User's attitude of satisfaction in usefulness using groupware have a positive effect on the use of groupware
P7: User's attitude of satisfaction in ease of use using groupware have a positive effect on the use of groupware

e. Anticipated system use behavior (IU)

When using a system, users' will respond to various ways to the actions of the system. The usage of the system is also affected by perceived ease of use and perceived usefulness [8], [7]. As a result, the following hypothesis based on TAM-relationship is proposed:

P8: User's anticipated behavior or intention to use the application influence user's actual system usage of a groupware application

4 Methods

A survey was developed to explore the TAM model across three different cultures,consisting of Indonesia, Malaysia and Germany. Data were collected by means of a five-page questionnaire (paper-based and web-based). The survey instrument consisted of 39 items to assess seven constructs of the proposed research

model (Fig.2). These items were self created and some were adapted from previous studies [2], [9], [10], which then refined to make them specifically relevant to the present research. These seven constructs were measured on a six-point Likert scale ranging from (1) "strongly disagree" to (6) "strongly agree".

Prior to the hypothesis testing, the measurement scales were examined in terms of the construct validity. In this study, construct validity and reliability were examined using SPSS v.16. Internal consistency was measured by applying the Cronbach's alpha test to each question in the constructs. The measurement items possessed adequate reliability with Cronbach's alpha 0.897 and all constructs had items with Cronbach's alpha above 0.80.

5 Results

The collected data and the proposed structural model were analyses and examined using the Structural Equation Modeling (SEM) approach. SEM is a comprehensive statistical approach to testing hypotheses about relations among the observed and latent variables and allows researchers to perform path analytic modeling with latent variables [11]. The software package used in this study is AMOS 16.0 test the structural model using Newton-Raphson iterative method.

The testing of the research model shown in Fig. 1 involves the evaluation of the structural model and its related measurement model. The measurement model represents the relationships between the latent variable and observed variables, and is tested to determine if the measurement possess satisfactory psychometric properties, in order to determine if the items in the questionnaire measure what they are supposed to measure. It is only possible to proceed evaluating the structural model for theory testing when the measurement model has adequate psychometric properties [12].

The data analyses were made to determine whether the differences between the three sample countries were significant. The total collected data in this study is 599 respondents. A minimum sample of 100 to 200 is considered adequate for structural equation modeling analysis [13]. The result of the analysis revealed that cultural specific preference as one of the external factors in TAM model was significant in explaining usage behavior in both Indonesia and Malaysia, but not in Germany.

The initial analysis was performed for all three models to assess the measurement model for each country's users (see Table 1). CMIN/degrees of freedom (d.f), goodness-of-fit index (GFI), adjusted goodness-of-fit index (AGFI), and root mean square residual (RMSR) were used to measure the model fitness. The model value for each country shows that the model overall shows good result (<5). This shows that the validity of the model can be trusted. The model value described the sample (GFI) and then it is readjust (AGIF). The data is analyzed using 95% confidence level (alpha = 0, 05). Most of the fitness measures were acceptable.

Table 1. Goodness of Fit Result

Goodness of Fit	Indonesia	Malaysia	Germany
d.f	4.879	3.216	2.634
GFI	0.781	0.684	0.83
AGFI	0.701	0.641	0.739
RMSEA	0.124	0.092	0.128

The statistical significance causal relation was examined, the summary result may be found in Table 2. The model Malaysia (Fig. 3) presents a good fit, which mean the collected data matches the research model. For Indonesia (Fig.2) and German (Fig. 4) model presents a good fit, but several data results did not match the result model.

Table 2. Summary of Hypotheses Result

Hypothesis	Country	Result	Relation value	Significant p value
P1 : Cultural specific design preference influence user's perception on system usefulness while using groupware application	Indonesia	Supported	2.524	<0.05
	Malaysia	Supported	0.243	<0.05
	Germany	Not supported	-0.001	0.99
P2 : Cultural specific design preference influence user's perception about system ease of use while using groupware application	Indonesia	Not supported	0.043	0.893
	Malaysia	Supported	0.878	<0.001
	Germany	Not supported	0.082	0.281
P3 : Perceive ease of use has a positive effect on the perceived usefulness	Indonesia	Not supported	-0.513	<0.05
	Malaysia	Supported	0.649	<0.05
	Germany	Supported	0.434	<0.05
P4: User's belief on usefulness influence their attitude of satisfaction in using groupware	Indonesia	Supported	0.394	<0.05
	Malaysia	Supported	1.032	<0.001
	Germany	Supported	2.258	<0.05
P5: User's belief on ease of use influence their attitude of satisfaction in using groupware	Indonesia	Not supported	0.075	0.988
	Malaysia	Supported	0.858	<0.001
	Germany		0.787	<0.05
P6: User's attitude of satisfaction in usefulness using groupware have a positive effect on the use of groupware	Indonesia	Supported	1.689	<0.05
	Malaysia	Supported	0.855	<0.05
	Germany	Supported	0.548	<0.05
P7: User's attitude of satisfaction in ease of use using groupware have a positive effect on the use of groupware	Indonesia	Not supported	0.2	0.696
	Malaysia	Supported	2.336	<0.05
	Germany	Not supported	-0.13	0.86
P8: User's anticipated behavior or intention to use the application influence user's actual system usage	Indonesia	Supported	0.09	<0.05
	Malaysia	Not supported	0.046	0.356
	Germany	Not supported	-0.051	0.6

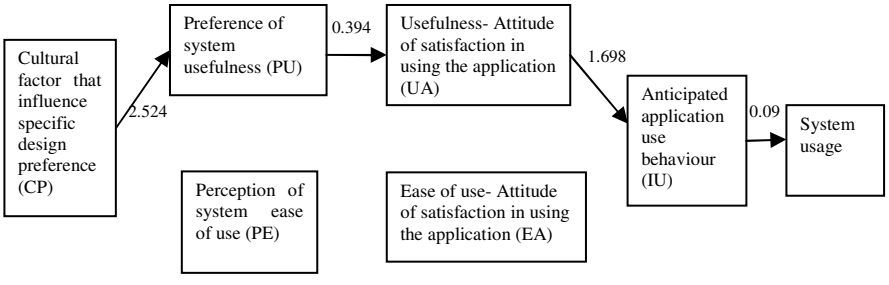

Fig. 2. Signification relation result for Indonesia

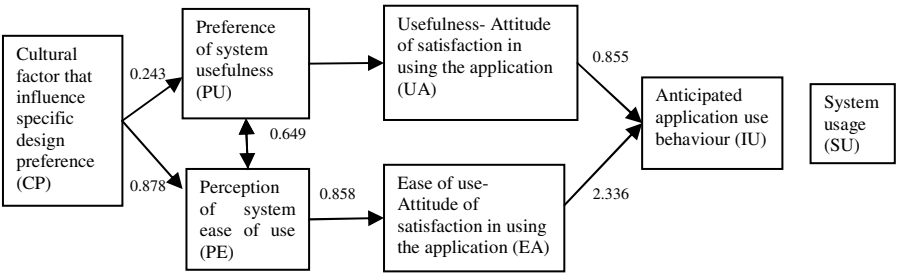

Fig. 3. Signification relation result for Malaysian model

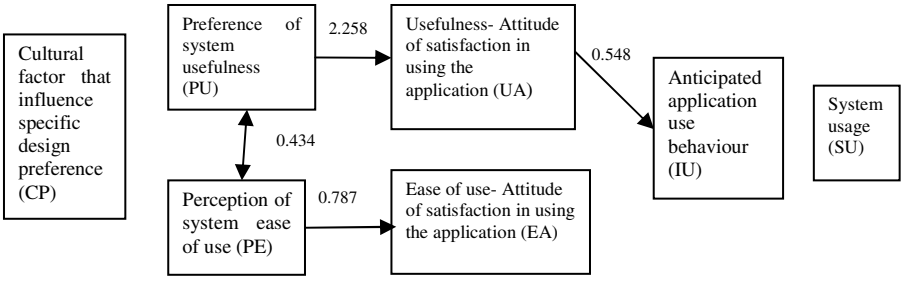

Fig.4. Signification relation result for Germany

6 Discussion

User preference and behavior within global virtual teams differ across cultures. Culture awareness is the crucial topic in international collaboration. Each culture has its own cultural values and style of communication. To better communicate with each other, one must distinguish some enormous difference between the cultural backgrounds. Designers and developers of global intercultural collaboration application need to be aware of the views of user's preference in order for the system to be useful. An example of a collaboration application is known as groupware. Groupware is a categorized as a social technology [14], where groupware is specifically designed and developed to support group of users working together in order to achieve common goals. In this research, the intent was to predict user's acceptance of a cultural designed groupware through the lens of the TAM by adding cultural factors that influence specific design preference to the model and explore whether user's are willing to adopt and use groupware application with cultural-influenced interface design.

The consideration of culture, as a social influence and how it affect the commitment of user toward the use of groupware system seems important for understanding, explaining, and predicting system usage and acceptance behavior. The findings of this study suggest that cultural influence play an important role in determining the acceptance and usage behavior in adapting new groupware

technologies. The result of this empirical study validates the proposed research model and hypotheses, and demonstrates that the hypotheses can be supported. Cultural specific design preference influences user's preference of system usefulness and user's perception of system ease of use. When users get greater satisfaction with culturally design interface system (e.g., it is interesting, not too hard, and meets the needs of users at different levels), the stronger their feelings about its usefulness and ease of use. In term of ease of use, it is when the system design is developed in a more culture-friendly form, users will feel more comfortable and find the system familiar and easier to use.

The findings demonstrate the existence of cultural differences in terms of users' specific design preference toward groupware acceptance. Users (from all three countries) show diverse preferences in features and acceptance process. Cultural specific design preference showed by the result is significant only for Indonesia and Malaysia, although the acceptance process seems to run differently from the two Asian groups (Indonesia and Malaysia). For the Indonesian user, acceptance's path is routed through cultural specific design preference, usefulness, attitude of satisfaction, and system usage, without having any relation to its perception of ease of use. This suggest that Indonesian user is only satisfied by the usability of the system rather than the easiness of the system, especially since the system use behavior and system usage is also affected by the system usefulness. The Malaysian model path flows to move more strongly along the ease of use side path. The "usefulness" path shows weaker significant relation compare to its "ease of use" path and the anticipated application use behavior did not show any significant relation to the system usage. The results suggest that Malaysian attitudes of satisfaction are attributable to user's preference and perception of system ease of use.

In the Indonesian model as elsewhere [15-18], perceived usefulness is the key aspect of adoption in comparison to perceived ease of use. One interpretation that can be used for this study is that as the groupware system become easier to use and users become more aware in the usage of the technology, the variation perceived ease of use dimension is reduced. The most interesting observation with the German users is that culturally design preference shown no significant relation to user's belief of usefulness and perception about system ease of use. Although result shows usefulness and ease of use seem to drive attitude of satisfaction, but only satisfaction of usefulness show significant relation towards users anticipated system use behavior. The German model indicated a non-significant relationship between cultural preference to both usefulness and perceived ease of use. This may suggest that the German user perception of usefulness and ease of use are not dependent to the design of the system that is made customized for multicultural users.

The result of this study suggest that Indonesian users find usefulness a more important variable toward the acceptance of a new application, Malaysian users find ease of use as more important, while German users seems to find a system to be acceptable when it meets their preferences in the system usefulness and ease of use, and not affected by the culturally specific interface design. This implies that Indonesian will be willing to try to cope with a useful interface design, even when it rather complicated to use. Malaysian, on the other hand, will have the tendency to

give up more easily when dealing with a complicated to use interface. Also, Malaysia's perception of ease of use influences anticipated system use behavior. This connote that when users find a groupware system that is easy to use, they will also be satisfied in using the system. Indonesian users, conversely, preference of system usefulness influence their attitude of satisfaction implies that when preferences for the design features are met, users will be satisfied with the groupware application usage. For Indonesian users, there seems to be no need to find out whether the system is easy to use. Maybe Indonesian users find that their needs and demands for ease of use are met when the system is designed the way they want it to, in which certain functionality levels must be met. Within the German users, the interface design of the groupware application seems not necessary to be influenced by cultural factors, since there is not significant relationship between cultural factor influencing specific design preference to neither system usefulness nor ease of use. However, both system usefulness and ease of use do influence their attitude of satisfaction in using the application. This would suggest that German users put more emphasis on the functionality provided by the systems than on the way the interface system is designed.

7 Conclusion

In this study, it shows that TAM provides explanation for groupware adoption and usage in all three countries studied, although with less effect for Germany. Relationships among primary TAM constructs found in this research are largely consistent with those typical in previous TAM research. The impact of usefulness in user's attitude of satisfaction on user's anticipated application use behavior is not as strong as that of user's belief on ease of use in user's attitude of satisfaction in using groupware. It shows that user's would be more intended to use a system that is easy to use rather that useful but complicated to use, especially since modern applications are becoming more and more sophisticated. The differences found in each culture can be concluded that culture does play an important role in determining users' preference in working with a groupware application. The main purpose of this study is to provide guidelines to developers in establishing an easy to use groupware and a useful groupware for its targeted users. In terms of user-interface design, an application that is comfortable and easy to use user-centered should be designed.

The main contribution of the expected result from this study is a requirement set provided for developers and designers to design a synchronous groupware applications for users of different cultures, in order to make technology to adapt to user's needs. Another expected result from this study, the result will be use as a requirement set for next generation groupware PASSENGER 2 that is currently under development at the Institute of Computer Engineering, University Duisburg-Essen. By implementing the cultural analysis to the PASSENGER 2 system, it will make this new groupware as an intercultural collaboration supporting tool, as well as a flexible synchronous groupware that can adapt to user's preference setting and provide the environment that promotes interest and respect for the backgrounds of all participants.

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Applying Local Culture Features into Creative Craft Products Design

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Abstract. The impact of worldwide commercial competition has brought about the emergence of cultural creative industries. We are now approaching a new era of aesthetic economy but also facing a decline in craft industries resulted from the impact of competitors' low-priced commodities. In order to upgrade our design industry, Taiwanese government has undertaken an important project titled "Challenge 2008: National Development Focus Plan". The emphases of the plan are on exploiting our rich cultural resources for developing design creativity and advancing the design industries by creating and promoting "experiential products," a reflection of the actual Taiwanese lifestyle. The purpose of this study is to convey/integrate Taiwanese local features into the design of cultural creative product. For the design processes, this study adapts the culture product design model, developed by Professor Rungtai Lin, with three main steps of attaining Cultural-specific features, formulating design concept model, and completing cultural product design. A series of craft products have been created as a demonstration to provide designers with valuable reference for successfully designing cultural creative products. An illustration for attributes of cultural product design is detailed for further synthesis of the design process.

Keywords: cultural creative industry, cultural product design, craft product.

1 Introduction

After entering WTO, Taiwan is now facing a decline in craft industries resulted from the impact of competitors' low-priced commodities. In order to reduce the manufacturing cost, many craft industries were forced to move to Mainland China and Southeast Asia. Some of the precious techniques of our traditional crafts were thus lost. How to make the best of cultural resources to create fashionable product with delicate craftsmanship becomes a critical issue.

With limited geographical resources, Taiwan could only survive the keen competition with excellent design products of high quality or high price. In other words, future commodities from Taiwan could be highly competitive only when they

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are of high design quality. Such quality products require not only enhanced manufacturing quality, strengthened functions and satisfaction for consumer use, but also emphasis on being unique and symbolic. As a result of over-emphasis globalization, only products with local cultural features would satisfy consumers' needs and curiosity.

The study aims to integrate Taiwanese native cultural features, on top of taking advantages of the uniqueness of craft materials, for designing fashionable craft products so as to solidify the craft industry. Its significance is manifested on three specific aspects in culture, design and education. For the cultural aspect, this study explores essential resources from native Taiwan culture and then presents Taiwanese-style cultural features, through application on craft products with transformational design, on everyday life items used in food, clothing, living and transportation. In addition to illustrating our culture, this study also provides essential references for future designers in the field here in Taiwan. Moreover, for the educational aspect, this study brings about the educational significance of maintaining our cultural features when consumers learn about the unique features and contents of Taiwanese culture through the aesthetic values manifested by the craft products.

2 Literature Review

The entire globe is now facing a LOHAS consumption era in which cultural creative industries and aesthetic economy prevail. Ray and Anderson [13] had predicted at the turn of this century the correlation between LOHAS consumption and cultural creative industries. They indicated in their book, *The cultural creatives: How 50 million people are changing the world,* that the growth of LOHAS industries resulted from the needs for cultural creativity.

Each and every country in the world today is making their best efforts towards developing experience economy, hoping that through changes on industry formation style and consumers' living style there could be spectacular transformation of commodities that are closely linked to the mass culture and life and thus create new lives for the industries and the commodities [3, 4, 6, 14]. In encountering the era of aesthetic economy, the government in Taiwan has undertaken the national project of "Challenge 2008: National Development Focus Plan", initiating the plan for developing cultural creative industries, based on the concept of industry chains. These industries include (1) the core industry of cultural arts, (2) the design industry, and (3) creativity supporting and peripheral creativity industry.

Aesthetic economy, a commonly used term here, is rarely used in western countries, experience economy instead is what is used. Pine and Gilmore, in their book *The experience economy: Work is theater & every business a stage*, classified industries into four categories -- commodity business, goods business, service business, and experience business [11]. They defined experience industries as those that appeal to consumers' emotion, and indicated that development of experience economy is an inevitable trend in the future, as the industries come with the highest add-on-values.

As Pine and Gilmore suggested in their book, *Authenticity: What consumers really want*, ubiquity is the fatal opponent of experience economy [12]. After the globalization, only products with local cultural features would satisfy consumers' needs and curiosity. Culture is the essence of creativity while creativity takes on the core of the industries; that is, only when craft works come with cultural significance will they be alive. To integrate cultural and craft design elements into products, to establish uniqueness of products and differences between brands, and to bring upon consumers irreplaceable aesthetic experiences are major challenges for present design industries [1, 7, 15].

Cultural creative industry seeks after emotional inspiration towards life, aesthetic economy emphasizes actual experience of life, and LOHAS consumption manifests the pursuit of life values. In other words, a good product is a craft which exercises discourse with people through its sensational image and brings inspiration to them. As American design expert Norman stated, affective/emotional factors are the ultimate determiner of the success or failure of product design [10]. There are two functions of emotional design, one is to outlet the emotions of the users' experience at the specific moment, the other is to demonstrate the emotional values humankind possess. Whether it is the former or the later, they both stress providing the consumers the most direct mental experience. The strongest power which can touch people originates from the function of empathy that aestheticians emphasize; the foundation of such function; however, usually is built upon the true reflection of life experiences each of us has. In the foreseeable future, our cultural creative industry will turn out to be a new arena of design in which arts from culture will be its content, aesthetic experience its appeal, LOHAS consumption its goal, and environmental sustainable development its emphasis.

3 Research Method

The purpose of this study is to, after exploring the value and content of Taiwanese local culture, integrate the essence of Taiwanese culture into the design and actual manufacturing of cultural creative products. The flowchart in Figure 1 illustrates our research process.

For the design process, this study adapts the culture product design model which was developed by Rungtai Lin [9]. The model comes with three main steps of attaining culture-specific features, formulating design concept model, and completing cultural product design (Fig. 2).

For cultural value added creation, the first step is to interpret the raw cultural information so that, by "value added information", they become usable "design information". The second step is to analyze and induce the design information through "value added knowledge" and to transform the information into applicable "creativity knowledge." Finally, with flexible application of "value added creation", precious "wisdom property" is achieved.

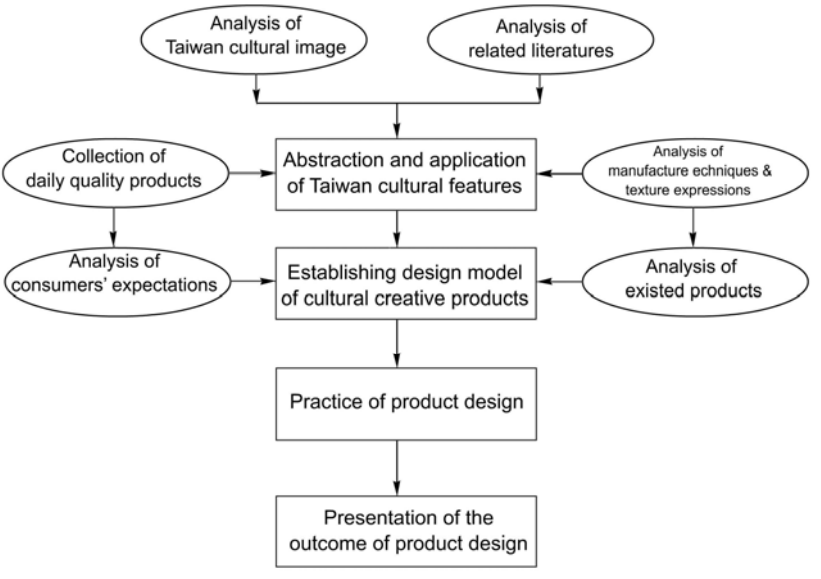

Fig. 1. The framework of the research process

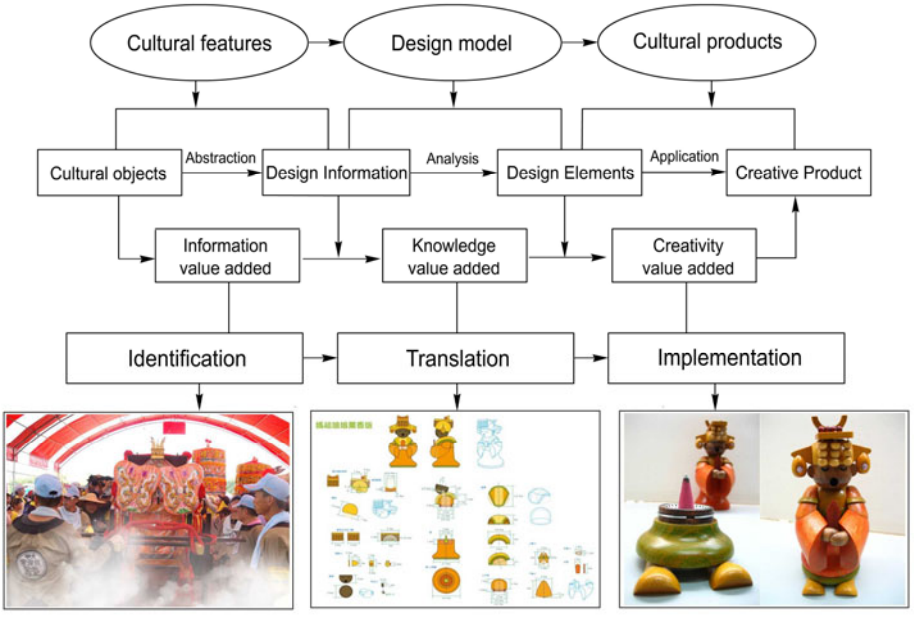

Fig. 2. The framework of cultural product design model (Lin, 2007)

4 Results and Discussion

The main achievement and contribution of this study is to provide designers and scholars a reference model in applying Taiwanese culture elements on the design of cultural creative products. In addition, through actual design and development of craft products, through effective promotion of art and cultural industries, craft with creativity becomes business. As initial results of the study, a major series of work, titled "I/Doll love you," includes two themes—the Beetle-nut Lady series (Fig. 3) and the Gods series (Fig. 4-6).

The God series serves to show a delicate example for how we integrated culture features into our design. In addition to the cultural significance carried by the gods' representative figures, the series also strive to illustrate deeper meaning of some cultural religious events in Taiwan. Each god figure is an incense–stove assembled by powerful magnets. Why incense–stove? More than a tool for healing, incense–stoves presents an essential symbol of beliefs and practices when people go worship the gods in the temples. Incenses are lighted for people to pray and communicate with Gods, then they are placed in the incense–stoves after prayer. The ash left in the incense–stoves is believed to have healing and heritage-preserving effects.

Fig. 3. The Beetle-nut Lady series (Designed by Shi-Jie Shen and Li- Juan Fu)

Fig. 4. The Gods series (i): The God of the Earth (Designed by Shi-Jie Shen and Li- Juan Fu)

Fig. 5. The Gods series (ii): The God of Wealth (Designed by Shi-Jie Shen and Li- Juan Fu)

Fig. 6. The Gods series (iii): The Ma-Zu (Designed by Shi-Jie Shen and Li- Juan Fu)

Take the figure of Ma-Zu, the Goddess of Mercy, for instance. She is characterized with deep complexion, hand-held token, and the pearl tassels on her decorative head-piece. The design adapting the incense–stove as our product originated from the most popular annual cultural events of "The Mar-Zu's annual trip". In Taiwan, the belief in Mar-Zu has become extremely popular. On Mar-Zu's birthday, March 23 in the lunar calendar, all the Mar-Zu temples in Taiwan will hold fantastic worshiping and trip-around events, which usually attract tens of thousands of followers and tourists, as it grows into an internationally-renown event. Among them, the one held by Chen-Lan Temple in Dar-Jar, Taichong County, is the most spectacular. Due to it's being the oldest Mar-Zu Temple in Taiwan, Mar-Zu from this temples receives highest popularity and thus creates the well-known national event of "Dar-Jar Mar-Zu trip-around for incense offering". Its popularity could be revealed by the phrase coined in recent years—"Craze about Mar-Zu in March".

The procedures of Dar-Jar Mar-Zu's trip-around include seven climax rituals—starting the trip, sitting on the temple , birthday celebration, lighting the incense, setting the incense, returning of the sedan chair, and adding the fire. On the fourth evening of her trip, before Dar-Jar Mar-Zu returns from her visit of Fong-Tien Temple, there is the "Returning ceremony", now titled "Passing on the incense". For this specific step, the Taoist priest passed three times the incense from the stove of the destination temple, Fong-Tien Temple, into the smaller incense–stove of the Chen-Lan Temple; the stove

then is put into a wooden box and sealed by the Taoist priest to completed the "Passing on the incense" ceremony. Poking the incense, also termed "continuing the incense" is the step in which the followers competed, extremely keenly, in poking the incense into the small stove in Mar-Zu's incense–stove so as to have their wishes granted. The followers will have four opportunities to do so—the first incense, the second incense, the third incense, and the incense patronizing. In the final ritual of "adding the fire" in the evening, the head of the praying group will use a long ladle to scoop the ash in the incense–stove and add it to each of the incense–stoves in the Dar-Jar Mar-Zu temple. The whole process of handing down the incense is then completed.

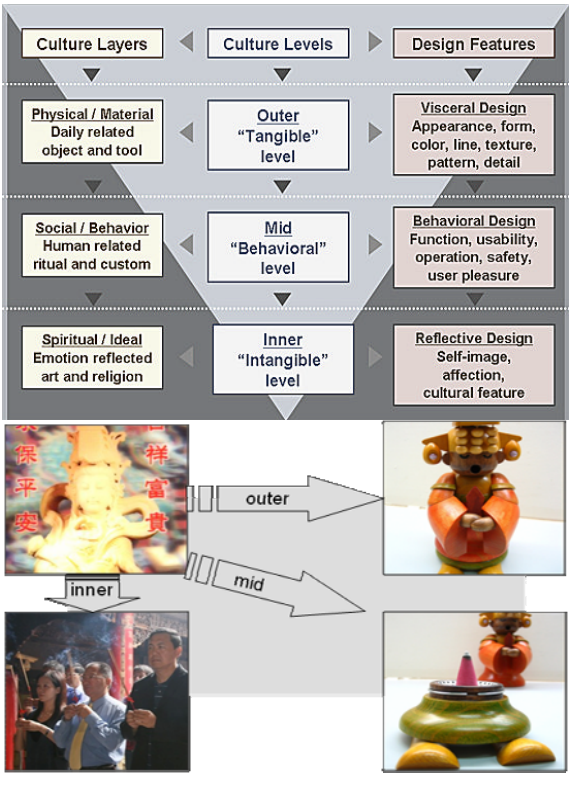

Fig. 7. Attributes of cultural product design (Hsu, 2004; Lin, 2007)

This globally-renown cultural event of "Mar-Zu trip-around" is completed with ritual stages which center themselves with the actual application of "Shun"—the incense, placed in incense–stoves. Our cultural creative product thus intends to shift the external formalities to rituals of internal blessing and further, the effects for mental comfort and relaxation.

This design process is completed according to the model of cultural product design attributes proposed by Hsu (Fig. 7) [5]. Besides the cultural space presented in the model chart, we have, with further literature review and adding three cultural levels, categorized the design factors into different product design attributes. As shown on the

right columns, the three attributes contain (1) outer or tangible level which includes color, quality, shape, surface decoration, lines, detail handling, assembling parts and so on; (2) mid or behavioral level that covers attributes such as function, operation, convenience in use, safety and user pleasure; and (3) inner or intangible level, for instance, a product comes with a special meaning, with a story, with emotional inspiration, or with cultural features.

With the attributes in mind, this series of cultural creative products has turned the abstract religious concepts of "Mar-Zu Culture", through the internal interpretation and field experience of the "Mar-Zu--trip" rituals, into the actual sensational "products of the incense–stove" which provide specific emotional memory, become part of life, and sustain the vitality of festival culture [2] . The whole process could be addressed as a circulation consisted of four phases: (1) conceptualization of cultural factors, (2) symbolization of cultural factors, (3) materialization of cultural factors, and (4) bringing cultural factors into daily life (Figure 8).

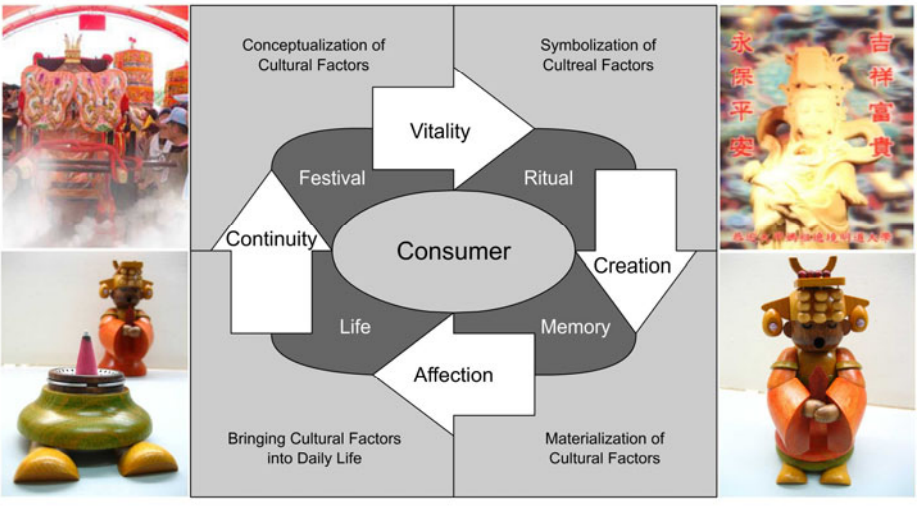

Fig. 8. The experience model of festival culture

5 Conclusion

The study engages in transforming "Taiwanese Cultural Elements" to "Cultural Creative". As stated in the introduction, with limited geographical resources, the competition power of Taiwan lies mainly on excellent design products of high quality or high price. Such quality products have to emphasize their being unique and symbolic. Only products with local cultural features would satisfy consumers' needs and curiosity. Exploring Chinese cultural features has become a trend. Along this trend, we could thus provide fresh, nature-flavored craft goods in the future market, by integrating Taiwanese cultural elements into craft aesthetics.

To encounter the threat of the low-priced competition from our neighboring countries, craft industry in Taiwan has moved their manufacturing section to areas with lower labor cost. When they sell their products back to Taiwan, it brings severe attack on the industries staying in Taiwan. A trend for globalization there is, still it becomes catastrophic to the development of local craft industry. This study targets at combining craft techniques with creativity, leading local craft manufacturers to enhance product value with design, redirecting what is lost in the OEM-production mode, and gradually eliminating the threat from low-price competition.

Acknowledgments. The creative craft products demonstrated in this study, including the Beetle-nut Lady series and the Gods series, were designed and made by Shi-Jie Shen and Li- Juan Fu. Mr. Shen and Miss Fu are graduate students of Crafts and Design Department at National Taiwan University of Arts. They are also the founder partners of Mufun woodworking studio.

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Part II
Culture and Usability

A Review of Driver Mental Workload in Driver-Vehicle-Environment System

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Abstract. This paper reviews mental workload literatures which focus on the field of driving task. The purpose is to identify and discuss shortcomings in present research and opportunities for future study. A comprehensive search of journal papers on ISI Web of Science® (WoS) data base was conducted. 50 most-cited studies [1-50] are analyzed and classified into 4 categories: characteristics of the driver, characteristics of the vehicle, characteristics of environment, measurement and modeling. Chronological historiograph is generated to highlight the relationship among these studies in the retrieved categories. We argue that the ambiguity of concept and dissociative measurement are still primary barriers for current workload research. The further application of driver mental workload research should fully consider various potential influence factors in the Driver-Vehicle-Environment (DVE) system.

1 Introduction

Driving behavior is a direct consequence of the stimuli received from the road infrastructure, surrounding environment and atmosphere inside the vehicle [51]. Currently, the evaluation of mental workload is a key point among the researches to the development of the Driver-Vehicle-Environment (DVE) System. The intent of this paper, therefore, is to provide a review of the mental workload literatures, which focus on the field of driving task.

The most organized discussion of mental workload can be found in the "Handbook of Perception and Human Performance" [52,54]. De Waard [51] conducted detailed overview of general characteristics of driver mental workload measures. In previous reviews, there is often a tendency to be highly technology driven and to focus primarily on methodology and measurement, while reflecting less on inherent relevance of current interrelated researches. Inspired by related studies within the field of road safety, we aim at evoking more discussion about effects of driver, vehicle, and environment characteristics on mental workload by presenting a snapshot, identifying and discussing shortcomings in the present research and opportunities for the future study. This paper is organized as follow. Section 2 begins with concept and fundamental researches about mental workload. Three aspects of mental workload are briefly viewed. In section 3, we conduct a comprehensive search of journal papers. 50 most-cited studies [1-50] are analyzed and classified into 4

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categories. Chronological historiograph is generated to highlight the relationship among these studies in the retrieved categories. Characteristics of the driver, characteristics of the vehicle, characteristics of environment, measurement and predictive model are then discussed in section 4, 5 and 6. Section 7 concludes with discussion of limitations in the reviewed research and potential trend in the future study.

2 Fundamental Researches of Mental Workload

Since the 1970s, the interest in defining and developing measures of mental workload has increased dramatically. Nevertheless, with about 40 years' interest in workload research, there is still no clearly-defined, universally-accepted definition of mental workload. Roscoe [55] provided an earlier review which acknowledges task demands, operator capabilities, and contextual temporal demands as being components of workload. Gopher and Braune [53] suggested that the workload construct is conceived to explain the inability of human operators to cope with the requirements of a task, and that workload measurement is an attempt to characterize performance of the task relative to the operator's capability. For those reason, three aspects of mental workload should be considered.

1. **Task demand**: tasks complexity for limited human capacity.
2. **Performance:** primary-task or secondary-task performance.
3. **Effort:** the strategy and conscious allocation of mental processing resources.

Workload measurement techniques are typically organized into three broad categories: self-assessment, performance measures and physiological measures. It has already been noted that different measures are sensitive to different aspects of workload and not all workload measures are assessing the same thing. In De Warrd's [51] review, different mental workload measures were presented and evaluated on their potential use as indicator of workload in traffic research.

3 Method

In this paper, a comprehensive search of journal papers on ISI Web of Science® (WoS) data base is conducted. To be included in this collection, a study has to (1) aim at studying mental workload of road driving task and (2) have great impact on subsequent researches, which is measured by Global Citation Score (GCS), the total number of citations to a paper in the WoS.

While operating a driving task, the information can come from the driver itself, current interactions, traffic environment and road scenario. As the result, the drivers' metal workload is influenced by the characteristics of driver, vehicle and surrounding environment. In addition, some studies consider those characteristics as a whole and focuse on developing a general measurement and constructing a predictive model of driver's mental workload. According to this thought, the topics of reviewed studies were categorized into 4 domains: characteristics of the driver, characteristics of the vehicle, characteristics of environment and measurement and modeling. Some of

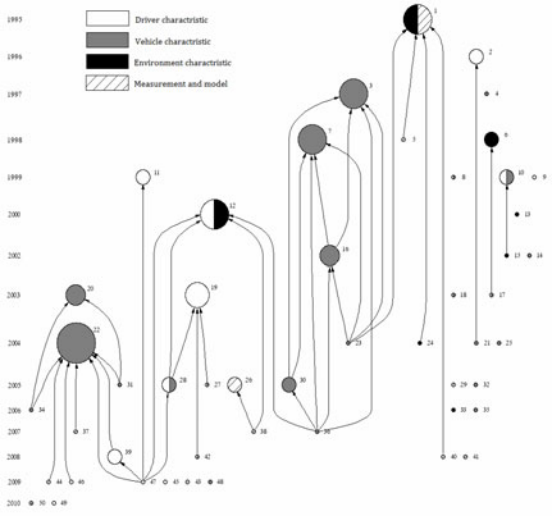

Fig. 1. Chronological historiographs of 50 most-cited reviewed literatures

reviewed studies belong to more than one category. A total of 50 most-cited studies [1-50] were reviewed and analyzed in this article. WoS export files were created in which all cited references for each source document were captured. We generated a chronological historiographs (Fig. 1) for those most-cited studies to highlight the relationship between these researches in the retrieved category.

4 Characteristics of Driver

Visual and information processing are the most important driver capacities for safe driving. Several researchers aimed at constructing a clear relationship between these capacities with mental workload. Liu [1] pointed out that the effects of visual scanning on workload are more pronounced in the dual task conditions than in the single one. In addition, Increases in scanning demand produce greater interference to a concurrent spatial task than to a verbal task. Recarte and Nunes [20] pushed this research to a step forward. They studied the effects of mental workload on visual search, discrimination and decision making in real traffic conditions. Results indicated that the increased workload produce endogenous distraction and spatial gaze concentration, affecting the capacity to process visual stimuli.

Age is associated with declines in perceptual, response time, cognitive memory, attention, physical strength and dexterity performance. Hakamies-Blomqvist, et al. [9] used instrumented car to test the age related differences in organizing car-controlling movements. The experiment result showed that older drivers organize their car-controlling movements in a more serial way in order to reduce the momentary mental workload produced by complex traffic situations. Makishita and Matsunaga [40] examined differences in reaction time of various age groups to assess the influence of

mental workload on reaction time. Results suggested that high mental workload increase the average reaction time for each age group, whereas mental workload influences elderly drivers' reaction time remarkably.

Other aspects of driver characteristics were also considered, such as injury experience, driving skills and training. Riese, et al. [10] focused on patients with very severe Closed Head Injury (CHI). Young and Stanton [16] analyzed how the development of automaticity within the driving task may influence performance of different levels of driver skill and workload. Wang, et al. [50] found that subjective mental workload of the trained drivers was significantly lower than novice driver in completing the simulated driving task of road hazard handling.

5 Characteristics of Vehicle

Nowadays, great challenge of increased demands during driving task is caused by the introduction of information system into the vehicle. All these In-vehicle Information System (IVIS) require drivers' attention to be divided between the system and the primary task of vehicle control. In an experiment of Lansdown, et al. [21], participants were presented with a primary task, representing some of the visual and manual aspects of driving, and three secondary tasks (visual, auditory, and visual & auditory stimuli), representing the aspects of in-vehicle system operation. Differences between the impacts of the three secondary tasks were not observed. Addition research [26] proved that analogous auditory and visual secondary tasks were of equivalent difficulty. Koo, et al. [45] studied the effect of voice or display information systems on drivers through the driver eye movement. Result suggested that effect of high workload produced by telematics services focuses on driver's object visual field. The effects of different display modes were compared between Head-Up Display (HUD) and Head-Down Display (HDD) [22]. Results indicated that using the HUD caused less workload for the drivers than the HDD.

Mobile telephones are most tangible devices that can distract the driver and change the workload. The effect of three types of cell phones (hand held, hands free with an external speaker and personal hands free) on total subjective workload and intelligibility was measured using the NASA-Task Load Index (TLX) and the modified rhyme test (MRT) [19]. In this experiment, the drivers rated all components of workload for each type of cell phone to be significantly higher than for a control condition in which no cell phone was used. It was also concluded that hands free cell phone would interfere least with the cognitive demands of driving. Patten, et al. [23] pointed out that the content of the conversation was far more important for driver distraction than the type of telephone. The more difficult and complex the conversation, the greater the possible negative effect on increment in workload. Tornros and Bolling [32] found driving speed decreased as an effect of dialing with the greatest effect for hands free phone mode. They interpreted effects on speed as a compensatory effort for the increased mental workload.

Vehicle automation is another irresistible trend in this century with undoubted benefits. The early study of the vehicle automation effect on mental workload was since 1990s. Stanton and Young [6] presented a review of vehicle automation. They shown a reduction in mental workload associated with some forms of automation.

Since then, much effort was spent on specific automation device. Ma and Kaber [30] verified the effects of an adaptive Cruise Control (ACC) system on situation awareness and mental workload. Their results was different from Stanton and Yong [31], which indicated use of the ACC system improves driving task situation awareness (SA) under typical driving conditions, and reduces driver mental workload. Young and Stanton [38] exposited the adaptive nature of the ACC system to reconcile this contradiction and advised to use variable-speed tasks to ensure that all aspects of device functionality are covered. The effect of automated system of bus docking on drivers' mental workload was also tested [18]. Results showed that docking precision is improved when the system is used. When drivers monitored the functioning of the system, their workload was higher than that observed during manual docking. However, reduced workload was evidenced after a learning process. It's interesting that the docking system was shown to increase workload highly in the event of dysfunction, especially when drivers had to take over control. A similar experiment [35] was also conducted on Lane Support System (LSS). The general suggestions about automation design in vehicle were given by Young and Stanton [16]: according to proposed malleable attention resources theory, future vehicle designers should employ their technology in driver support systems rather than in automation to replace the driver.

6 Characteristics of Environment

Verwey [13] suggested that road situation is a major determinant of visual and mental workload of the driver. Numerous specific road characteristics were studied separately, including road curvature change rate, road mark, roadside advertising etc. Richter, et al. [5] and Backs, et al. [17] introduced the road curvature change rate as an independent variable, which served as a criterion of objective road difficulty. Both psycho-physiological variables (heart rate, blink rate, skin conductance response) and speed varied as a function of the curvature change rate of the road segments, indicating that driving performance significantly deteriorated and visual demand significantly increased as curve radius decreased. Steyvers and De Waaed [12] compared two types of road-edge delineation, continuous or dashed edge lines with two control roads without lines or with only a dashed line on the road axis. Subjectively rated effort was higher for the unlined control road than for the three other roads. It was concluded that edge-lines may provide a simple and effective way of inducing a more favorable lateral position on rural roads without having negative effects on mental workload. Another comparison of an enhanced road-marking system with commonly used highway markings was undertaken by Horberry, et al. [33]. A similar pattern was found for the subjective measures: workload was rated lower for the enhanced markings.

Some specific driving scenarios were also considered. Horrey and Simons [36] examined the impact of mental workload on safety margins (distances) that drivers keep when engaged in a tactical control task (passing other vehicles). The result show although drivers did increase their headway adaptively when engaged in steady-state car following, they did not adapt their behavior to accommodate mental workload when performing tactical control maneuvers and implicate the difference between

steady-state and tactical control driving contexts. Some studies [39] focused on assessing effects of Heavy Goods Vehicles (HGVs) on other drivers' behavior and mental workload during filtering into traffic and exiting from the motorway. It was concluded that an increase in HGVs will make merging into and exiting from traffic more mentally demanding and will decrease safety margins.

7 Measurement and Modeling

The systemic overview of drivers' workload measurement can be found in De waard's [51] handbook "The Measurement of Drivers Mental Workload" on the basis of the following properties: sensitivity, diagnosticity, primary-task intrusion, implementation requirements and operator acceptance. Later studies were almost following this framework. In Backs' study [17], cardiac, performance, and visual demand measures of driver workload were obtained. The patterns of dissociation were interpreted as being capable of isolating the perceptual demands of driving from the central and motor processing demands. Several studies [23,28] using the Peripheral Detection Task (PDT) method to measure driver workload compare with subjective workload ratings as well as physiological measures. Result suggested that the PDT proved to be sensitive to peaks in workload; subjective workload ratings reflected overall route demands; physiological measures were less sensitive to workload and indicated emotional strain as well. Di Stasi et al. [49] found that saccadic peak velocity could be a useful diagnostic index for the assessment of operators' mental workload and attention state in hazardous environments. Mehler, et al. [46] examined the sensitivity of heart rate, skin conductance, and respiration rate as measures of mental workload in a simulated driving environment. The pattern of results indicated that physiological measures can be sensitive to changes in workload before the appearance of clear decrements in driving performance. On the whole, consensus of current investigations indicates that a battery of assessment techniques will provide the most sensitive assessment of workload in complex environments. Meanwhile, with the technical development in the area of physiology, more and more physiological measures are recommended.

Several conceptual and numerical models of mental workload have been introduced sine 1990s. Zeitlin [1] conducted a long-term field trial to estimates driver mental workload. Increment of mental workload was a function of traffic density, average speed, and uncertainty (estimated by the number of brake depressions). Following this result, he [7] suggested that driving workload has two components, a steady-state load dictated by road conditions, speed, and traffic density and a transient load determined by the degree of uncertainty in the driving situation. An objective workload index of the general form, workload= F (brake actuation rate + log (2) speed), based on this model of driver behavior predicts subjective driving difficulty and workload. The concept of driving task difficulty [27] is elaborated within the framework of the Task-Capability Interface (TCI) model. In this model, task difficulty homeostasis was proposed as a key sub-goal in driving and speed choice was argued to be the primary solution to the problem of keeping workload within selected boundaries. Several more sophisticated numerical models, including artificial neural network architectures [29] and queuing network [37] were used to simulate drivers' mental workload and the performance. However, the accuracy of these numerical models still needs to be improved.

8 Discussion and Conclusion

With about 40 years development, the concept that mental workload is multidimensional is not seriously challenged today. Meanwhile, there still have not been any major developments in the understanding or measurement of mental workload in the recent literatures. The recent techniques used to measure mental workload are similar to those used over the past 30 years, namely subjective measures, performance measures and physiological measures. When measuring workload empirically, the current recommendations are largely the same as twenty years ago: a battery of assessment techniques will provide the most sensitive assessment of workload in complex environments [52]. However, with the technical development in the area of biomedicine and physiology, more and more psycho-physiological measures are recommended for application. It's necessary to develop a formal, unified theory that can explain the interactions of various physiological phenomena and their relationship to workload.

On the other hand, drivers' metal workload is influenced by characteristics of the driver, vehicle and surrounding environment in the DVE system. As to characteristics of the driver, studies in this domain concentrated upon constructing a clear relationship of driver capacities with mental workload, considering individual difference such as age, skill and experience as influence factors.

Meanwhile, increased demands are from the introduction of new technology into the vehicle, primarily including IVIS and vehicle automation. Information form (visual, auditory, and visual & auditory) and display modes are hotspots of the IVIS researches. Although vehicle automation is suggested by most investigators to be able to improve performance and reduce mental workload, overburden workload may occur in the dysfunction of automation, especially when drivers had to take over control. In general, further investigation of these human-vehicle interactions can offer fundamental guidance for efficiency and safety vehicle design without negative effects on mental workload.

Looking at studies concerning with traffic environment, assessment of driving task demands and mental workload in different traffic condition is consider as the starting point for road design. A lot of specific road characteristics were studies separately, including road curvature change rate, road mark, roadside advertising, etc. Some specific driving scenarios (steady-state car following and tactical control maneuvers) are also considered. However, there are still enormous opportunities for future study in road situation and road construction.

In conclusion, this review examines mental workload literatures which focus on the field of driving task. Large numbers of impact factors among the DVE system on driver's mental workload have been considered in recent studies. But there have not been any conceptual model to interpret the inner link between those characteristics. An important reason contributing to this situation is fuzzy concept of mental workload. To measure, assess and predict workload accurately, the further research of mental workload research should fully considering the impact factor from driver, vehicle device, road environment and scenario as an uniform input of human information process.

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Testing Touch: Emulators vs. Devices

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Abstract. Conducting usability tests is a time and resource intensive process. The ability to do remote testing significantly reduces the cost associated with testing while still providing rich feedback. However, mobile touch interfaces provide a unique challenge for remote testers. This paper compares the results of testing an application on a mobile touch device (the iPod Touch) and an emulator using a between subject test. In it, we examine the differences in time on task, usability issues discovered, and task completion. Results suggest that emulators can be used to detect some but not all usability issues and that they may provide some false positives as well. Further research is required to separate issues with the emulator vs. device from the remote vs. in-person test environment.

Keywords: Touch Interface, Emulator**,** Remote Usability, Usability Test, User-Centered Design.

1 Introduction

Mobile touch interfaces are daily becoming more ubiquitous. In addition to the popular uses of such devices as entertainment and social networking supports, many large software firms are delving into the mobile market. These companies are developing applications that provide extensions to enterprise software, allowing customers access to functionality that had previously required them to be on-site. As these applications tend to be complex, usability testing becomes more important.

Remote usability tests are often the mainstay of corporate testing. Getting feedback on a global level has become paramount with the worldwide market pursued by most large software companies. Getting feedback from an international audience early in the process reduces costs and ensures a universally-usable product design. This is especially true of mobile application development, where guidelines are still being developed and the interaction challenges are not well-understood.

Unfortunately, remote testing with mobile applications is problematic at best. Short of shipping the device to the end user and asking them to film themselves using the application, user researchers must rely on emulators which simulate the mobile experience on the subject's computer. Studies looking at traditional remote usability tests [1], [2] suggest that significant differences between remote usability tests (both synchronous and asynchronous) and traditional tests do not exist, in terms of the

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number of usability issues found, their types, or their severities. But using an emulator is not an identical experience to using a mobile application, especially one with a touch interface. The emulator cannot be manipulated like the mobile device and the required use of the mouse adds another layer of difference to the experience. Previous in-person studies [3] suggest that this difference is not significant when detecting usability errors.

This experiment seeks to understand the differences in results from a remote test done with an emulator and an in-person test done with a physical device, specifically the iPod Touch®.

2 Methodology

We chose a product for our study that is currently available through the iTunes app store, but sufficiently specialized and technical that the majority of test subjects would not have seen it. The application lets users track and predict the location of satellites in the sky. Primarily used by satellite watchers and ham radio operators, the application was developed by an enterprise software designer. The application was ideal for this experiment as it had some obvious usability issues that the designer had not had a chance to evaluate and correct.

Fig. 1. ProSat Application

We evaluated the product using standard usability heuristics and chose tasks for the test that would highlight these issues.

2.1 Participants

All participants were CA Technologies employees with normal or corrected-to-normal vision. A total of 49 users were tested, 24 remotely and 25 in-person. For the in-person tests, all subjects were located in either Colorado Springs, CO or Plano, TX. For remote tests, subjects were located in numerous locations around North America.

The demographic breakdown of the participants was as follows:

Table 1. Gender

	Male	**Female**
Gender (emulator)	18	6
Gender (device)	16	9

Table 2. Age

	21-30	**31-40**	**41-50**	**51-60**	**61-up**
Age (emulator)	0	6	15	2	1
Age (device)	0	3	14	5	3

Table 3. Frequency of use of touch device

	Never	**Once or Twice**	**Monthly**	**Weekly**	**Daily**
Frequency of use (emulator)	0	3	2	3	16
Frequency of use (device)	2	7	0	0	16

2.2 User Preparation

When they arrived at the test, all users were given a brief description of the purpose of the test, a general description of the software and its uses, and the format of the test. They were provided an opportunity to ask questions both before and after the test.

In addition, before the test, remote users received an instruction email that provided them the time and date of their test. They were asked to have the following items ready before the test started:

- Access to a speaker phone or a headset, with toll-free access. Because the test required the use of a mouse and keyboard, we asked that the users have a way to communicate with us without encumbering their hands.

- A printed copy of the task list. We wanted the users to access the software in a full screen mode, which made it necessary for them to have a printed copy of the tasks.

2.3 Test Environment

All subjects were presented with the same tasks in the same order. In-person tests were performed in a team room with standard office seating (fixed height table and chairs) and overhead fluorescent lights. Remote tests were performed at the subject's individual location which could vary significantly. Remote users accessed the software using Microsoft LiveMeeting. The test then proceeded like a traditional usability test.

During the test, users performed the following eight tasks:

1. Rotate the globe to see North America.
2. Zoom in on the ISS (ZARYA) Satellite.
3. View the current details of the ISS Satellite. Change the base frequency of RCV for the ISS Satellite to 5. View the latitude/longitude data for the ISS Satellite for the next 7 days.
4. Add the COSMOS Satellite, under Amateur Satellites (CelesTrak), to the satellite list. Change the COSMOS Satellite color to blue and set Number of Orbits to Draw to 2. Remove the COSMOS Satellite that you just added from the satellite list.
5. Find which disaster monitoring satellites can be viewed from your location during the next hour.
6. Find the Sun rise/set information for tomorrow. Make the Sun rise/set menu display as the second icon in the tool bar on the bottom.
7. Change the system time within the application to be 7PM today.
8. Find information on how to set viewing information from the help document.

In addition, subjects were asked to rate the usability of the interface on a Likert scale of 1 to 7 and were asked open-ended questions about their experience with touch interfaces.

We found the remote setup had very poor response time. This was largely due to the subjects having to interact with the emulator through Microsoft LiveMeeting.

2.4 Measurements and Analyses

A number of metrics were measured in this study, such as number of errors, number of assists, time taken for completing each task, and task completion. Errors are defined as any action, either intentional or unintentional, that adds to, deletes from, modifies, or otherwise affects the systems, or a failure to save changes. An assist is any help given to the user by the test administrator that helps the user perform the task. If a user committed three errors or needed three assists for a given task, the task was marked as not completed.

The analyses were carried out by Analyses of Variance and t-tests.

3 Results

We found significant testing environment effects on time and errors. Users in the device group made more errors ($F(1, 47) = 7.81$, $p < .01$). In addition, it took users in the emulator group more time to complete tasks ($F(1, 47) = 51.46$, $p < .00$).

Table 4. Mean (SD) of time, assists and errors, and p-values from ANOVA analyses

	Device N=25	Emulator N=24	P-value
Time	102.62 (35.96)	177.21 (36.82)	.00
Assists	0.37 (0.24)	0.47 (0.31)	.19
Errors	0.13 (0.12)	0.47 (0.81)	.01

Fig. 2 shows age effects on assists. We found a relationship between the number of assists and the age of the user, in which older users requested assistance more frequently ($F(3, 45) = 5.77$, $p < .00$). The post-hoc Tukey test revealed a significant difference between the 31-40 age group and the 61 and up age group ($p < .00$) and a significant difference between the 31-50 age group and the 61 and up age group ($p < .00$). There was no significant difference between the 51-60 age group and the 61 and up age group. This finding was independent of the environment (device or emulator).

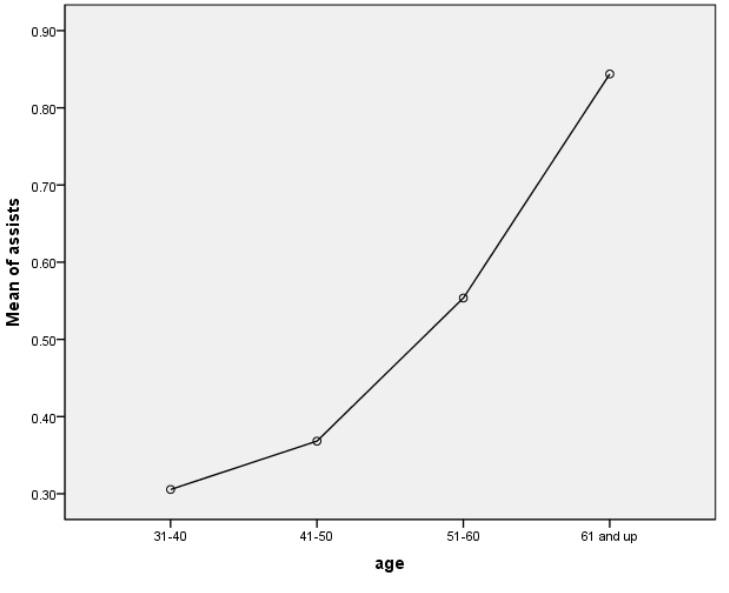

Fig. 2. Age affect on assists

Finally, we found the abandonment rate (users deciding to abandon the task rather than try to finish with or without help) was significantly higher on the emulator tests. Nine out of 25 users on the emulator abandoned Task 8, rather than finish it. None of the device users abandoned this task.

4 Discussion

The difference in results between the emulator and device are interesting, if not entirely surprising. The difference in time on task is easily explained by the significantly poorer response time for the emulator. However, the difference in error detection is significant. Subjects were more likely to find and detect errors on the device than through the emulator. Generally, we found the emulator participants were more likely to overlook issues with the arrangement of interface elements (see following figure) and visibility of features.

Fig. 3. Number of orbits to draw error

In Fig. 3, the field, Number of orbits to draw, is slightly off the bottom of the screen by default. Device users frequently tried to touch this field to enter a number but selected the Settings toolbar button instead. Emulator users did not have this accuracy issue due to use of a mouse and keyboard, rather than fingers.

The abandonment issue was also interesting. It was unclear from this study what caused emulator participants to be more willing to give up on a task. The response time was significantly worse for the emulator and may have caused enough frustration to cause users to be more willing to give up. However, the lack of social pressure (test administrator over the phone rather than in the room) or the lack of novelty (most device users commented that using a touch device is "fun") could also have contributed to this finding. Future research will have to be undertaken to gain a better understanding of this effect.

5 Conclusions

This study showed some limitations of remote testing for mobile touch interfaces, outlining the unique challenges currently faced in this area. While some results may be gathered using emulators, it is not an adequate substitute for in-person testing at this time. This finding is particularly interesting given the large number of developers who currently use emulators to test their interfaces during the development process. Tests run by the Nielsen group noted some common design issues for touch screens, such as 1) fat fingers- accidental tapping and the back button; 2) invisible controls; 3) getting lost in an application, i.e., lack of navigational aids; 4) inconsistent interaction design [4]. Certainly, more research should be done into how to improve the development environment as well as the test environment to prevent usability issues before they arise.

The marked difference between these findings and those of previous studies regarding remote usability testing suggests that traditional usability testing techniques, and perhaps even usability heuristics, need to be re-evaluated when approaching touch interfaces. Some work has already begun in this area [5] recognizing the differences in design requirements for mobile devices.

The abandonment issue provides an interesting mystery. It is uncertain from this experiment if the higher rate of abandonment on the emulator was due to the slow response time of the environment, the remote nature of the test, the lack of "cool" factor when compared to the actual touch device, a combination of these factors, or other factors entirely. Further research is needed to answer these questions.

Similarly, more research into the increased number of assists, as related to participant age, could provide significant insight into the effects of age on usability testing. With an aging IT workforce, the results of this type of research could take on new significance in software and interface design.

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Heuristic Evaluation and Usability Testing: Case Study

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Abstract. The goal of this user centered design (UCD) study was to to identify usability issues on the Boğaziçi University Industrial Engineering (BUIE) department website user interface (UI) and also to provide a re-design guideline for the website. In this context, the website was evalauted via using heuristic evaluation, remote usability testing, and post-test questionnaire methods. Every single screen of the BUIE website was evaluated, and design problems along with associated severity rankings were determined. Based on the heuristic evaluation findings, various task scenarios were created for the remote usability testing study. Four diffferent user groups were identified for the study: high school students, BUIE undergraduate students, BUIE Graduate students/academic staff, and other university students. The users were asked to perform tasks relavant to the group characteristics and expectations related to the website. Their performance were evaluated in terms of task completion success rate, number of clicks, and time spent till either accomplishment, failure, or quittance by a remote usability testing tool, Loop11. A post user testing questionnaire was also administered online where the user subjective rating data were collected for each task in terms of ease of use. The results indicated numerous UI design issues, as confirmed by both heuristic and usability testing methods. Further redesign study is required to implement the results of this sudy in order to enhance the ease of use of the BUIE department website.

Keywords: Heuristic Evaluation, Usability Test, User-Centered Design, Web Design.

1 Introduction

In the information era, a college web site is one of the most important tools for different user groups, including current college students, academic staff, prospective students and other college students. And, most often the users do not visit the website frequently unless it is a registration time, college application time or student transfer time of the year. Thus there is no learning factor of using a college department web site. Designing a web site for different user groups with different user needs and background is a challenge for the web site designers [1][2][6]. And, designing for different user groups is one of the most important factors that needs to be considered in order to ensure an ease of use of a website. In addition, the frequency of a website

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usage is another important factor and needs to be considered for ease of use [1][2][6] because the learning factor cannot be counted into account if a website is not used frequently. Those two important facts need to be considered for a successful web site design.

This project started with the fact that there has been a known negative user experience of BUIE department website. Recently, the website was degraded negatively in terms of ease of use by the undergraduate students in a student survey. The student group stated that the website needs to be redesigned. Then, a UCD project was initiated by the human factors professor at BUIE department, and it was assigned to three undergraduate students as a senior graduation project. The project plan including the deliverables, schedule and resources was prepared by the professor and it was implemented by the students in fall 2010 semester.

In this paper, it was illustrated what UCD methodologies were used, how they were used, what type of data were collected, how data was analyzed, and how the analyses results can be utilized to redesign the BUIE department website to enhance user experience.

2 Objectives

The objectives of this user-centered design (UCD) study were:

- Identifying high-level UI design issues about the web site by conducting a heuristic evaluation
- Conducting a usability study to identify the details about the high-level issues found by the heuristic evaluation for different user groups
- Providing solutions for the identified usability issues discovered by the usability tests sessions

3 Methodology

This UCD study was assigned to a group of senior undergraduate students of industrial engineering as a graduation project. The students chose their department's web site; because of the fact that this website is the most commonly used one amongst both undergraduate and graduate students, faculty members and prospective students from other universities and high schools. The usability of this web site is very important in order to meet the needs of these different user groups.

First, a heuristic evaluation was conducted in order to identify high level usability issues via using both "Research-Based Web Design and Usability Guidelines" of U.S. Department of Health and Human Services [2] and Nielsen´s [3] heuristic evaluation principles. However, [2] was used as the primary resource. The BUIE website was evaluated using 129 of 209 of these usability guidelines. Every single window of of the BUIE website was evaluated, and design problems along with associated severity rankings were determined. Heuristic evaluation was performed by three senior undergraduate students who were familiar with the website and somewhat knowledgeable about usability principles. Based on the results of this evaluation, the usability test scenarios were created. The following heuristics were the major ones

considered while creating usability test scenarios:

- Ensure that necessary information is displayed
- Group related elements
- Match link names with their destination pages
- Avoid misleading cues to click
- Design for working memory limitations
- Place important items at top center
- Structure each content page to facilitate scanning
- Use scrolling pages for reading comprehension

The test scenarios were implemented by using Loop11, www.loop11.com, a remote usability testing tool. The users were not moderated during the usability test sessions. The user data were collected and analyzed by the Loop11 tool automatically.

3.1 Participants

Four groups of users were selected for the study: 1) high school students who are potential candidate students for the BUIE department, 2) BUIE undergraduate students, 3) BUIE graduate students/academic staff, and 4) other university students. A total of 115 users participated in the study. User testings were performed remotely using loop11. The users in each of the four groups were asked to perform tasks relavant to the group characteristics and expectations related to the website.

Table 1. User Groups and number of participants

User Group	Number of Users
High School Students	15
Other University Students	47
BUIE Undergraduate Students	24
BUIE Graduate Students & Academic Staff	29
Total	115

The demographic breakdown of the participants was as follows:

Table 2. Gender distribution accros user groups

	Undergrad	Graduate	Other University	High School	Total
Male	13	15	21	5	54
Female	11	14	26	10	61

Table 3. Frequency of internet usage

	Undergrad	Graduate	Other University	High School	Total
More than 8 hr a day	3	8	13	-	24
More than 4 hr a day	12	13	17	7	49
More than 1 hr a day	7	5	15	5	32
Daily	2	3	2	2	9
Weekly	-	-	-	1	1

3.2 User Testing

After design and approval of the pre-task, task and post-task evaluation questions, pilot studies conducted with two users who are counted as expert users for each category. In this manner, we observed real-time reflections of the users towards the tasks. We traced performances of pilot users while they complete each stage of the evaluation process and noted problems faced. We faced some minor errors in the tasks that could lead the users to ambiguity or misunderstanding. After correction of wording or other miscellaneous problems faced during pilot studies, we agreed on appropriateness of tasks uploaded to the Loop11 test environment and sent links to the participants by email.

Before the usability test questions, the participants were asked several pre-task questions about demographics, frequency of internet usage and their website usage purposes.

During the test, the high school students performed the following five tasks:

1. Please find information about the definition of Industrial Engineering and its fields. *Guideline 16.3: Ensure that necessary information is displayed [2].*
2. Please find the communication information (phone number and e-mail) of the department. *Guideline 16.3: Ensure that necessary information is displayed [2].*
3. You are a successful high school student and want to get more information about the Department. Please find the Department Leaflet. *Guideline 16.4: Group related elements [2]. Guideline 10.3: Match link names with their destination pages [2].*
4. Please find the descriptions of the courses given in Industrial Engineering. *Guideline 16.3: Ensure that necessary information is displayed [2].*
5. Please find the internships that Industrial Engineering students are supposed to fulfill? *Guideline 10.4: Avoid misleading cues to click [2].*

During the test, the students from other universities performed the following five tasks in Turkish language:

1. You are a student at a university in Turkey and want to get graduate education in Boğaziçi University, Industrial Engineering. Please find the minimum grade point average to apply. *Guideline 10.4: Avoid misleading cues to click [2].*
2. You want to transfer to Boğaziçi University, Industrial Engineering. Please find the transfer requirements. *Guideline 10.4: Avoid misleading cues to click [2].*
3. Please find the descriptions of the courses given in graduate program in Industrial Engineering. *Guideline 10.3: Match link names with their destination pages [2].*
4. Please find the communication information (phone number and e-mail) of the Department. *Guideline 16.3: Ensure that necessary information is displayed [2].*
5. You want to get graduate education in Boğaziçi University, Industrial Engineering. Please find the general application conditions of Boğaziçi University in the Departmental website. *Guideline 16.3: Ensure that necessary information is displayed [2].*

During the test, the BUIE undergraduate students performed the following ten tasks:

1. You are interested in Flexible Automation. Please go to the website of the related laboratory. *Guideline 10.4: Avoid misleading cues to click [2].*
2. You want to call the chairman of IE department. Find his/her phone number. *Guideline 2.5: Design for working memory limitations [2.]*

3. Find the link to Office of International Relations website to get information about Erasmus or Exchange. *Guideline 10.4: Avoid misleading cues to click [2].*
4. You are interested in searching academic staff and want to know which courses are given by an IE Professor, namely Prof. Dr. Barbarosoğlu. Find the courses given by her. *Guideline 10.4: Avoid misleading cues to click [2].*
5. You heard that Boğaziçi University Industrial Engineering Dept. has a research group called "Quantitative Finance Research Group". Please go to the webpage of the Group. *Guideline 10.4: Avoid misleading cues to click [2].*
6. Please go to related information page to see if you can get PSY 101 as an HSS elective. *Guideline 16.2: Structure each content page to facilitate scanning [2].*
7. You finally graduated from BU-IE. Find the Alumni list of the IE Department to stay in touch with peers. *Guideline 10.4: Avoid misleading cues to click [2].*
8. You want to call Instructor Dr. Yasemin Aksoy to get detailed information about an elective course. Find her phone number. *Guideline 16.4: Group related elements. Guideline 2.5: Design for working memory limitations [2].*
9. You have heard that Dr. Suat Genç is a very successful instructor. Find out if he has any undergrad courses available as an elective course. *Guideline 16.4: Group related elements [2].*
10. Find the list and descriptions of IE-Elective courses you may take during your undergraduate education. *Guideline 16.2: Structure each content page to facilitate scanning [2].*

During the test, the BUIE graduate students and academic staff performed the following eight tasks:

1. You are interested in Flexible Automation. Please go to the website of the related laboratory. *Guideline 10.4: Avoid misleading cues to click [2].*
2. You want to call the chairman of IE department. Find his/her phone number. *Guideline 2.5: Design for working memory limitations [2.]*
3. Find the link to Office of International Relations website to get information about Erasmus or Exchange. *Guideline 10.4: Avoid misleading cues to click [2].*
4. You are interested in searching academic staff and want to know which courses are given by an IE Professor, namely Prof. Dr. Barbarosoğlu. Find the courses given by her. *Guideline 10.4: Avoid misleading cues to click [2].*
5. You heard that Boğaziçi University Industrial Engineering Dept. has a research group called "Quantitative Finance Research Group". Please go to the webpage of the Group. *Guideline 10.4: Avoid misleading cues to click [2].*
6. Find the academic program of Masters Degree education in IE. *Guideline 16.2: Structure each content page to facilitate scanning [2].*
7. Find the syllabus of the course IE 544. *Guideline 10.3: Match link names with their destination pages [2]. Guideline 10.4: Avoid misleading cues to click [2].*
8. You are interested in Master or Doctorate theses reports by IE students. Find the list of these theses reports. *Guideline 8.3: Use scrolling pages for reading comprehension [2].*

After each task performed, the participants rated the ease of use of each task using a Likert scale (-3 -2-1 0 1 2 3; where -3 corresponds to "very difficult", 3 corresponds to "very easy" and 0 corresponds to "neutral").

In addition, the participants answered 13 subjective evaluation questions to rate the usability of the website on a Likert scale (-3 -2 -1 0 1 2 3; where -3 corresponds to "strongly disagree", 3 corresponds to "strongly agree" and 0 corresponds to "neutral") and were asked open-ended questions about their experience with the web interfaces.

Loop11 is used to obtain the descriptive statistics of the collected task data and Google Docs is used to obtain the collected usability rating data of the website from the four participant groups.

3.3 Collected Data and Analyses

Task completion time, task completion success rate and number of clicks were recorded for each task and participant. Effects of three factors (user group, gender and internet usage) on two response variables (success rate and task completion time) were investigated with Analysis of Variance (ANOVA) and Tukey's multiple comparison tests using Minitab statistical package. For all comparisons, $p \leq 0.05$ were accepted as statistically significant, and $0.05 < p \leq 0.1$ were accepted as marginal.

High school students' data were not included in the analysis, since there are so few data on this group.

4 Results

Mean task completion rates for each user group are shown in Fig. 1. BUIE graduate students and academic staff completed the tasks with a success rate of 86% and all other groups completed the tasks at the success rate of less than 58%. Table 4 and Table 5 depict the success rate and task completion times separated by gender, respectively. As it can be seen BUIE undergraduate and graduate/staff groups took less time to complete the tasks compared to the group of students from other universities. Table 6 and Table 7 show the success rate and task completion time with respect to groups separated by internet usage factor, respectively.

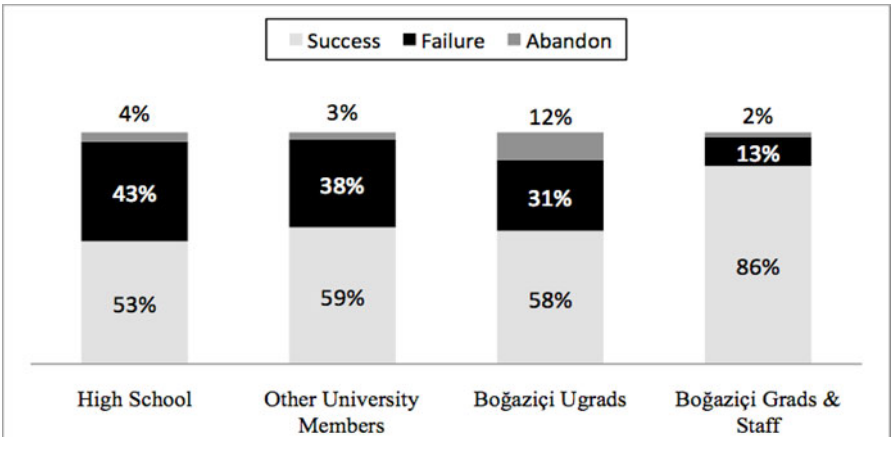

Fig. 1. Task completion rate for each user group

Table 4. Mean success rate % for each user group seperated by gender

	Male	Female
Undergraduate	55 (N=13)	56 (N=11)
Graduate and staff	88 (N=15)	83 (N=14)
Other universities	49 (N=20)	60 (N=23)

Table 5. Mean task completion time (sec) for each user group seperated by gender

	Male	Female
Undergraduate	37.09 (N=13)	37.63 (N=11)
Graduate and staff	28.67 (N=15)	32.16 (N=14)
Other universities	50.36 (N=20)	73.99 (N=23)

Table 6. Mean success rate % with respect to internet usage for each user group

	8+ hr	4+hr	1+hr	Daily
Undergraduate	36 (N=3)	60 (N=12)	52 (N=7)	65 (N=2)
Graduate and staff	78 (N=8)	85 (N=13)	95 (N=5)	91 (N=3)
Other universities	56 (N=12)	63 (N=17)	43 (N=12)	40 (N=2)

Table 7. Mean task completion time (sec) with respect to internet usage for each user group

	8+ hr	4+hr	1+hr	Daily
Undergraduate	40.33 (N=3)	33.35 (N=12)	44.35 (N=7)	32.20 (N=2)
Graduate and staff	28.29 (N=8)	28.87 (N=13)	35.45 (N=5)	33.83 (N=3)
Other universities	99.02 (N=12)	51.98 (N=17)	37.92 (N=12)	91.1 (N=2)

ANOVA results indicated significant ´user group´ effect on ´success rate´ ($p<0.001$) and marginal effect on ´task completion time´ ($p<0.055$). Following the ANOVA, Tukey´s multiple comparison tests indicated that the success rate of the group of graduate students/staff was higher than the other two groups (undergraduate students and students from other universities) ($p<0.001$). Similarly, Tukey´s tests indicated that the group of graduate students/staff, on average, completed the tasks marginally shorter time than the group of other university students ($p<0.051$). On the other hand, ´gender´ and ´internet usage´ did not have any significant effect on the two response variables.

Table 8 shows the mean ease of use ratings for each user group by using a Likert scale (-3 -2-1 0 1 2 3; where -3 corresponds to “very difficult”, 3 corresponds to “very easy” and 0 corresponds to “neutral”). Although the undergraduate students were expected to be the most experienced user group, the results show that their user experience with the web site is quite negative based on the collected task completion success rate, task completion time and subjective rating data.

Table 8. Mean ease of use rating based on Likert (-3 to 3)

User Group	Ease of use rating
Undergraduate	0.883
Graduate and staff	1.24
Other universities	1.42
High School	2

Based on the results, all the tasks except Task 4 need a major redesign for undergraduate students. The graduate students and staff completed almost all the tasks successfully. The task 7 is the one recorded with the lowest completion rate and needs to be studied in details before redesigning. For other university students success rate is a mix among five tasks. Task 3 and Task 5 are the most problematic tasks for this. Both of them need major redesign effort. Overall, the high school students’ average task completion success rate is low except Task 2. On the other hand, surprisingly they found the tasks easier than the other groups.

5 Conclusions

This study showed the website has major UI design problems. The completion of tasks related to finding information on the web site was low, task completion time was high and ease of use rating was low. Because of this fact, this web pre-test question findings suggested that the most users need this web site to locate the interested courses, instructors, rules and regulations. The information architecture of the web site should consider all these user needs and structure the web site around the information needed by the users.

Both gender and internet usage factors do not affect the task completion time and task completion success rate according to our analyses. Because of this fact we can conclude that the web usage experience or learning factors do not affect the users’ performance on the website interaction. This should be taken into account that the new design should not relay on the learning factor.

The individual screens need to be redesigned based on the collected data available for each screen. And, there is a need to repeat this study on the redesigned website and compare the pre and post design data in order to prove the impact of this study on the ease of use of the website.

Acknowledgements. We would like to thank all the participants who generously volunteered their time for this study.

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Analysis of the Applied Pattern of Distributed Computing Used in Simulation

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Abstract. This paper discusses about the future applications of distributed computing from the aspect of simulation. It also talks about the concept, classification and application used now of distributed computing. It puts an emphasis on the applied pattern of distributed computing in the field of simulation and comes out with a particular statement on the practice of distributed computing used in the simulating system of human sports biomechanics.

Keywords: Distributed computing, Simulation, .NET Remoting.

1 Introduction

From distributed computing to network computing, from J2EE to .NET Framework, from XML RPC to Web Services, there comes so many conceptions about distributed computing that it's really tough for most technicians and researchers to master them all. This phenomenon is a shadow of the highly developing of computer technology. In spite of this, have all these great concepts and technologies been used widely? Or are they just passing by? How far is the distributed computing away from us, and when can it be really used? This paper presents the application of distributed computing in the field of human sports biomechanics as an example to discuss the problems of distributed computing, hoping that more discusses will come out to promote the developing of the technology of distributed computing.

2 Related Works

2.1 Concept of Distributed Computing

Distributed computing is a science and technology of computer cooperation. It first cut a project which needs lot's of computing into small and easy jobs, then, it distributes the them to many computers separately. When all the computers finish their jobs, the results will be uploaded and combined together. By this way, the complex project is finished[1].

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2.2 Classification of Distributed Computing

There are many ways to classify distributed computing.

From the aspect of net, it can be classified as Local Area Network Distributed Computing and Wide Area Network Distributed Computing[2]. The main difference between them is where the nodes lie---in Local Area Network or in Wide Area Network. Another difference of them is the protocol they used. In Wide Area Network, the protocol of Http is used while in Local Area Network TCP/IP is used.

From the framework of application system, it can be classified as follows:

Firstly, the J2EE system. The developing language is in Java. It has an standing out advantage ---- independence on platforms. It needs the JVM as the runtime environment. Since it is a translated language, the efficiency is somewhat lost.

Secondly, the .Net system. It is a distributed system supplied by the Microsoft Co. It is quite similar to the J2EE system. All the developing language from the Microsoft Co. is supported in this framework, including C#, VC.NET, VB.NET, etc. It needs the .Net Framework as the runtime environment. What's more, the operating system should be Windows 2000/XP and later systems.

Thirdly, the CORBA system. It's the distributed system supplied by the organization of OMG. It provides the application developing rules instead of details. From this point, we can use any language to develop a COBRA system. However, since it's hard to master it, success applications of COBRA are rather few by now.

2.3 Application Situation of Distributed Computing

So far, most distributed computing projects make full use of the volunteer computers' capability which has been left unused. These computers communicate by Internet from different places in the world.

A project named SETI@home is the biggest project of distributed computing. It analyses the radio signal from outer space in order to find the evidence of life there. The data it contains are quite huge ---more than ten million digits. Four million computers have joined this project (about 40 thousand volunteers in mainland of China).

Another project called Folding@home analyses the inner structure of protein and drugs related. More than 100 thousand volunteers have joined (about 60volunteers in mainland of China). It is such a huge project that the amount of calculation is striking and it is impossible for a single computer to carry it out.

The application of distributed computing is not common so far. It still stays at the phase of research and doesn't come to the step of really use. With the highly developing of hardware, the ability of calculating has greatly improved. For single applications, it is already enough. However, in fact, most huge projects of today are not single applications; they are combination of many single applications, usually called a team or a group. So, the problem of distributed computing pattern should be solved from application pattern rather than concepts.

3 Methodology

3.1 Analysis of Application Situation of Distributed Computing in Simulation

Distributed computing has not been really applied in simulation yet. The existing mature software for simulation does not contain any pattern of distributed computing. That's to say, these software such as Proe, Ansys, Adams are all stand-along version and do not have the concept of distributed computing at all. It takes a very long time to develop this software. At the very beginning of designation, there exits no concept of distributed computing at all. For these two reasons, it is impossible to add the concept of distributed computing into this software. Then, is there any possibility of using this concept in simulation? The answer is yes. There is a bright future for the application of distributed computing in the field of simulation.

Why saying that? First of all, software for simulation are all complicated and huge ones. The requirements on hardware are rigid. Generally speaking, a personal PC (not a workstation) can run simulating software only at same time. In this case, if we want to run more than one simulating software at same time or if we want to run more than one examples in one simulating software, we need more than one computer to cooperate. Second, the existing software for simulation does not support the mode of distributed computing. So, we have to load the computing task step by step while not computing parallel. Today, the hardware level of personal PC has already exceeded that of a workstation years ago. Why not use the resource left unused of the computers in the network of local area or wide area?

So, if we can gather the resource of computer available in local area and wide area to form an environment for simulating, we can no only make full use of our computers without any need to increase hardware but also optimizing our developing of software for simulation. In this way, every node can be developed step by step separately. At the same time, we can build the developing mode by cooperating with other companies easily in this distributed developing environment.

In a word, by building the mode of distributed computing, we can optimize both the software and hardware environment. We can say that, applying the concept of distributed computing in the field of simulation is no only feasible but more than feasible.

3.2 Carry Out Distributed Computing Using .NET Remoting

Most of the operating system of personal PC is Windows with the version of 2000+, and most of the software for simulation has a version for windows. Each system of J2EE, COBRA and .NET has its own advantages and disadvantages. J2EE is platform independent, but its efficiency is low. The worst of all is that most software for simulation do not support the API for java. COBRA is common, but it takes time to master its technology. It is no easy. Only .NET satisfies us. It is not the key problem that it doesn't have the ability to cross platforms. For the reasons above, we choose .NET to carry out the distributed computing for simulation.

NET Remoting is a new concept born in the .Net Framework. It's a further development of COM+. It supplies a framework which allows objects to influence each other through applications. This framework supplies many services including

activating and lifetime support together with communicating channels for transferring messages with remote applications.

NET Remoting supplies two communicating channels: HTTP and TCP. This means that we can no only construct a application of distributed simulation by TCP channels in a local area network but also distribute our node for distributed application by HTTP in the wide area network.

HTTP channels use the protocol of SOAP to transfer messages with a remote object. When the messages go through the SOAP-Formatting application, they are formatted into XML and serialized. TCP channels use a Binary-Formatting application to format the messages into a binary stream and transfer them to the target URL by the protocol of TCP.

When we use the .Net Remoting to construct an application of distributed computing for simulation, we should first figure out how the simulating system should be distributed in the network environment (local area network or wide area network). In details, where the node should be distributed and what is the relationship between them.

Then, we should build the control center of the distributed computing system. The control center is responsible for controlling the work of each node including starting and stopping the application, the control of action, importing and exporting data, working procedure arrangement and executing, dynamic distribution and adjustment of nodes, etc.

What's more, we should install corresponding control service on each node so that each node can receive the commands from the control center and feeds back its results.

3.3 Application of Distributed Computing in the Simulation of Human Sports Biomechanics

In the practices of building our human sports biomechanics simulating system, we make full use of the concept of distributed computing. By this way, all the nodes unite closely. Under the control of controlling center, it makes full use of the computer resource available in the local area network, succeeding in binding Adams and Ansys closely together so can influence each other. This does realize the integration of the application of distributed computing simulation. The picture for this model is as follows:

This system is based on .NET Framework. The developing language is C# and VC++.NET. The key distributed technology is by .NET Remoting.

During the process of building the system, we focus on these problems:

✧ Layout of the nodes

This relates to two problems. The first one is the problem of hardware. We figure out the distribution of application according to the computer resource in the local area network. The second one is the software problem. According to the plot of the nodes, a different person is responsible for corresponding simulating application[3]. By this way, each node is developed separately and distributed dynamically.

✧ Carry out of node service

Each node is corresponding to a client of the control center in fact. It follows the commands from control center and acts. The precondition for receiving the

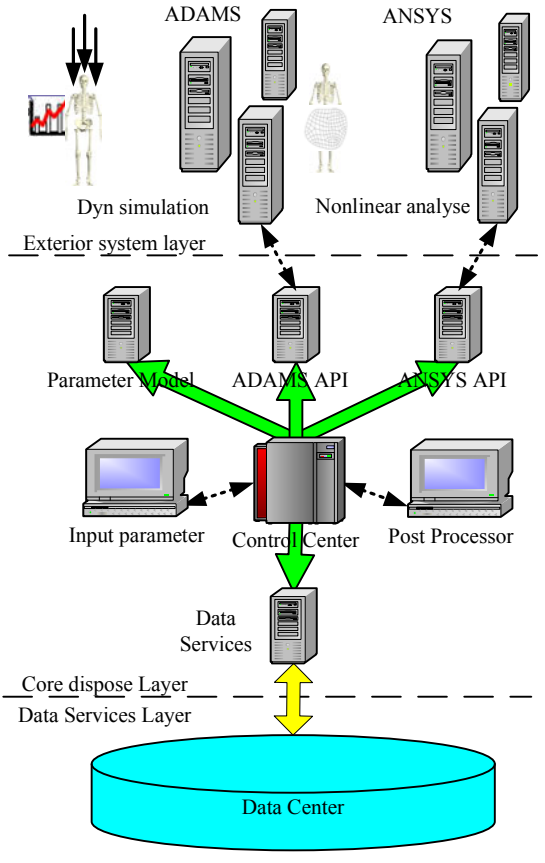

Fig.1. Human Dyn Simulation System Framework

commands is that the service of the node should be started first. This service is the key of the distributed computing system.

There are many forms to build such a service of the node. Here we choose the NT Service to construct our stand windows service. When the service starts, HTTP channel and TCP channel of .NET Remoting are registered. At the same time, the service for receiving commands form control center is bind. Therefore, when this service of the node is started, the node will connect to the control center automatically.

✧ Further developing of the application of nodes

There distributes different kinds of application in each node, which should be further developed so that it could be accepted by the distributed computing system. This is because that all the existing software for simulation are in stand-along mode and they finish all the procedure in one computer. Further developing of the application of node is to realize the target that the software for simulating and control center can act to influence each other by the supplied further developing tools and

corresponding node service. For example, we can use the APIs supplied by Adams to build a connection between Adams and the service of the node[4]. By using the methods the .NET Remoting we can call the service of the HTTP channel and TCP channel so as to connect the service of the node with the control center. By this way, we make Adams able to receive the commands from the control center and feed the result back.

✧ Communication between nodes

The communication between nodes is realized by the control center in principle so as to avoid direct communicating. The main benefit of doing so is that we can avoid the reticulate structure of the software and make sure it is a star structure. It is good for the the system to expanse and maintain. In detail, the communication between node A and node B goes in this way: "node A ------control center-----node B".

✧ Constructing control center

Control center is the heart of the system. All the commands come out from it and all the working procedures are figured out here. Control center manipulates from the input of parameters to the building of concrete model for human body, to the building of dynamic model, to the building of partly nonlinear model and later processing model[5]. It is consisted of the following components:

[1] Component Function Trigger: Controller to trigger all the function of the components.
[2] Work Flow Marshal: Configure the work flow of the system.
[3] Distributed Computing Marshal: Configure the distribution of the components.
[4] System Parameter Marshal: Configure the system's runtime parameters.
[5] System Monitor: Monitor the situation when system is running.

Above content presents key steps when developing a distributed computing human sports biomechanics simulating system. It takes quite a long time to develop such a system and needs a software developing mode of waterfall. It accumulates and updates little by little and day by day. We should follow this rule when developing this system so as to guarantee for success.

4 Results

It is sure that we can build a distributed computing application in the field of simulation. There are three modes to build it: .NET、J2EE、CORBA. The best is to use the .NET framework. Use the .NET Remoting to build the communicating channel and inter-invoke mechanism. The practice of the distributed computing human sports biomechanics simulating system proves that: As a result of the developing of hardware and software, the field of simulation will surely develop into a distributed structure.

5 Discussion and Conclusion

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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)

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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.

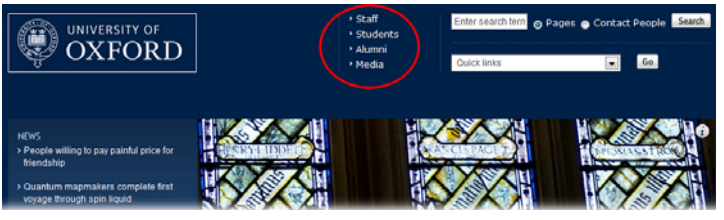

Fig. 3. The homepage of University of OXFORD

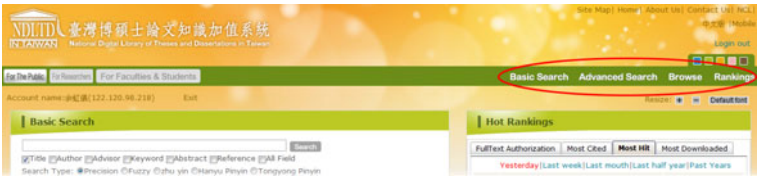

Fig. 4. The homepage of National Digital Library of Theses and Dissertations in Taiwan

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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Friendship Display Medium in Response to Academic Major Influences in Visuospatial Abilities

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Abstract. This study evaluates the effects of display medium (tablet PC, paper-pencil), academic major (design, technology major) and gender on visuospatial ability tests, visuospatial short-term memory test, visual fatigue, subjective preference and mental workload. Sixty university students participated in the study. The results indicate that the display medium had a significant effect on all measurements ($p<0.001$). When using a paper-pencil test, the visuospatial test performance was higher, visual fatigue and mental workload were lower than using the tablet PC test. The interaction effect of display medium and academic major is significant on visuospatial test performance. The design major students performed better on visuospatial ability test but worse on visuospatial short-term memory test than technology major students under the tablet PC test. The gender effect is not significant on all measurements. When assessing visuospatial ability using the tablet PC based test, it should be noticed that the visuospatial ability may be underestimated especial for male testers or design major students.

Keywords: visuospatial ability, visuospatial short-term memory, display, academic major, gender.

1 Introduction

The visuospatial ability, imagining an object's shape while it is rotated and remember the positions of objects and including the cognitive processes of perception, attention, memory, mental imagery, and problem solving [6], is an important ability for some professional tasks, for example, medical students who are learning anatomy [9]. Moreover, the visuospatial ability test has been used for the assessment of cognition ability in neurodegenerative disease patients [1], mental development in children [10] and human intelligence [17]. The "nature" (the biological differences, e.g. gender) and "nurture" (environmental factors which lead to the differences, e.g. education) factors would affect the visuospatial ability performance.

In the early years, males have an advantage on visuospatial ability [16], but the gender differences may be decreasing in recent years [3]. The visuospatial ability can

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be classified into three aspects: mental rotation, spatial perception and spatial visualization [14]. The large gender differences in favor of males were found only on mental rotation [26]. Smaller differences were present on spatial perception [14], whereas for tests in the spatial visualisation, the differences were not significant [26]. Crawford et al. [7] also reported that a decline in gender differences in spatial visualization performance in the past forty years.

Apart from gender effect, Vlachos et al. [24] reported that the effects of educational background was also significant on the visuospatial ability test and the performance was better for technical faculty's students than humanities faculty's students. Moreover, the gender differences on visuospatial ability may be decreasing by academic training. Quaiser-Pohl and Lehmann [19] investigated mental rotation performance in males and females of different academic majors, concluded that the difference of test performance between genders was largest with students majoring in arts, humanities, and social sciences and smallest with those majoring in computational visualistics.

From another point of view, the visuospatial ability is also affected by environmental condition. Chung et al. [6] investigated the effect of 30% and 21% oxygen inhalation on visuospatial cognitive performance, and conclude that more oxygen inhalation enhanced visuospatial performance. Traditionally, visuospatial ability tests were performed with pen and paper [21] due to the ease of administration and existence of well-established normative data [18]. It would be interesting to find out whether the computer-based visuospatial ability test would have a similar outcome as the paper-pencil based test.

The aim of this study is to investigate the possible influences of display medium, academic major and gender factors on visuospatial functioning. The study examined the hypothesis that the pattern of academic major and gender differences in visuospatial tasks may be differential due to display medium factors. Thorough an evaluation of display medium effect would benefit to develop a more refined visuospatial ability test method for different characteristic subjects.

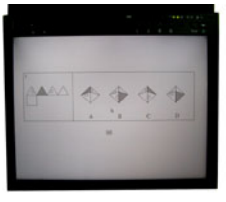
2 Methods

2.1 Subjects

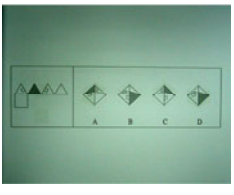
Sixty university students (29 men and 31 women) voluntarily participated in the study. Mean age (S.D.) was 20.4 (1.00) years for the males, and 20.0 (0.78) for the females. Subjects were divided into two groups based on their academic majors. Twenty-seven (13 males, 14 females) subjects who enrolled in the department of industrial design were classified in design group. Another thirty-three (16 males, 17 females) who were science major or technology major students were classified in technology group. They were required to have at least 20/25 corrected vision and without physical or mental problems. They were also requested not to stay up late, take medicine, drink alcohol and any other substance that may possibly affect the test results. All subjects had no previous experience using a tablet PC.

2.2 Experimental Design

Independent variables. This study employed a nested factorial design. The independent variables included gender, academic major (design and technology) and display medium (tablet PC and paper-pencil). The academic major was nested within gender and subject was nested within academic major and gender. Subjects were requested to take both a tablet PC and paper-pencil test. To avoid the differences caused by display medium, all subjects used a touch screen tablet PC for the computer-based tests (IBM ThinkPad, 14 inch screen, visual area 180x245 mm, resolution 1024*768, 16-bit color). The paper-pencil test was prepared in the same format as the computer-based test to minimize the differences between the two. The aspect ratio and the paper size of the paper-pencil test was the same as the tablet PC viewing screen, as shown in Fig. 1.



(A)



(B)

Fig. 1. The illustration of (A) tablet PC test and (B) paper-pencil test in this study

Visuospatial short-term memory test. The visuospatial short-term memory test is the arrow span task [22] (Fig. 2). In each image, a direction is shown by an arrow for one second. After viewing a series of three images, the subject is asked to write down the sequence that the arrows appeared in the boxes. The test score for each task is calculated, with a higher score indicating a better short-term memory. The time required to complete test was also recorded.

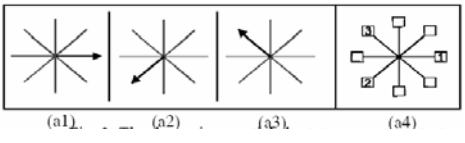


Fig. 2. The three visuospatial short-term memory tests

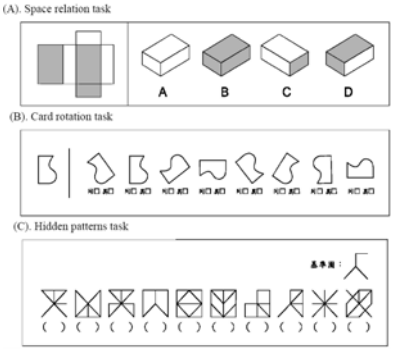


Fig. 3. The three visuospatial ability tests

Visuospatial ability test. The visuospatial test battery includes the space relation test [4], card rotation test and hidden pattern test [8] as shown in Fig. 3. In the space

relation test (Fig. 3(A)), each question consists of a two-dimensional image and four three-dimensional images. The subject should envision the shape of the two-dimensional image after it has been folded, and identify the corresponding three-dimensional image being provided. In card rotation test (Fig. 3(B)), an original image will appear on the left side, and there will be an image of the same pattern after rotation on the right-hand side. The subject is asked to choose if the image on the right is the same as the original, or it is a reflection. In hidden pattern test (Fig. 3(C)), a "standard" image is presented to the subject. The subject is asked to identify if the "standard" image is hidden in each of the presented images. A higher score indicates a greater visuospatial ability.

Visual fatigue, subjective preferences and mental workload. To measure visual fatigue, the critical flicker fusion (CFF) frequency and the subjective eye fatigue were evaluated. The CFF is an effective measure of visual fatigue [25]. It measures the minimal number of flashes of light per second at which an intermittent light stimulus no longer stimulates a continuous sensation. A drop in CFF value indicates a drop in the sensory perception function, attributable to a decrease in alertness. As for subjective eye fatigue evaluation, the Borg CR-10 scale [5] was used. The Borg CR-10 scale is a 10-point scale, with 0 denoting 'nothing at all' and 10 denoting 'almost maximal'.

For subjective preference, a five point scale was used with -2 means "dislike it very much" and +2 means "like it very much". The subjective mental workload was assessed by using the NASA Task Load Index (NASA-TLX) [11]. NASA-TLX is a multidimensional mental workload rating which contains six factors: mental demand, physical demand, temporal demand, performance, effort and frustration level. The workload assessment using the NASA-TLX is a two step procedure. First, the subject evaluates the weighting of each of the six factors through pair-wise comparisons. Next, the subject gives numerical ratings to each of the six factors. The rating scale ranged from 'low' to 'high' in linguistic terms for all factors except for the 'performance' factor which is rated from 'poor' to 'good'. The overall workload score is calculated by the weighted average of the ratings ranging from 0 and 100.

2.3 Experiment Procedure

A standard classroom computer desk and chair were used for experimentation. Prior to the experiment, each subject was instructed about the purpose and procedure of the study, and to fill out a written consent form.

At the beginning of each session, the subject's CFF and subjective fatigue were colleted as a baseline measure for making comparison. Two tests, i.e. visuospatial short-term memory test and visuospatial ability test battery were arranged. The visuospatial short-term memory test does not have a time limit, and the subject continues to write until he/she finishes tests. The visuospatial ability tests include three parts, with twelve minutes given for the space relation test, six minutes for the card rotation test, and three minutes for the hidden pattern test.

In paper-pencil tests, each subject completed the tests with a pencil (Fig. 4(A)). In tablet PC tests, each subject used a touch pen on the screen to complete the tests (Fig. 4(B), (C)). After completing the tests, the test scores and answer times were

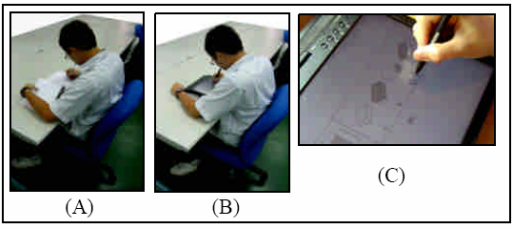


Fig. 4. Subject taking (A) paper-pencil test (B) tablet PC test (C) subject used a touch pen to answer the question on the screen

recorded. In addition, the CFF, the subjective fatigue rating, the subjective preference and subjective mental workload were also taken. After finishing one experiment session, the next one will be scheduled one week later.

3 Results

The summarized ANOVA results are shown in Table 1. The test display medium had a significant effect on all measurements ($p<0.05$ or better). Table 2 shows the corresponding mean values of all measurements for display media, academic majors and gender. As can be seen in the table, the average arrow span task scores for the paper-pencil test and tablet PC test are 78.43 and 72.47, respectively. In other words, the tablet PC test score is about 8% lower than that for the paper-pencil test. The answer time for the arrow span task for the tablet PC is about 22% longer than those the paper-pencil tests.

Table 1. The ANOVA results (n=60)

			Independent variables				
Dependent variables			Medium,(M)	Academic major,(A(G))	Gender,(G)	M*A(G)	G*M
Visuospatial test	Visuospatial short-term memory test	Scores	***			*	
		Answer time	***			*	
	Visuospatial ability test (scores)	Space relation task	***	**		**	*
		Card rotation task	***				
		Hidden patterns task	***				
Visual fatigue	CFF change		***				*
	Subject eye fatigue		***				
Subjective preference			***				
Subjective mental workload			***			***	

*p<0.05, **p<0.01, ***p<0.001

The average score of the space relation task is 38 for the paper-pencil test and is 24 for the tablet PC test. The test score with the tablet PC test is about 58% lower than for the paper-pencil test. The tendency of test card rotation and hidden patterns task scores are similar to that for the space relation task. The card rotation and hidden patterns task scores for the tablet PC test are about 26% and 33% lower than for the paper-pencil test, respectively.

Table 2. The corresponding mean values of measurements under display medium, academic major and gender effects

	Display medium		Academic major		Gender	
	Paper-pencil test	Tablet PC test	Design	Technology	Femal e	Male
Visuospatial short-term memory test						
Scores	**78.43**	**72.47**	74.39	76.31	75.02	75.90
Answer time (s)	**166.07**	**203.02**	189.70	180.32	183.74	185.40
Visuospatial ability test (scores)						
Space relation task	**37.47**	**24.42**	**35.57**	**27.16**	32.70	29.06
Card rotation task	**137.33**	**108.85**	127.65	119.36	121.08	125.24
Hidden patterns task	**128.90**	**96.80**	114.35	111.62	106.56	119.57
Visual fatigue						
CFF change (Hz)	**0.98**	**1.74**	1.24	1.46	1.31	1.41
Subject eye fatigue	**1.50**	**2.48**	1.83	2.12	2.02	1.97
Subjective preference	**0.68**	**-0.43**	0.06	0.18	0.05	0.21
Subjective mental workload (scores)						
	63.17	**67.19**	65.22	65.15	64.19	66.24

Bold face indicates significant differences ($p<0.05$) between levels of a factor for that measure

The increase in CFF change after the tablet PC test is 1.74 Hz which is about 0.98 Hz greater than for the paper-pencil test. Moreover, the subjective eye fatigue rating for the tablet PC test is about 65% higher than that of the paper-pencil test. The mean value for the subjective preference for the tablet PC is negative, which means the subjects do not like to use the tablet PC for performing visuospatial tests. Additional, tablet PC test produces about 6% increase in mental workload than paper-pencil test.

As shown in Table 1, the academic major effect is only significant on space relation task. The test score of design group students is about 33% higher than technology students (Table 2). For two-way interactions, the interaction effect of display medium and academic major is significant on four of the nine response measures as shown in Table 2 and Fig. 5. Changing the display medium from paper-pencil to tablet PC decreases the score of arrow span task by about 4% for technology group and 13% for design group students (Fig. 5(A)). Further, the complete time of arrow span task shows a greater increase in design group as comparing to technology group when the display medium is changed from paper-pencil to tablet PC (Fig. 5(B)). For the test score of space relation task (Fig. 5 (C)), the score decrease caused by changing display medium from paper-pencil to tablet PC for design group is greater than the decrease caused by display medium changed for technology group students. As shown in Fig. 5(D), the subjective mental workload is similar for technology group students under both display media, but the workload increases about 16% for design group students.

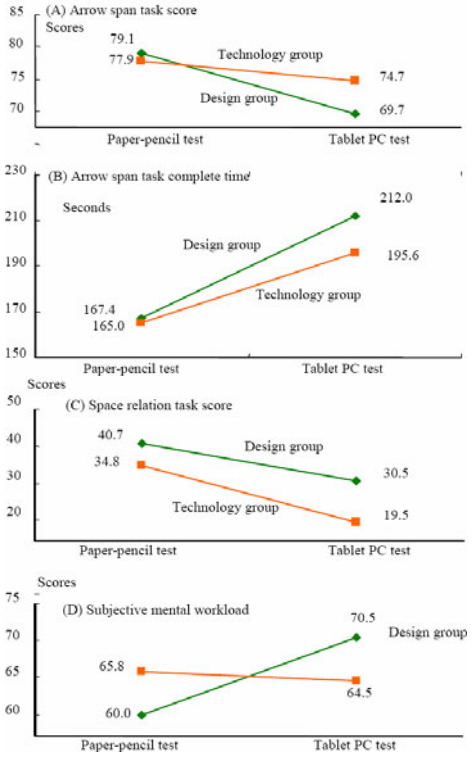


Fig. 5. The effect of medium* academic major interaction on (A) arrow span task score, (B) arrow span task complete time, (C) space relation task score and (D) subjective mental workload

The gender effect is not significant for all measurements. However, the interaction effect of gender and academic major is significant on the test score of space relation task ($p<0.05$) and CFF change ($p<0.05$). Fig. 6(a) shows the gender and academic major interaction on the test score of space relation task. It shows a greater decrease on the space relation task score for males as comparing to females when the test is changed from paper-pencil to tablet PC. On the other hand, Fig. 6(b) shows that the CFF change for female is about 0.3 Hz higher than that of male subjects when using paper-pencil test. The situation is reverse for using tablet PC test that the CFF change for male is 0.5 Hz higher than that of female.

4 Discussion

Present results provided evidence that display medium, apart from gender and academic major, relates to the performance on both visuospatial short-term memory task and visuospatial ability task. The processes of performing visuospatial short-term memory task include perceptual recognition of objects and visual imagery of the reconstruction of objects [2]. In the perceptual recognition phase, the subjects' visual

load was greater for the tablet PC tests due to the higher subjective eye fatigue rating and the greater CFF change and resulting in the subjects' visual perceptive sensitivity decreasing more for the tablet PC tests. Besides, in the visual imagery phase, the luminance contrast and the screen resolution were worse for the tablet PC than for paper and pencil, resulting in decreased visual acuity and visual identification performance. It seems that the screen image quality is still not good enough to process visuospatial material, resulting in a decrease in visuospatial short-term memory performance.

In the study, the visuospatial ability test score tended to be significantly higher under paper-pencil than under tablet PC. This is consistent with the previous findings of Kang et al. [13] that comprehension of verbal material was better for reading from paper than reading from a screen. To perform the visuospatial ability test need not only perceptual recognition and visual imagery but also rotations and translations of visual imagery [2]. These results of the study probably result from the attention decreased more while reading from screen than form paper [23] and manipulation differences between these two test material display media. Although adequate controls were taken to ensure that the tablet PC and paper-pencil tests were similar, there are still some differences. For the table PC test, the subject had to click on an icon to go to the next page, whereas in the paper-pencil test the subject only had to turn to the next page. Additional mental resources are needed to manipulate the tablet PC resulting in a visual imagery translation processing delay and visuospatial ability decreasing.

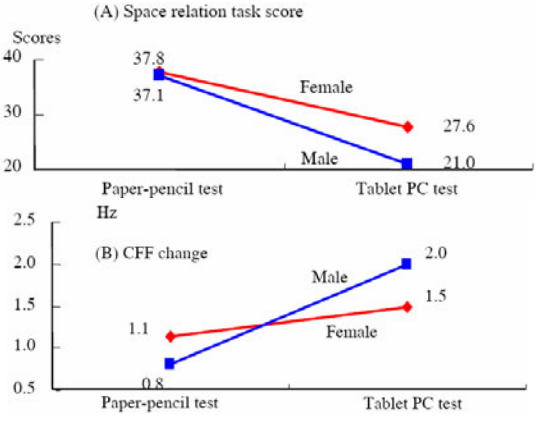


Fig. 6. The effect of medium* gender interaction on (A) space relation task score, (B) CFF change

The industrial design students performed better than the technology major group on the space relation task, where spatial visualization was required [12]. This further supports the notion of undergraduate programs improving specific abilities, such as visuospatial processing, exemplified as perspective taking and looking at mental objects from different angles, which are strategies that are used in the space relation task. Thus, spatial visualization might have been performed well in the design student

group. However, the effect of academic major was not significant on card rotation task and hidden patterns task in the study. Compare with space relation task, the card rotation task and hidden patterns task are simpler [17] and the visuospatial ability training is also included in undergraduate programs of technology major [24]. Thus, the performance of card rotation task and hidden patterns task were similar for both academic groups.

Unexpected findings are that the interaction results of display medium and academic major. Under tablet-PC test condition, the performance of visuospatial ability (space relation task) for design group is better than technology group students but tendency is contrary for the visuospatial short-term memory test. In comparison with the technology students, it seems that the visual perceptivity of design students is more sensitive and the efficiency of perceptual recognition and visual imagery (visuospatial short-term memory test was required) decreases more easily due to the negative effect of display medium. However, because of the effect of academic training, the better performance during visual imagery translation phase (visuospatial ability was required) offsets the loss of perceptual recognition and visual imagery phases and results in better visuospatial ability for design students.

For gender effect, the current study found no difference between the performance of males and females on visuospatial ability, which is consistent with the finding reported by Loring-Meier and Halpern [15] and Weiss et al. [26]. It could be explain by the interaction between academic major and gender. Academic training with more visuospatial related task practice, benefited females more than males and, as a result, reduced the original gender differences in performance [20]. More interesting finding was that under tablet-PC test, the space relation task score for male was lower than female, but the CFF change was greater for male students than female students (Fig. 6). Kang et al. [13] also reported that female subjects had less eye fatigue than male subjects while reading the electronic book. Thus, males' eye fatigue increased more easily than females' and resulted in visuospatial ability decreased greatly.

In conclusion, the current findings show that the display medium effect is more significant than academic major and gender effects. The visuospatial ability test was better administered with paper-pencil than with a tablet PC. This would underestimate the visuospatial ability when using the Tablet PC, especial for male or design major students. An improvement in PC display quality is needed to increase performance and preference in the visuospatial ability test.

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Study of the Influence of Handset Modeling Characteristics on Image Cognition

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Abstract. The influence of handset modeling characteristics on people's image cognition was studied based on the theory of Kansei engineering and using questionnaire and statistical analysis. According to the results-designers can get the corresponding handset modeling characteristics which most fit the ideal Kansei image chosen by the consumers. It's a new way of directing the development of new products' modeling design.

Keywords: handset, modeling characteristics, image cognition, Kansei engineering.

1 Introduction

After years of development, the mobile phone has entered the product life cycle of maturity and has been widely used. Not only is the cell phone a communication tool, but also it carries much things such as the spiritual significance and the social image during the social activity, thus the appearances of the cell phone is a important factor that those consumers consider about a lot. With the development and popularity of the technologies used in mobile phones, similarization in cell phone industry among many brands leads to fierce competition and the consumers could not make their choice easily according to the parameters. In such a situation, the styling of those products plays an important role in the process of the consumers determination.

In the process of design activity, because of the subjective feeling of different people, the judgement of a good design is so difficult to make and the designers may become confused without the design rules. Kansei engineering is a method for translating feelings and impressions into product parameters. Kansei Engineering can "measure" the feelings and shows the relationship to certain product properties. In consequence, products can be designed to bring forward the intended needs and feelings of the consumers which lead to a more sucessful product design. The paper focus on the design of the cell phone ,mainly study the Influence of Handset

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Modeling Characteristics on Image Cognition in the perspective of Kansei engineering, aims at finding the most effective design solution only for the best products that the consumer feels. The sample we chose are the products of NOKIA which are well recognized and familiar, making the research more feasible and reliable .

Group of mobile phone users aged decreases evidently nowadays and the university students are the group of people who use mobile phone a lot and their preferences are quite important for designers and companies. Based on these reasons, we chose the university students as our study participations and tried to puts forward some useful opinions in the perspective of Kansei engineering in mobile phone design.

2 The Related Theoretical Analysis

Kansei engineering is a method for translating feelings and impressions (Consumer's feeling and desires of the target product)into product parameters. It utilizes engineering techniques to detect the relationship between consumer's perception and product features. Quantitative techniques are used in the process of translating people's perception into detailed consumers' attitudes to the products that we designed and sold. In consequence, products can be designed to bring forward the intended feeling. According these design elements worked out before, designers can make their designs much easier and reliable.

Relevant content Kansei engineering concerned about most as follows,

1. Detecting consumers' needs and perception from the perspective of HCI and Psychology.
2. Identifying the design elements according to the consumer's perception.
3. Constructing the HCI system of product design with Kansei engineering.
4. Changing according to the society and consumer's preferences.

Kansei engineering is very useful in the process of studying the relationship between new product design and consumer's psychology .The paper mainly focus on the second content , studying the Influence of Handset Modeling Characteristics on Image Cognition.

2.1 Morphological Analysis

A design unit can be regarded as part of the integrated combination. Such as the lid is part of the coffee pot,and the coffee pot is part of the coffee machine. Tree diagram can show this concept (Fig.1),which can absolutely describe the relationship of hierarchical structure and combination between each units. In addition, Mortenson also proposed combination of basic elements.

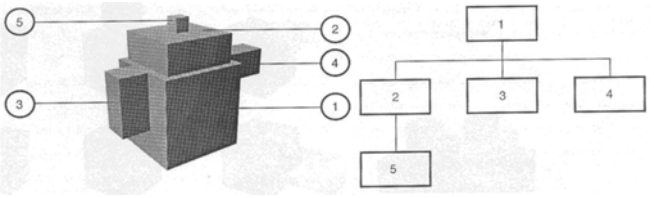

Fig. 1. Method of modality analysis

Morphological Analysis, put forward by Zwicky, is the most easily understood and widely used by designers. the method can create new modelling through arrangeing and combining different the design elements or component. In this paper, we try to deconstruct and classify the morphology of mobile phone samples by morphological analysis.

2.2 Quantification 1

The purpose of Quantification 1 is approximately to reveal functional relation between one variable(purpose variable)and all other "personality" Items (for taking 0 or 1 virtual variable), we determine the intension that each items effect the purpose variable by multiple regression analysis ;many categories compose a item. we assume that all samples will be chosen in every project, and each project only choose one sample to set up a regression formula, which forecast the variability between data and events. The minimum number of testing samples that set up a regression formula can be determined by the following formula.

$$NC= NL-NA+1 \quad (1)$$

NC: the minimum of product's sample that is able to work out a utility values
NL: the number of categories in Total
NA: the Total number of projects in Total

In this paper, each projects that have been deconstructed and classified are transformed into virtual variables by quantification 1,which will form the dependent variables of the multiple regression analysis.

3 Research Methods

3.1 Assessment Project of NOKIA Mobile Phone

We chose NOKIA bar phones of 2006 and 2007 on the market to avoiding excessive research, and collected 44 of NOKIA mobile phone labeled by high resolution face images. To effectively control the error, all images were handled as a monochrome and mobile phone unified same screen mapping.

According to subjective feelings,20 college students divided 44 mobile samples to7 or 8 categories by similarity degree of Morphology, and we recorded a result to get the phase heterosexual isometric matrix of the samples. Classified data was simplified by Multiple scales method, then each samples also were classified by clustering analysis method. At last, all samples were divided into 7 categories, and we chose 7 representative samples, which could represent center variables in the categories (Fig.2).

Fig. 2. 7 representative stimulators chose finally

3.2 Choosing Perceptual Semantic Adjectives in the Project

We widely collected 116 adjectives that could describe the Morphology of mobile phones; after preliminarily testing, we further chose 30 adjectives that could be more representative cognitive ability of participants. then we combined 7 representative samples with 30 adjectives by semantic difference method, and 30 college students took the test, we got the mean that each samples scored in the adjectives. This data were analyzed by factor analysis method and rotated by Maximum variance, we finally obtained 13 perceptual semantic adjectives that could be representative (table 1).

Table 1. 13 pairs of adjectives finally determined

calm-intense	demotic-elegant	leggiere-sedate	grim-amiable	careless-exquisite
popular-individual	common-professional	thin-full	motional-ational	artless-breathtaking
unimaginative imaginative	simple-complex	informal-orthodox		

3.3 Deconstruction and Classification of Product Modeling

Using morphological analysis method to make 44 mobile phone samples being morphology deconstruction and classification, the results include seven projects and 17 categories; Using one category quantification,the project will be converted into dummy variables,dummy variables will be the dependent variable in multiple regression analysis.

3.4 Determining the Number of Product Samples

The minimum number of samples this paper NC =17-7+1=11. As the principle that possibility distributed according to the various objectives for each project number, and the differences between the samples as large as possible,finally selected 12 mobile phone samples, with 13 pairs of representative adjective elected before, then made into a semantic image evaluation questionnaires.

3.5 The Issuance and Recovery of the Questionnaires

The issuance of questionnaires started at JiangNan University. When officially tested, the teachers (contacted before)assisted to distribute and recovery questionnaires at class. Because the question numbers are large and hard to answer, this move will ensure a high response rate and efficiency. Totally about 400 questionnaires were issued, returned about 384 copies, of which 330 are valid, the effective rate was 82.5%. Then use SPSS13.0 to entry and manage data.

4 Discussion about the Research Results

According to the 12 psychological evaluation of projects in 13 cell phone form adjective's score data, and the 12 samples of the modeling elements of disaggregated data, by the quantification one class method and multiple regression statistical analysis, You can get all adjective semantics' modeling elements functional, according to the weight value in functional, you can observe the interactional relationship between each pairs of adjective semantics and modeling elements.

Following this adjective " calm-intense " as an example of the analysis to the statistical results.

Table 2. Regressive equation summary of "calm-intense"

Model	*R*	*R Square*	*Adjusted R Square*	*Std. Error of the Estimate*	*Durbin-Watson*
1	0.968	0.936	0.921	0.59783	1.750

Summary of the regression equation (Table 2) shows the fit conditions, R Square coefficient of determination is equal to 0.921, indicating that the independent variables explain the dependent variable for a high degree, the regression equation fits well; Durbin-Watson is 1.750, closer to 2.0, indicating that there is no autocorrelation of variables [9]. The number of categories of a class project utility values and weights of the situation summarized in Table 3.

Utility values for each category has positive and negative points, negative means popular bias; positive means passion bias, The more negative bias that the more quiet, more positive bias on behalf of the more elegant. For example, make utility values for each category in the top shape (project) from small to large order: -0.677 (flat shape)

Table 3. Category scores of Quantification 1 on "calm-intense"

Project (Items)	A. top shape			B.waist shape		C. body ratio			D.bottom shape		E.screen ratio		F.surface segmentation			G.function position		key
(Categories)	A1 flatt-ened shape		A2 sm-all arc	A3 Gre-at cir-cle	B1 lin-ear	B2 arc-type	C1 th-in ty-pe	C2 mode-rate type	C3 wi-de	D1 sma-ll arc	D2 gr-eat ci-rc-le	E1 hori-zont-al	E2 ver-tic-al	F1 screen/ Keyboarc conjoinec	F2 screen/ keyb-oard separ-ate	G1 wi-th sc-ree-n	G2 In-de-pe-nd-ent	G3 With number keys
Category utility value	-0.917	-0.568	1.486	-1.065	1.065	-0.33	0.15	0.181	0.963	-0.963	-1.766	1.766	-0.53	0.53	-0.442	0.849	1.289	
Item weights	0.181			0.16		0.038			0.145		0.266		0.08			0.13		

Table 4. Relation between part of kansei image adjectives and form characteristics

Number	Adjective	Modelling Element						
		top shape	waist shape	body ratio	bottom shape	screen ratio	surface segmentation	function key position
1	intense	Great circle	Arc-type	wide type	small arc	vertical	screen/ keyboard separate	With number keys
2	calm	flattened shape	linear	thin type	great circle	horizontal	screen/ Keyboard conjoin	with screen
3	elegant	Great circle	Arc-type	wide type	small arc	vertical	screen/ Keyboard conjoin	With number keys
4	demotic	small arc	linear	moderate type	great circle	horizontal	screen/ keyboard separate	Independent
5	sedate	flattened shape	linear	moderate type	great circle	horizontal	screen/ keyboard separate	Independent
6	eggiere	Great circle	Arc-type	wide type	small arc	vertical	screen/ Keyboard conjoin	With number keys
7	individual	Great circle	Arc-type	wide type	small arc	vertical	screen/ Keyboard conjoin	Independent
8	popular	flattened shape	linear	thin type	great circle	horizontal	screen/ keyboard separate	With number keys
9	professional	Great circle	Arc-type	wide type	small arc	vertical	screen/ Keyboard conjoin	With number keys
10	common	small arc	linear	moderate type	great circle	horizontal	screen/ keyboard separate	Independent

<0.328 (small circle) <1.726 (large circle), which can be make out that the great circle most biased of intense, the flat shape most bias calm, while other projects can be the same way. Item weights reflect the design elements relative to the importance of other design elements. The greater its value, the relative importance is greater. For example, the item weight: 0.266 (screen ratio)> 0.181 (top form)> 0.16 (waist shape)> 0.145 (bottom shape)> 0.13 (function key position)> 0.08 (surface segmentation)> 0.038

(the proportion of body), Indicating that to the adjective "calm – intense " , screen ratio has greatest effect, and segmentation and the proportion of the surface and the effects was not significant. Therefore, when designers consider to design calm or intense mobile phone, they should focus on the screen ratio, ratio of body weight and other items with higher modeling elements.

Designers or consumers simply choose the ideal perceptual semantic, can get the product model of the semantic interpretation elements successfully, such as, " passionate mobile phone" modelling element combination for: great arc (top shape) + arc type (waist shape) + moderate type (body ratio) + small arc (bottom shape) + vertical (screen ratio) + screen/keyboard separate (surface segmentation) + With number key (function key position). As the same way, we can get other perceptual semantic mobile modelling element combination. The relationship between partial adjectives semantic and modelling elements is shown in table 4.

5 Conclusion and Limitations

Based on NOKIA cellular phone for test sample and college students for application under test object, using questionnaire and statistics methods according to the perceptual engineering theory construct the corresponding relationship between college students' perceptual semantics and mobile phone modelling elements, for example, "passionate mobile phone" modelling element combination for: great arc, arc type, medium type, small arc, vertical, the screen/keyboard apart, and the number key together. With such corresponding relation, according to the target consumer choice ideal perceptual semantic, stylist can get corresponding mobile modelling elements. thereby designers ensure its design most appropriate to target consumers expect perceptual semantic, and guide new product design as well.

There are also has some limitations in this paper, for instance, we cannot use of mobile phones as objects under test samples, and we have to use such proportion of the plan as the experimental samples; research object is only NOKIA cellular phone, its modelling characteristic brand still cannot cover all mobile phones; test object only for college students, failed to test more crowd, etc. If there is a follow-up study, I hope we can solve the problems above.

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The Effect of Music on Spatial Ability

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Abstract. In the first Mozart Effect study, Rauscher, Shaw, and Ky [1] found that exposure to a Mozart sonata enhanced visuo-spatial task performance. In this study, we sought to examine whether there was such an effect on three spatial ability sub-factors, namely spatial visualization factor (the paper folding test), spatial relation factor (card rotation test) and perceptual speed factor (hidden pattern test). In a between-subject design, 90 participants were exposed to 10 minute periods of a Mozart Sonata, Bach, or silence. After listening to a music stimulus or silence period, participants completed three spatial tests. The treatment conditions did not yield significant differences between groups. The results from all three spatial tests did not support the Mozart effect.

Keywords: Mozart effect, music, spatial ability.

1 Introduction

The Mozart Effect is a well known phenomenon in that listening to Mozart's music may improve spatial task performance. Rauscher, Shaw, and Ky [1] found that 36 undergraduates who had spend 10 minutes listening to Mozart's Sonata for two pianos in D Major (K.448) scored 8-9 points higher on the Stanford-Binet Paper Fording and Cutting (PF&C) test than participants who had listened to "Music With Changing Parts" or silence. However, they also found that the Mozart effect was temporary, having disappeared within 10 to 15 minutes.

Spatial ability plays a key role in many types of reasoning and communication, and is important in domains such as design, mathematics, natural sciences and engineering. Researches have demonstrated that spatial ability is a predictor of success in an engineering graphics design class [2], [3]. For example, tests of spatial abilities are the best predictors of success in engineering courses, particularly engineering drawing [4]. Industrial design is based on technical expertise and creative thinking. Creative thinking involves mental transformation, mental combination and mental synthesis [5]. According to Roth [6], creative thinking, conceptual problem solving and concept generation are associated with spatial ability. Thus, spatial ability would seem to be very important in designers.

Since listening to music can temporarily improve spatial ability, does listening to background music help designers increase their spatial ability and indirectly improve

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their design performance? The purpose of this study was to investigate whether listening to music enhances spatial ability. This study utilizes a between-subjects design similar to that used by Rauscher et al. [1].

1.1 Spatial Ability

It is said that spatial ability is important in designers. However, what is spatial ability? Spatial ability may be defined as the ability to generate, retain, retrieve and transform well-structured visual images [7]. Halpern [8] states that the term "visual-spatial abilities" it is not an easy term to define, because it is not a unitary concept. McGee [9] proposed that there are two factors of spatial ability: spatial visualization and spatial orientation. Spatial visualization refers to the ability to manipulate, rotate, change the position in mind of an object depicted as a picture. Spatial orientation is proposed to measure someone's ability to image the appearance of objects from different perspectives. Thurstone [10] suggested three space factors named mental rotation(S1), spatial visualization(S2), and spatial perception(S3). Mental rotation was described as the process of recognizing an object from different angles. Spatial visualization was imagining the movement of parts of a configuration. Spatial perception emerged as having to do with body orientation. Lohman [7] argues that there are three factors for spatial ability: spatial visualization, spatial orientation, and speeded rotation. Spatial visualization is the ability to manipulate objects in imagination or the ability to comprehend imaginary movements in a three dimensional space. Spatial orientation requires only a mental rotation of configuration. Speeded rotation is the ability by the speed in manipulating simple visual patterns such as mental rotations. According to Carroll [11], the spatial ability sub-factors include: spatial visualization, spatial relation, closure speed, closure flexibility and perceptual speed. Spatial visualization, spatial relation and perceptual speed are frequently mentioned sub-factors.

The most extensively studied factor is the spatial visualization factor [12]. Tests that identify this factor involve "processes of apprehending, encoding, and mentally manipulating spatial forms" (as cited in [13]). The spatial relation factor is similar to spatial visualization. It also requires mental transformations but differ in that it involves manipulations of two-dimensional objects that can be completed in a single step. This factor tends to emphasize speed. Perceptual speed involves no spatial transformations and primarily requires rapid matching of visual patterns. Psychometric tests that identify this factor assess individual differences in the speed or efficiency with which one can make relatively simple perceptual judgments [11]. These three factors are moderately correlated with one another. In fact, depending on the tasks included in the analysis, some factor analysis studies have failed to find a clear distinction between the Spatial Visualization and Spatial Relations factors (Lohman, 1988; Carroll, 1993) (cited in [13]).

1.2 Associations between Musical and Spatial Ability

A number of studies suggested that listening to Mozart's work may temporarily increase spatial abilities. There have been several studies that replicated the Mozart effect study [14], [15], [16]. For example, Rideout and Taylor [15] used the same

Mozart sonata and a relaxation instruction. They found that paper folding and cutting test performances were significantly higher for the Mozart group than for the relaxation group. Rideout, Dougherty, and Wernert [16] compared a Mozart sonata to Yanni Acroyali: Standing in motion and Relaxation condition. They found no difference between Mozart and the Yanni group in spatial performance, but increases occurred for both groups. Rideout et al. [16] argued that music similar to Mozart could also positively affect spatial performance. Under this perspective, a "Bach effect" [17] and "Schubert effect" [18] were also reported.

However, the results have been inconsistent, with some studies reporting that they were unable to reproduce the Mozart effect (e.g. [19], [20], [21]). For example, Kenealy and Monsef [22] were unable to produce a Mozart effect when the measurement tests were the paper folding and cutting task. Stough, Kerkin, Bates, and Mangan [21] reported no Mozart effect when the dependent variable was the Raven's progressive matrices test. Newman et al. [20] found that there was no evidence for the Mozart effect in their experiment. The results from their studies showed that participants assigned to the Mozart group scored only slightly (0.06 points) higher than participants assigned to the relaxation instruction group and only marginally (0.15 points) higher than participants in the silence group. These differences were not statistically significant. Hui [23] investigated the Mozart effect in preschool children using a maze test. His data showed no difference between the Mozart group and two control groups, also failing to support the Mozart effect.

There is no consistency in the literature regarding the relationship between music and spatial task performance. Rauscher and Shaw [24] explained that the reason for the inconsistency is that the Mozart effect only applies to spatial temporal tasks. Further analysis of the data from Rauscher et al. [1]showed the participants' scores on the paper folding task were significantly higher after they listened to Mozart sonata, but the Pattern Analysis task and Matrices task did not differ in three listening conditions. These results suggest that exposure to music may affect spatial temporal tasks but not other spatial tasks. Rauscher and Shaw [24] argued that two components of spatial temporal tasks: "spatial imagery" and "temporal order" are essential for the Mozart effect. In addition, some studies tried to replicate the Mozart effect using the Minnesota Paper Form Board Test. For example, Carstens, Huskins, and Hounshell [19] failed to found the Mozart effect. The researchers noted that the Minnesota Paper Form Board Test involves the mental rotation of two dimensional figures, making it a "Spatial Orientation" test. The Paper Fording and Cutting tasks used by Rauscher et al. [1] in their study were "Visualization" tests [19].

2 Method

2.1 Participants

A total of 90 undergraduate students (45 male, 45 female) were recruited from the National Kaohsiung Normal University, Taiwan. All of the participants were from a non-design background (i.e. from Industrial Technology Educational Department, Optoelectronics Communication Engineering Department, and Software Engineering Department). Participants in this research were randomly assigned to one of three groups: a Mozart group (n = 30), a Bach group (n = 30), or a silence group (n = 30).

2.2 Materials

Mozart's Sonata for Two Pianos, K.448 and Bach BWV 916 were used in the experimental condition. The musical excerpts consisted of 10 minutes from Mozart sonata K.448, or from Bach BWV 916. For the Mozart sonata, we recorded the entire first section (8 minutes and 24 seconds) and replayed it until 10 minutes were accumulated. The Bach BWV 916 was built in the same way.

Three spatial ability tests were used in this study. The spatial visualization factor was evaluated using a paper folding test. The spatial relation factor was evaluated using the card rotation test. The perceptual speed factor was evaluated using the hidden patterns test [25].

Paper folding test: This test consisted of two parts, each of which has 10 items. Participants were required to mentally fold a piece of paper and punch a hole in it. Participants were asked to determine the position of the hole when the paper is unfolded. For each part the participants were given 2.5 minutes to complete the task. The score was the result of the total number of correct answers minus the number of incorrect answers.

Card rotation test: A 2D mental rotation test in which participants were required to determine whether rotated figures were identical to the original figure or were a mirror image. This test consisted of two parts, each of which had 10 rows of eight test figures. The participants were given 2 minutes to complete each part of the test. The score was the result of the total number of correct answers minus the number of incorrect answers.

Hidden patterns test: This test also consists of two parts, with each part containing 200 figures composed of line drawings. Participants were asked to identify whether the model pattern was embedded in each test figure. The participants were given 1.5 minutes to complete each part of the test and asked to respond as quickly and as accurately as possible. The test was scored using the total number of correct answers minus the number of incorrect answers.

2.3 Procedure

Following the completion of consent procedures, the procedure and the purpose of the study were explained to the participants.

In the Mozart and Bach groups, the experimenter told participants that they would hear a music piece for approximately 10 minutes. While the music played participants should sit quietly and listen to the music. In the silence group, participants sat in silence for 10 minutes. A computer with a windows media player was used to play the music for the Mozart Sonata and Bach BWV 916. The music volume was adjusted for comfortable listening. After the listening or silence period, participants completed the paper folding test, card rotation test and hidden patterns test. Before taking the three tests, each participant was instructed to take a tutorial followed by the test. There was a time limit of 5 minutes for the paper folding test, 4 minutes for the card rotation test and 3 minutes for the hidden patterns test. The experiment took an average of 15-20 minutes to complete.

3 Results

The main research question about group differences in the mean scores on the paper folding test, card rotation test and hidden patterns test were addressed using one-way ANOVA with LSD post-hoc test. Table 1 shows the means and standard deviations for the Mozart, Bach and silence groups.

As shown in table 2, the one-way ANOVA revealed no significant group effects on the paper folding test [F (2, 87) = 1.64, p = 0.19], the card rotation test [F (2, 87) = 1.22, p = 0.30], or the hidden patterns test [F (2, 87) = 0.13, p = 0.88]. The ANOVA results indicated that listening to Mozart does not enhance spatial performance and provided no support for the Mozart effect.

When comparing the mean scores for the three groups, participants who were exposed to Mozart and Bach had a higher mean score on the paper folding test in comparison to the silence group. The mean scores were 14.73, 14.57, and 13.60 respectively. The card rotation test and hidden patterns test, however, did not show this phenomenon.

4 Discussion

The treatment conditions (Mozart Sonata, Bach BWV 916, and silence) did not yield significant difference between groups. This is inconsistent with the finding of Rauscer et al. [1]. However, it is consistent with reports from several studies (e.g. [19], [20], [21]). One explanation for not finding a Mozart effect could be related to the use of different dependent measures. The paper fording and cutting tasks used by Rauscher et al. [1] in their study were "Visualization" tests [19]. The most commonly used test of spatial visualization is the paper folding test. In this study, the paper folding test did not produce a significant difference between groups. In conclusion, this study found no evidence to support the Mozart effect. Listening to Mozart's music does not enhance spatial ability.

Table 1. Descriptive statistics for the three spatial tests

	Treatment	Mean	SD	Range
Paper Folding Test	Mozart Group	14.73	2.53	9-20
	Bach Group	14.57	2.84	10-19
	Silence Group	13.60	2.46	9-17
	Total	14.30	2.63	
Card Rotation Test	Mozart Group	91.87	15.85	59-138
	Bach Group	92.17	17.88	54-128
	Silence Group	85.70	20.26	40-126
	Total	89.91	18.13	
Hidden Patterns Test	Mozart Group	127.83	27.52	64-191
	Bach Group	124.33	30.96	53-176
	Silence Group	125.87	19.91	86-162
	Total	126.01	26.28	

Table 2. ANOVA summary for the three spatial tests

		SS	df	MS	F	Sig.
Paper Folding Test	Between	22.47	2	11.23	1.64	0.19
	Within	594.43	87	6.83		
	Total	616.90	89			
Card Rotation Test	Between	799.36	2	399.68	1.22	0.30
	Within	24861.93	87	327.15		
	Total	29261.29	89			
Hidden Patterns Test	Between	184.69	2	92.34	0.13	0.88
	Within	61270.30	87	704.26		
	Total	61454.99	89			

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Toward Understanding the Relationship between Task Complexity and Task Performance

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Abstract. Task complexity has been recognized as one of the most important determinants of human behavior and task performance. This paper reviews the relationship between task complexity and task performance. Influencing mechanism of task complexity is tentatively explored. Then, a conceptual framework is proposed to present the possible relationships among task complexity, task difficulty, self-efficacy, task characteristics, task performer characteristics, and task performance, for the sake of sharing and generalizing scientific findings across different areas.

1 Introduction

Tasks are activities that people should conduct to move their life and work on. As Hackman (1969) argued, "[t]asks play an important role in much research on human behavior, and differences in tasks and task characteristics have been shown to mediate differences in individual and social behavior." [1, Abstract]. One of task characteristics, task complexity, has appeared in numerous studies. Although we could use various tools and techniques, such as automatic machines and computers, to support us in performing tasks, it is undeniable that some our tasks are becoming more and more complex, especially those performed in safety-critical systems. Confronted by more and more reliable tools and techniques, the limitation of human being has been increasingly exposed.

Usually, complex tasks are ill-structured, ambiguous, dynamic, and difficult to be performed. Compared to low-complexity tasks, high-complexity tasks require greater demands on skills, knowledge, cognitive abilities, memory capacities, and task efforts. The complexity of practical problems of decision tasks would prevent people from integrating options, even if they purport to do so [2]. So, to gain a satisfying task performance, we must consider the relationship between task complexity and task performance. On the one hand, it would help us determine whether or not a specific task have an expected performance. On the other hand, it might be possible to predict the direction and magnitude of task complexity effect under the combination of specific tasks and individual differences. In practice, it would improve our ability of staff distribution and effective intervention.

Task complexity has been investigated in fields of goal-setting, decision-making, auditing, learning, human-computer interaction (HCI), and information seeking, retrieval, and searching, etc. Research on task complexity has been reviewed by

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several researchers [3,4]. They primarily focused on the constructs of task complexity. No review on the complexity-performance relationship was found in the literature. This study attempts to fill the gap and to give a better understanding of the relationship.

This paper proceeds as follows. The constructs of task complexity and the differences of several concepts (objective vs. subjective task complexity, task complexity vs. difficulty) are discussed. Four types of the relationship studied in the literature are summarized. Influencing mechanisms of task complexity are tentatively explored. A conceptual framework is proposed to present the relationships among task complexity, difficulty, self-efficacy, task characteristics, task performer characteristics, and task performance and human behavior.

2 Task Complexity

Task complexity has been defined in various ways. However, little consensus existed among researchers who were concerning the properties that make a task complex [3]. Different researchers and studies had a great variation and confounding about the way to understand and to operationalize task complexity [5,6]. As a result of this epistemological problem of task complexity, it is difficult to integrate the findings of task complexity from these studies across different areas, or even in the same area.

Several studies summarized various constructs of complexity [3,4,7-10]. Wood (1986) classified task complexity into three types [5]: component, coordinative, and dynamic complexity. Component complexity is defined as a function of the number of distinct acts that need to be executed and the number of distinct information cues that need to be processed. Coordinative complexity is defined as relationships between task inputs (acts and information cues) and task products. Dynamic complexity is due to "changes in the states of the world which have an effect on the relationships between task inputs and products" [5, p. 71]. In information-intensive tasks, component, coordinative, and dynamic complexity would be interpreted as the amount, relationship, and variation of information, respectively. Campbell (1988) considered four characteristics of task complexity in his review [3]: (1) multiple paths, (2) multiple outcomes, (3) conflicting interdependence among paths, (4) uncertain or probabilistic linkages. Bonner (1994) classified elements of task complexity according to three components of general information processing models [11]: input, processing, and output. Each element of task complexity consists of the amount and clarity of information which correspond respectively to task difficulty and task structure. Harvey & Koubek (2000) proposed a model with three classes of task complexity [12]: scope, structurability, and uncertainty. Their model could be viewed as an extension of Wood's (1986) model. In addition, cognitive effort [13], environmental predictability [14], uncertainty [15], inconsistency [16], priori determinability [9], structure [17], and presentation homogeneity [18] were employed to delineate task complexity. It is acknowledged that the quantity, interaction, and variation of task elements contribute to task complexity [19].

Task complexity is viewed from both objective and subjective perspectives [20]. The former considers task complexity to be directly related to task attributes and independent of task doers [3,5,21]. Subjective perspective considers task complexity

as a conjunct property of task attributes and task doers. This view has been widely-supported by researchers from information domain [9, 22]. Subjective complexity is also termed as experienced, perceived, or psychological complexity. In related scientific research, the "objective" view is dominant. In this review, task complexity is specified as an objective property of tasks. When this term indicates a subjective concept in other studies, it will be prefixed with "subjective".

Task difficulty is always confused with task complexity. They are considered to be interchangeable [15], or two different things [11]. Task difficulty is also classified into two types: pre-task difficulty and post-task difficulty [43]. Essentially, pre-task difficulty that defined as the perceived likelihood of success is similar to self-efficacy [23]. We define task difficulty as the amount of effort task doers have to exert in performing tasks, which is closes to post-task difficulty in [43]. Thus, task complexity and difficulty is two different concepts in this review.

Measurement of (subjective) task complexity/difficulty is another controversial issue. There are no general quantification methods for task complexity measurement. Wood suggested three general formulas for calculating component, coordinative, and dynamic complexity, and a simplified weighted formula for total task complexity [5]. In reality, these four formulas were rarely used for quantification. Several existing quantification methods were just appropriate for specific task types. Elementary information processes (EIPs) was used to calculate cognitive effort (a proxy for task complexity) in decision tasks [13, 24]. TACOM (TAsk COMplexity), which is based on graph entropy in software complexity measure, was applied to measure the complexity of proceduralized tasks in emergency operating procedures of nuclear power plants [25]. A similar method was used to evaluate operation complexity in Spaceflight [27]. In HCI, there are several methods that can be used to quantify task complexity, such as cognitive complexity theory [28] and structured task analysis methodology [8]. In laboratory settings, tasks were usually dichotomously designed as relatively "simple" or relatively "complex" based on constructs of task complexity. Subjective task complexity and task difficulty were usually assessed by self-report scales.

3 Complexity-Performance Relationships

Compared to low-complexity tasks, high-complexity tasks require higher human information processing, which would challenge short-term memory, working memory, and long-term memory [38]. Thus, task complexity would influence task performance; however, such influence is less consistent [29]. The determination of such influence depends on the measurement and operationalization of task complexity, measurement of task performance, other task characteristics (e.g., presentation, task type), and task doer characteristics (e.g., experience, motivation). This review primarily concerns with performing tasks, partly with learning tasks.

3.1 Four Types of Relationships

The effects of task complexity on task performance have been investigated in various areas, including goal-setting, auditing, HCI, decision making, material learning, etc.

According to the literature, the measurement and manipulation of task complexity have a great deviation. Task complexity was assessed by self-report scales [30, 32], production rules [31], or dichotomously manipulated as relatively simple and relatively complex according to pure experience [11,36] or constructs [34]. Task performance was evaluated by completion time, correction rate, decision accuracy/bias, or by self-report scale. Some of these previous studies have associated task complexity with the task doer factors such as job experience [30], gender [16], age [31], leader behavior [32], skill [11], knowledge and accountability [33], or with non-task doer-related factors such as presentation [26,34], and training method [35], time pressure [36] and time availability [37].

The relationship between task complexity and task performance are summarized as follows:

- Negative. A majority of researchers suggested that task performance was negatively related to task complexity [11,10,26,31,34,37,38]. For example, decision accuracy was better under the low complexity condition [10]. Based on Campbell's complexity model with four basic characteristics [3], Jack & Ward shown that the presence of two basic characteristics in combination prompted a significant decrement in task performance compared to the cases when a single characteristic was present [38].
- Positive. Several researchers conceived that there existed a positive relationship between task complexity and task performance [18,29,36,39]. The "positive" view in learning tasks is pervasive [39]. Task doers with expert system acquired more procedural knowledge in complex tasks than those in simple tasks [39]. In team tasks, "an increase in task complexity does have a positive motivational effect through maintaining interest in the performance of repetitive operations" [36, p. 37]. Greater task complexity was consistently associated with greater productivity [36]. In job tasks, a high complexity condition would benefit to strategy quality and development [30]. Female auditors showed greater efficiency on the high complex tasks than on the low complex tasks [16].
- Contingent. In this perspective, the complexity-performance relationship is contingent on and moderated by other factors. For example, task performance declined with increasing task complexity only under combinations of low knowledge and high accountability or low accountability and high knowledge; task performance was unaffected by increasing task complexity when auditors had high knowledge and high accountability or have low knowledge and low accountability [33].
- Inverted-U shape. Notwithstanding lacking enough direct evidences of such relationship, a considerable number of researchers believed its existence [3,5,40]. Driver & Streufert demonstrated several evidences when task complexity was operated as the number of input stimuli [44]. Wood argued that the relationship would possibly have a curvilinear form: increasing levels of complexity might initially lead to higher levels of challenge and activation level and have a positive effect on performance; at a much high level of complexity, however, it might lead to lowered performance, because task demands exceed task doers' capacities [5]. In Bonner's study [11], if we just reconsider the relationship between objective task complexity and task performance in ratio analysis tasks, a significant quadratic

relationship was found ($F(2, 8)=3.20$, $p<0.1$), but not a linear negatively relationship ($F(1,9)=1.43$, $p>0.1$). However, in going-concern evaluation tasks this inverted-U relationship was not significant ($F(2, 5)=8.41$, $p>0.1$). To our best knowledge, the inverted-U relationship is only found between visual (or interface) complexity and performance.

3.2 Influence Mechanism of Task Complexity

As this study summarized, the complexity-performance relationship could be negative, positive, contingent, or even inverted-U shape. So, to gain an explicit understanding of this relationship, the influence mechanism of task complexity should be considered. In most pertinent studies, a high-complexity level had a negative impact on performance. It could be explained by several theories. For example, according to the human information processing model, a complex task is likely to challenge short-term, working memory, long-term memory [38]. In complex tasks the amount of information for processing overruns the capability of human beings, which might lead to the deterioration of human performance.

According to schema theory, for a low-complexity task, task performers would have corresponding schemata in long-term memory to deal with the task; however, for a high-complexity task, task doers would be lack of such corresponding schemata in problem-solving process so that they have to take much time to process and to develop the schemata. However, in complex learning tasks, if they have enough time to process information and to integrate new information with schemata in long-term memory, they would develop new schemata and gain more knowledge acquisition [39].

Activation theory has been used to explain the existence of inverted-U relationship between task complexity and task performance [40]. This theory predicts an inverted-U relationship between activation level and performance. Because activation level is believed to have a monotonically positive relationship with task complexity (operated by the number of stimuli, variation, novelty, etc.), thus, the relationship between task complexity and performance appears to be an inverted-U shape. It is pitiful that a few evidences exist to support the inverted-U relationship between task complexity (except visual complexity) and performance. The existence of *Hawthorne Effect* in laboratory settings may hamper the observation of this relationship.

3.3 A Conceptual Framework

It is difficult to generalize the scientific findings in existing studies. Except the absence of a unified definition and measurement of task complexity, different roles that task complexity plays on performance in existing studies contribute to the difficulty of generalization. Researchers focused on the direct effect of task complexity on performance [38], or the interaction effect of task complexity and other factors on performance [32,34,35], or the effect of task complexity and the moderating effect of other factors [11,34], or the effect of other factors and the moderating effect of task complexity [30,41]. Additionally, the confusion between objective and subjective task complexity also contributes to the difficulty of generalization.

To share and generalize scientific findings from different areas and to understand the mechanism of task complexity effect on performance, a general framework is proposed to present the relationships among task complexity, subjective task complexity, task difficulty, self-efficacy, task characteristics, task performer characteristics, and task performance and human behavior (shown in Fig. 1, the number attached the arrows indicates a path of relationship). Several examples of these relationships have been found in existing studies. Task difficulty can predict task performance and task doer behavior [45]; subjective task complexity and self-efficacy affects task performance [35] [46] (See Arrow 1). Self-Efficacy is believed to be influenced by personality, motivation, and the task [47]; subjective task complexity are determined by task complexity, cognitive ability and task motivation [46] (See Arrow 2, 3, 4). Subjective task complexity mediates the effects of task complexity and cognitive ability on task performance [46] (See Arrow 3→1, 4→1); however, task complexity and cognitive ability affect directly task performance [46] (See Arrow 5, 6). Other characteristics, such as time pressure [36], are believed to influence task complexity and task performance (See Arrow 7,8). To verify these relationships and the mediating effect of task difficulty/subjective task complexity, hierarchical regression analysis [41] or data mining tools [42] could be used.

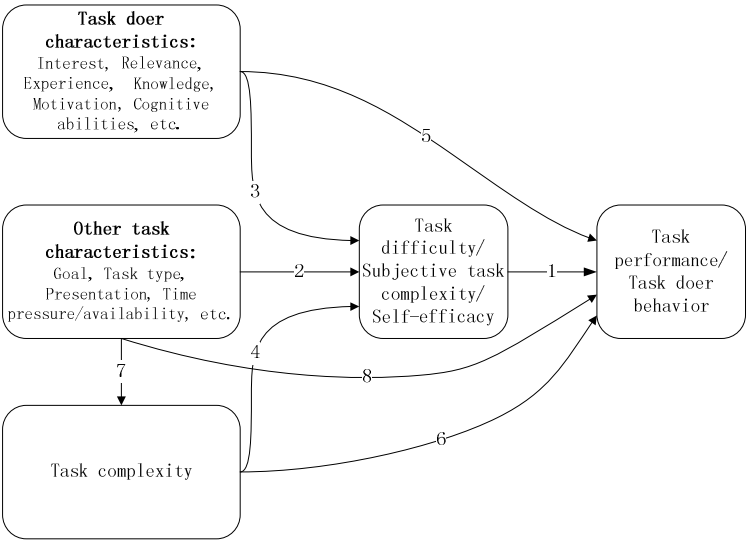

Fig. 1. Conceptual Framework for Studying the Complexity-Performance Relationship

Focusing on the complexity-performance relationship, other factors, such as cognitive abilities, knowledge, and time pressure, could be viewed as moderator factors. It depends on researchers' intentions. This review is interested in the mechanism through which task complexity relates to performance, self-efficacy or task difficulty could be regarded as mediators or moderators. In other research, in which task complexity would be regarded as a moderator, the complexity-performance relationship may not be given. It would be better to provide the complete information so that other researchers could benefit from the shared findings.

4 Conclusion

Accompanying the technological development, specific tasks are becoming more and more complex to be performed and need more cognitive intelligence. For highly reliable systems, the weakness and importance of human beings that confronted by complex tasks have received more attention than ever before. Around the complexity-performance relationship, its type, mechanism, and framework were explored. To minimize the negative effects of task complexity and at the meanwhile to maximize the positive effects of task complexity, future research should go further toward considering the effects of task complexity components on human performance and behavior, the moderating effects of other factors, and the influence mechanism of task complexity.

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A Study of Producing Ceramic Glaze Utilizing Shihmen Reservoir Silt

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Abstract. This study is based on the Shihmen Reservoir silt, where the largest quantity of silt is deposited and is located right next to the National Taiwan University of Art, and with combinations of other simple components, like various kinds of clay, plant ashes or other raw materials, to produce quality glazes that can perform artistic charm and give great additional values. The development of the new glaze formula is processed by the "Triangular Coordinate Method" to organize and distribute proportions of the raw materials and through the practical reconcile and firing experiments to acquire the suitable formulas. This study has successfully produced glazes such as the Oil-spot Glaze, Red Iron Glaze, Red Iron Crystalline Glaze, Golden Black Glaze, Golden Purple Glaze, Amber Glaze, Yellow Glaze, Beige Glaze and Celadon Glaze. In some of these glazes, the employment proportion of the silt can reach up to the range of 80% to 90%. In general, to employ the Shihmen Reservoir as a type of raw material can not only be practical, but possess many distinctive qualities.

Keywords: Shihmen Reservoir silt, Triangular coordinate method,ceramics glaze.

1 Introduction

The landforms in Taiwan are mostly distributed with steep slopes and, in addition to the abundant annual rainfall, severe surface overland flows are caused during the rainy season. In the past three decades, due to the destruction of the upstream reservoir, the erosion of the soil has been increasing each year. According to statistics, the deposit silt in the reservoir has accumulated 14 million cubic meters, which has reached the exact effective volume as the Meandear Reservoir. For the time being of the 70 reservoirs, the volume of deposit silt adds up to a total volume of 470 million cubic meters, which is more than the amount of water that the Feitsui Reservoir can hold[14]. Therefore, the dredging process for the reservoir silt becomes an exceedingly important job; on the other hand, how to find a way to process or reuse the great quantity of deposit silt is also an inevitable issue to achieve.

The silt from the Shihmen Reservoir comes from the debris that washed out from the watershed, which turns out to be the same source of raw material used in the ancient times in China, where they use the deposit silt distributed around the valleys[6]. Therefore, exception of the particular geology status, the chemical compositions of the

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silt, that origin from the reservoir, mostly qualifies all the requirements for the glaze. Presently, the chemistry analysis for the Shihmen Reservoir silt shows[2], that besides the slight lower value of the CaO (can be resolved by adding limestone), the chemistry composition of the silt is very similar to the famous kilns that were well know through out history of China.

The reservoir silt contains large amount of iron oxide, therefore, the employment of the material can only be used to perform maroon or black color glazes. Although the glazes has color limitations, to make capital of the crystalline effects can also perform varieties of glazes. Notable example like the black glazed tea cup from Jianyang Kiln in the Sung Dynasty, the different crystalline effects, including the Yao-change, Hare-fur, and Oil-spot Glaze, shows unique artistic charm[7, 8, 12, 13, 15]. Therefore, the employment of the reservoir silt to the aspect of ceramic glaze has great potentials and can also bring in great additional value effects.

2 Research Purposes

This project is based on the Shimen Reservoir silt, where the largest quantity of depositing silt is located and is located right next to the National Taiwan University of Art, and with combinations of other simple components, like various kinds of clay, plant ashes or other raw materials, to produce quality glazes that can perform artistic charm and give great additional values. Meanwhile, it can also reduce the amount of other raw material put into use, providing another method to resolve the reservoir silt, therefore, contributing to environmental issues. Furthermore, the follow up of this study may also combine with production of tea cups for the "Longquan Tea" in the Longtan area to create a distinctive feature as a cultural creative product for the local region. The importance of this research reflects on the following aspects:

a. Cultural aspect: to continue traditional culture of the Chinese glaze for the "slip glaze" system.
b. Environmental aspect: the employment of reservoir deposit silt into the glaze, besides reducing the dependency for raw material, can resolve difficult preparation issues for the reservoir silt to obtain the double benefit towards the recycling of waste resources. Moreover, the process of producing glaze is also friendly to the environment.
c. Economy aspect: the high efficiency of employing the Shihmen Reservoir silt into glaze can reduce production cost and create great economy effects.

3 Literature Review

Up until today, there has not been any correlated research studies that uses the reservoir silt as an ingredient for ceramic glaze, therefore, this issue intends to possess innovation and seeks as a challenging task to explore.

As for the present employment for the reservoir silt, the most successful employing method is using it as a light weighted aggregate for architectures. So far the Chaio Tung University, Chung Hsing University, Kaohsiung University of Applied Sciences, China University of Science and Technology, Cheng Kung University, Meiho University,

Chung Hua University, Taipei University of Technology has all processed related research and discussions with positive outcomes[1, 3, 4, 5, 9, 10, 11, 14]. According to research: "Employing the fired reservoir silt as an architectural material results in light weighted aggregate that has inner voids and a solid case, light yet receiving an appropriate intensity, which can be made into concrete that is not as heavy; moreover, it is also usable for garden planting. As light weighted, seismic, insulating, and fireproofing as the concrete is, Europe, America, and Japan has already been employing these lightweight concrete to structural or non-structural constructions in the early 20th century." "Employment of the lightweight concrete to architecture can not only increase the insulation for the house, but also cuts back on the consumption for energy resources, therefore, the material demonstrates the concept of 'Green Buildings'. In addition, firing the reservoir silt to make lightweight aggregates not only can consume deposits to increase the water storage capacity for the reservoir, but also supply the insufficiency of the sandstone resource. As the results serve multiple purposes, the employments of this material marked a significant milestone. " The manufacturing development and applications of the lightweight concrete, made from the reservoir silt, has aroused the attention to the industries. On the contrary, the difficulty of obtaining space and establishment for the lightweight concrete factory, the manufacturing process has not been able to take on the practical full-scale production.

The reproduction and research on the black crystalline glaze involves ceramic artists and scholars, which relative results are quite significant. Plenty of ceramic artists focused on the reproduction and development for the black glaze of Jian Kiln; many like the Japanese artists, which includes Ken Andou, Yashushi Oketani, Hirage Kazumichi, Kyousuke Hayashi and Sugihara Motoo, Taiwanese artist, involving Yu-ting Chiang, Chun-ho Li, Kun-ho Chen, Liang-yang Shao, Chin-ying Liao, and Chinese artists, such as Hsaio-hu Mau, Ta Li, Jian-hsing Sun, Wen-tan, and Ping-lung Tsai, all contributed effort to this aspect. But as to experimental results for these artists are mostly considered as a piece of their art creation, therefore, techniques are often held on to the artists themselves. As for academic studies, research content mainly focused on the glaze ingredient analysis, microstructure discussions and so on, but as to the issue of how it is produced and fired, we may still find many questions waiting to be resolve. The physical chemistry process of black crystalline glaze that happens during firing has always been a typical problem of thermal chaos. The glaze which has the exact ingredients may perform an entirely different visual effect due to various firing processes and the different atmospheres within the kiln. According to current reproduction results, the Hare-fur and Oil-spot Glaze have been successfully reproduced, yet the Yao-change Glaze still has efforts to be made for improvement.

As for the present reproduction status for the Jianyang Black Crystalline Glaze, people in China still use traditional ball clay, stone glaze, and plant ashes from the local region. On the contrary, the Taiwan region has a shortage on ball clay and natural resources; therefore, the glaze production relies upon the imports of raw materials or chemical materials. Materials which the Japanese use are more diverse, but some do claim that the source of the materials origin from the Jianyang region. The current overall results show that the reproductions made from China and Japan are more

exquisite than Taiwan, which speculates the possibility of the resource origin being an obstacle in the production process of the black glaze. As mentioned earlier, the formation of the reservoir silt and the silt glaze (the deposit fine soil between the valleys) used in the Jianyang area are quite similar, on the other hand, the ingredient analysis on the two had also came out only in small differences, thus, the reservoir silt indeed is a quality source for the Jianyang Black Crystalline Glaze study. In general, this research is highly innovative and the results are worth expecting.

4 Research Methods

4.1 Research Aspects

This project that is correlated to the glaze research aspect is divided into two portions; the first aspect is to develop a new glaze and the second aspect is the reproduction of the specified glaze.

The development of the new glaze formula is processed by the "Triangular Coordinate Method" to organize and distribute proportions of the raw materials and through the practical reconcile and firing experiments, we will be able to acquire the suitable formulas (Fig. 1, 2) [16]. This process often comes up with unexpected results, providing a unique style of glaze. The using the existing Seger Value of the specified glaze reproduction, like Tea Glaze, Red Iron Glaze, and famous glazes known through out the history of China, are all calculated into weight values of the relative raw materials, then by processing the expansionary experiment of the "Triangular Coordinate Method" to obtain the most suitable formula (Fig. 3,4). This method not only can effectively acquire the specified glaze, but also can lead to unpredictable results.

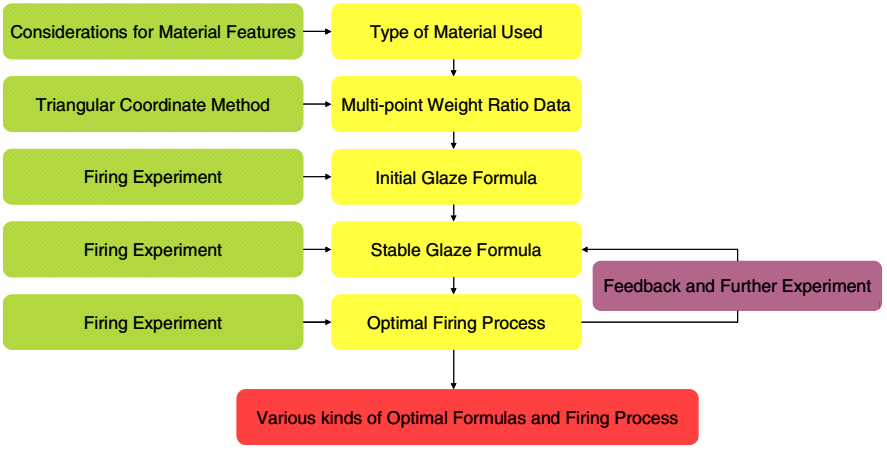

Fig. 1. Experiment Proportion of the Organized Raw Material

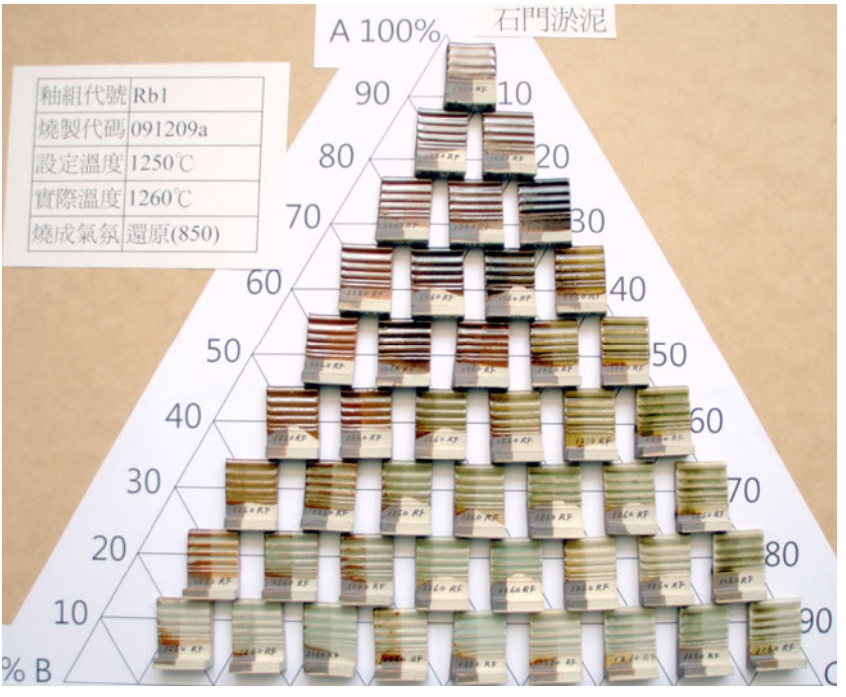

Fig. 2. Examples of the Organized Raw Material Experiments

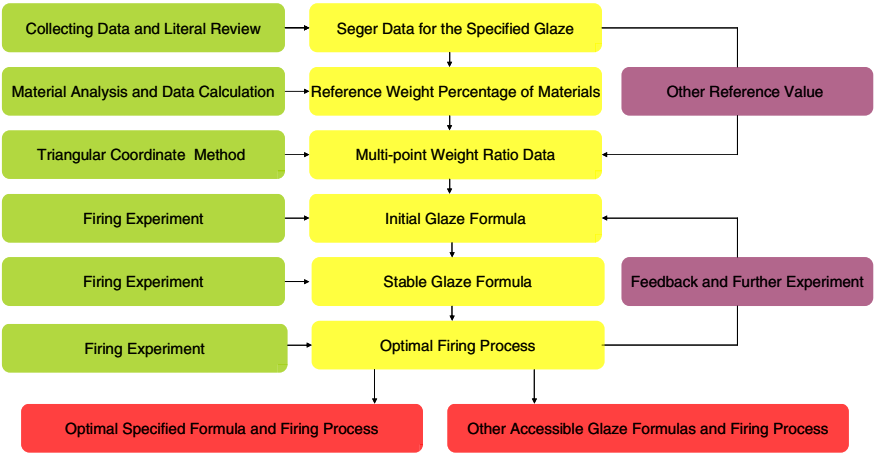

Fig. 3. Recovery Process and Method of Specified Glaze

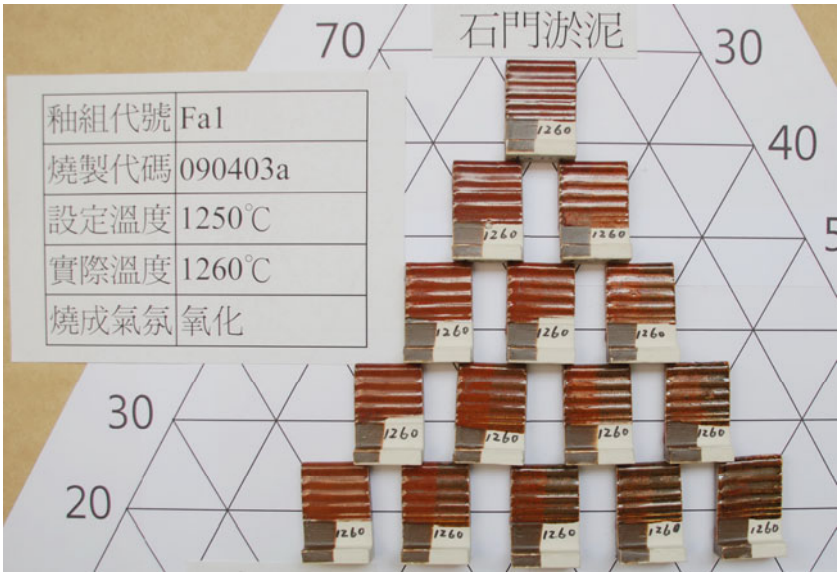

Fig. 4. Examples of Specified Glaze Experiments

4.2 Executive Procedures

a. Reservoir silt preparation process:
   Mining → Screening → Drying → Pluverizing → Calcining.
b. Reservoir silt ingredient analysis: Using the ingredient analysis as the data source for the "Triangular Coordinate Method" calculation.
c. Based on "Triangular Coordinate Method" to create 4 test tiles for each formula at the first phase, and then processing the experiments by firing each individual through different temperatures or diverse kiln atmospheres.
d. Selecting the best test tiles to make discussions and perfection experiments, including adjustments of the formula, the firing temperatures, and the firing process.

5 Discussion and Conclusion

The result and contribution of this research is to provide the ceramic design industry, ceramic industry, ceramic art or schools on how to effectively employ the waste resource as a replacement of the raw materials, moreover, to resolve the important issues concerning environmental destruction and energy depletion.

5.1 Research Results

This study has successfully produced glazes such as the Oil-spot Glaze, Red Iron Glaze, Red Iron Crystalline Glaze, Golden Black Glaze, Golden Purple Glaze, Amber Glaze, Yellow Glaze, Beige Glaze and Celadon Glaze. In some of these glazes, the

Image			
No. Title Fire Temperature Maturation Range Quantity of Silt	db100-a3 Golden Oil-Spot 1290℃ OF 1260～1300℃ 65%	rc105 Leopard Oil-Spot 1290℃ OF 1250～1290℃ 80%	rc105 Purple Temmoku 1290℃ OF 1250～1290℃ 80%
Image			
No. Title Fire Temperature Maturation Range Quantity of Silt	da138-1 Black Temmoku 1270℃ RF 1240～1280℃ 50%	da112-1 Golden Purple 1270℃ RF 1240～1280℃ 50%	fa119 Iron Red Crystalline 1265℃ OF 1230～1270℃ 40%
Image			
No. Title Fire Temperature Maturation Range Quantity of Silt	rb149 Light Celadon 1270℃ RF 1240～1280℃ 10%	rb149 Light Yellow 1270℃ OF 1240～1280℃ 10%	dc118 Amber 1280℃ RF & OF 1240～1290℃ 50%

employment proportion of the silt can reach up to the range of 80% to 90%. In general, to employ the Shihmen Reservoir as a type of raw material can not only be practical, but possess many distinctive qualities:

a. Reservoir silt glaze is classified in the category of natural silt glaze, which involves more variety of trace elements and people generally consider it as a support to the performances of the glaze color and texture. According to practical results, we find that even though the Shihmen Silt Glaze production carries a smooth surface, it still preserves a reserved, implicit sheen and possesses a fine variation effect.

b. From present observation of the experimental results, the combination of the reservoir silt with feldspar, limestone, rice husk ash, and a few other materials, can create a diversity of tone, sheen, and crystalline effects for a quality glaze. And through the manipulation of the atmosphere in the kiln, whether by oxidation firing or reduction firing, we can retrieve more variation for the glaze to perform full extent.
c. Based on experiment statistics, the maturation temperature of the glaze, which mainly contains reservoir silt, has quit a large range (from 40~50℃ or higher), therefore, uneven temperature within the kiln seldom becomes a cause for failure.
d. On the aspect of material preparation, to employ the reservoir silt to the ceramic industry can almost leave out traditional process of water tossing, the screening procedure only needs to eliminate a small portion of sand grains. According to practical executing experiences, the Shihmen Reservoir silt has more than 95% of the content that can be taken into good account, moreover, the preparation procedures are not as complicated. If mass production is possible to achieve, the prime cost of the silt will be much more efficient to the economy benefit.
e. As for the succeeding glazes, with the formulas, which uses the similar modern raw material that relates to the calculation of the "Seger Method", we can find the conclusion where the Shihmen Reservoir Silt Glaze can reduce the needs of diverse raw materials, furthermore, making significant impact on narrowing down the time and labor cost.

5.2 Promotion and Employment Values

a. Research Contributions

1. To arouse the industry with the idea of local waste resources by combing local resources with the creative industry; further on, expanding the horizons of culture and economy.
2. To find another solution for the prompt depositing silt and, meanwhile, reduce the ceramics dependency for natural ore. By this way, we can fulfill actual environmental protection and become a classic industrial icon.
3. Transforming the waste materials into beautiful ceramic decorations, therefore, stressing both environmental protection and aesthetic values to full extent.
4. Using Taiwan raw materials to create a local ceramic industry feature.
5. To establish a new employment for the traditional industry, developing a broader possibility either for production techniques or marketing demands.

b. Employment Strategy I: Creating Local Creative Merchandises

1. Tourist Souvenirs: To develop a series of goods which will unite with tourist attractions and sells within souvenir shops. Ceramic industry has always been closely related to the natural environment resource, examples such as ball clay resources and fuel resources. Employing the Shihmen Reservoir silt to ceramic craft, can not only provide environmental value, but is also an intimate combination with the features of the local raw material. Slogans such as "Take the…..soil home!" or "Sending you a handful of the……soil" will be quite an attractive souvenir to take home.

2. Longtan Tea Ware: The Shihmen Reservoir is located next to the Longtan Town, which is well known for its Longtan Tea. Uniting the sophisticated Shihmen silt tea ware with the famous "Lontan Tea" will absolutely make great improvements to the quality of diet as well. In general, to create a series of creative culture product that involves a local look.
3. Shihmen Fish Tableware: The Shihmen has a very famous reputation for its fish dish, but has also faced a severe problem of competition. Many restaurants have superior cooking expertise, but compromises with unattractive or even extremely poor quality tableware. If it is possible to create exquisite ceramic tableware with the employment of the Shihmen Reservoir silt, the quality of diet will then be enhanced, promoting a higher enjoyment level for the gourmet feast.

c. Employment Strategy II: Development of Merchandise with Quality Glaze

1. Reservoir silt glaze is classified in the category of natural silt glaze, which involves more variety of trace elements and people generally consider it as a support to the performances of the glaze color and texture. According to practical results, we find that even though the Shihmen Silt Glaze production carries a smooth surface, it still preserves a reserved, implicit sheen and possesses a fine variation effect. On the contrary, the performance of modern material, such as stains, provides more of a cold, monotonous sense of feeling. Therefore, the successful results in this research is proven to be worthy of developing a series of distinctive products which emphasizes the beauty of the glaze.
2. Ceramic is multidisciplinary aspect of professional knowledge and techniques, including chemistry, physical thermodynamics, aesthetics, and artistic techniques. Although modern ceramic artist are expertise in sculptural creations, exploring the ceramic aspect from a different point of view, finding the perfect glaze for their creation is frequently quite a difficult task to achieve. "Shihmen Slip Glaze" can be a cooperation project with these artists, either developing or producing ceramic art works with the reservoir silt, but still emphasizing each individual artistic statement and style. Therefore, creators may resolve their desire for certain glaze and can put more focus into their creation. In short, the coordinated relationship rests in harmony.

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Reading Chinese in e-Book Readers: A Review

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Abstract. In this paper, a comprehensive review of related studies concerning reading Chinese in eBook readers is presented. This review aims at finding out related factors influencing the reading performance on eBook readers, especially for Chinese readers. The result of this paper could be useful for designing appropriate eBook readers to Chinese customers.

1 Introduction

An electronic book (also e-book, eBook, digital book) is a "text- and image-based publication in digital form produced on, published by, and readable on computers and other digital devices." [1]. In comparison to conventional printed books, Ebooks have several advantages. The electronic version does not only provide a new method of publication, but also is environment friendly. Ebooks are much more efficient than printed books from various perspectives, such as storage, transfer, and delivery [2].

Besides personal computers and mobile phones, eBooks are often read on dedicated eBook reading devices (e-Readers). Currently, there is no strict definition concerning e-Book readers. In this paper, e-Book readers are defined as a handheld device on which e-Book is readable. An e-Book reader can be identified by the following characteristics: light weight, portable, and low-power consumption. In recent year, a number of e-Readers have been launched in the market, such as Kindle DX, Hanvon, iPad etc. Those e-Readers can be roughly classified according to their display characteristics, such as display size, resolution, paper-like characteristics, and so on. Due to these characteristics, the e-Book readers provide an ideal solution for reading-intensive tasks, especially for those e-Readers with paper-like electronic paper displays [3].

Only in mainland China, Chinese e-Reader market has entered the rapid development stage since 2009. The sales volume of e-reader in China exceeded 300,000 with the market scale of about CNY 450 million in 2009, and it is promising that an increase of the sale for e-Readers is huge in the coming years [4]. However, most of the e-Readers developed out of the mainland China and Taiwan do not support Chinese language quite well. For instance, Chinese fonts are not easily installed or used in those e-Readers. In addition, there are still some design factors remained unknown for designing a suitable e-Reader for Chinese readers.

Reading Chinese differs from reading other alphabetic orthographies in many special features, such as the fundamental linguistic unit, the relative transparency of the orthography, and the orthographic boundaries between units [5, 6]. Previous

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research has been done and contributed on the legibility and readability from different types of displays, such as computer displays, mobile devices, dynamic line displays, etc. Only a few studies have been contributed to Chinese e-Readers. In this paper, special technical requirements for e-Readers will be analyzed by reviewing studies on different displays, especially for e-Readers.

The structure of this paper is organized as follows: in Section 2, several basic definitions concerning reading performance are addressed at first, and then different measurements regarding reading performance are classified and analyzed into different groups; in Section 3, several linguistic features in Chinese will be summarized and described in comparison to alphabetic languages (e.g., English); in Section 4, different factors influencing performance of reading Chinese on different displays are collected and classified according to their hardware dependency and task dependency; in Section 5, some design suggestions are proposed in order to improve current Chinese e-Readers' design in the future.

2 Reading Performance

2.1 Basic Definitions

Before the discussion on key factors influencing designing Chinese e-Readers, there are several important basic terms used in previous studies for assessing different reading tasks on different displays. Those terms are general concepts or basic definition framing the discussion in this paper, and they are: reading, legibility, readability, and visual fatigue.

In Rayner and Pollatsek's work [7], reading is defined as:

Definition 1. Reading is the ability to "extract visual information from the page and comprehend the meaning of the text."

The reading performance can be analyzed from different aspects, and it is closely related to two issues from the script aspect: legibility and readability.

Legibility is defined in [8] and [9] as:

Definition 2. Legibility refers to "the degree to which text items can be identified".

Readability is defined in [10] and [11] as:

Definition 3. Readability refers to "the ease or difficulty with which the meaning of the text can be understood".

Legibility and **readability** are two terms indicating the user's perception while completing certain reading tasks. The former one indicates how easy a text item can be identified, while the latter one indicates how easy the text can be understood. Both terms can generate potential influences on the usability of a given text displayed on a given screen.

Besides reading performance, another objective measurement is often used to assess reading operations by combining reading activities and display factors, and that is so called visual fatigue. It is defined as [12, 13].

Definition 4. Visual fatigue refers to phenomena related to intensive use of the eyes. It includes complaints of eye or periocular pain, itching or burning, tearing, etc.

"eyestrain" and "asthenopia" are used as synonyms of visual fatigue to characterize the pain, discomfort, or fatigue in and around the eyes.

2.2 Measurements

Several measurements are used for measuring reading performance. The evaluation of reading performance includes different aspects, such as reading speed, searching speed, accuracy, comprehension, fatigue and preference [6, 14]. Different reading task types have different requirements for reading performance, and different aspect of reading performance is actually influenced by different factors. Therefore, the contribution of the different factors should be analyzed according to different reading tasks.

Different reading tasks are required to be performed, and those task related factors are not distinguished well in previous researches. Normally, the tasks can be roughly classified into browsing tasks (searching tasks, target searching tasks) and reading tasks. Different tasks have different requirements for readers engaged in those reading activities; and therefore, different tasks might use different performance index to assess the reading performance. Generally, for a searching task, two measurements are used for evaluating the reading performance: searching time and searching accuracy; for a reading task, two similar measurements are used for evaluating reading performance: reading time and comprehension scores.

Visual fatigue can also be assessed objectively for different reading tasks. Seven quantitative methods have been summarized and compared for their sensitivity to visual load in [15], and those methods are accommodation power, visual acuity, pupil diameter, critical fusion frequency (CFF), eye movement velocity, subjective rating of visual fatigue, and task performance. CFF method has been used in the literature for assessing visual fatigue of reading on an electronic paper display [16, 17].

Besides the objective measurements, some subjective measurements are also used in the literature for measurement subjects' preference and their reading experience. Some questionnaires were designed towards the presented conditions.

3 Reading Chinese Versus Reading English

Most previous studies used English as the experimental text for reading. English belongs to the alphabetic system, and it is different from Chinese which belongs to the logographic system. The differences between Chinese and English result in limitations of applying conclusion derived from studies on reading English on displays, and the special features of reading Chinese can provide us some fundamental guidelines for designing a Chinese e-Reader.

3.1 Spatial Complexity

Words in English are com-posed of roman letters. These letters consists only a small number of strokes. Hence, the spatial complexity of them is relatively low. Meanwhile the spatial complexity of these letter are relatively uniform, and can be easily distinguished as a stimulus set in which it contains a set of style features. Similar to roman letters, Chinese characters are composed of a number of strokes as

well. However, the number of strokes varies greatly among different characters, from 1 up to 32 [18]. Therefore, the spatial complexity is relatively higher than Roman letters.

3.2 Font Style

Besides the spatial complexity caused by the great number of strokes, font style is another factor deciding the appearance of the language on a display. English and other western languages are composed of alphanumeric letters in one dimension. The presence and absence of a limited subset of features can create different font styles in English.

In contrast to English, Chinese characters displayed in a two dimensional manner, and they are composed of radicals with or without stems [19]. Only an alphabetic letter is meaningless in a complete English sentence. However, in Chinese, radicals are usually derived from simple Chinese character in order to indicate the attributes or partial meaning of the character, while the remaining part of the character, so-called stems are used to indicate the pronunciation or some other attributes of the character, which means a Chinese character might convey much more meaning than an English word.

3.3 Segmentation of Chinese Words

Words are regarded as the basic meaningful element unit of a language. In English, different words are separated by providing spaces in-between to assist readers to segment them. However, in Chinese, it is totally a contradictory situation: there are no spaces between the words to segment different meaningful parts [20].

3.4 Eye Movement

Besides linguistic differences between English and Chinese, different behaviors in eye movement provide additional evidence for designing Chinese reading environment. The effective vision region covers 1 character to the left fixation to 2-3 characters to the right of fixation when reading Chinese from left to right, while the region covers 3-4 letters to the left fixation to about 14-15 letters to the right of fixation, which is larger than that in reading Chinese. Furthermore, the average gaze range for reading Chinese is about 2.6 characters and 7-8 letters for reading English.

4 Key Influencing Factors

In this section, related factors which have been taken into account in previous studies are collected from previously published papers. Google scholar was used to find related articles published in this area. “Reading”, “Chinese”, “legibility”, “readability”, “electronic paper”, and “e-Book reader” are used as keywords for searching related articles, and only paper with high relevance are collected for this review. Several important papers were selected according to their relevance. Related factors (or variables), reading tasks, reading performance measurements, and displays used in the experiment are listed in Table 1.

Table 1. Different influencing factors for reading Chinese

Ref	Related factors	Reading task	Reading performance	Display
[3]	Display medium Light source, ambient illumination polarity, font styles	A series of target search task	Searching performance Visual fatigue	Ch-Cl display, E-ink display, and conventional paper
[6]	4 resolution displays, 6 character sizes	1. Visual searching task; 2. Reading task: 24 text excerpts	Reading speed, Searching speed, Subjective evaluation	Display of mobile phone
[14]	Book type, gender	Ten nouvelettes	Reading speed, Reading accuracy, Eye fatigue	Electronic paper display
[21]	Font type, character size, column setting, line spacing, display polarity	16 simple passages	Reading effectiveness	15-in color CRT display
[22]	Leading speed, presentation mode	Static Chinese character search task ; A leading-display Information reading task	Static search score, Comprehension	Sony Ericsson P910i mobile phone
[23]	Screen type, character size, text/background color combination, whole body motion	Search for and identify the specific buttons and Chinese characters	Searching time NMCB, Visual fatigue	17-in LCD and CRT
[24]	Display screen type, Chinese typography, text/background combination, speed, jump-length	72 paragraphs with about 120 words	Proportion of errors	CRT, LCD displays
[16]	Light source, display medium, ambient illumination, character size	A series of letter-search task	Searching performance visual fatigue	VGA e-Reader, E-ink reader
[25]	Surface treatment, illumination level, radius of curvature	A series of letter-search task	Searching performance visual fatigue	simulated electronic paper
[26]	Display type, light source, ambient illumination, interline spacing, character size	A series of letter-search task	Searching performance visual fatigue	Ch-Cl display, E-ink display

From Table 1, different factors were investigated in different experiment for different purposes. These factors can be classified by following two different approaches according to their task dependency and hardware dependency. According to the hardware dependency, those factors can be further divided into two groups: hardware-related factors and software-related factors. In addition, if considering the task dependency, those software-related factors can be further divided into different subgroups according to different task types.

4.1 Hardware and Software Related Factors

Hardware-related factors are the factors determined by the producer of the display, while software-related factors are the factors determined by the software developer.

In the literature, different display medium has been investigated for reading Chinese, such as mobile phones, small leading displays, electronic papers, LCD, and CRT displays. Although some of them (CRT) are far different from display medium in e-Readers, there are still some information useful for designing an e-Reader. From the investigation, it is observed that some variables are totally determined by the technical specifications of a display, such as, display resolution, refresh rate, color performance, lighting mechanism, and so on.

Some conclusions have been drawn in previous studies concerning the effects of display types. In [26], it was found that searching accuracy of electrophoretic electronic ink display was greater than chlorestic liquid crystal display; in [6], significant differences were found relative to resolution for text reading tasks, and the combination of resolution character size was found influencing the target searching speed significantly.

Besides hardware dependent factors, there are still lots of factors determined by the configuration of software. Those software-related factors can be easily adjusted according to display specifications, and these factors include: font type, character size, text/background color combination, column setting, inter-line spacing, jump length, leading speed, polarity, etc. These factors can be set as default values for configuring the software in order to provide an easy configuration and nice reading experience.

4.2 Task Dependent Factors

In previous studies, different tasks were carried out to evaluate different aspects of an eReader configuration. Generally, the tasks can be classified into searching task and text reading task. The target searching task asks the user to locate the specific character or word on the screen rapidly and accurately, while the reading task gave different reading questions or assignments to the user to evaluate their comprehension after reading the text from the display.

As discussed in the literature, legibility is relatively more important for the quick browsing task (searching task), while readability is relatively more important for understanding the meaning of the text. However, currently, it was declared in [6] that both factors were not able to be distinguished simultaneously. In this section, related factors are summarized according to the conclusions drawn from previous high relevant studies. The summery is shown in Table 2.

Table 2. Task dependency of different factors investigated in the literature

Task types & Measurements	Font type	Character size	Text/background color combination	Column setting	Interline spacing	Jump length	Leading speed	polarity	Ref
Reading speed	x	x		x	x			x	[21]
Reading Comprehension		x							[21]
			x			x			[24]
		x					x		[22]
Searching speed		x							[6]
		x							[16]
		x						x	[3]
		x			x				[26]
Searching accuracy		x							[16]
		x			x				[26]
Legibility	x	x							[19]

From Table 2, it is observed that different measurements are influenced by different factors. Sometimes, the combination of different factors could also affect the reading performance in a reading task [6]. And obviously, for reading tasks and searching tasks, different type setting parameters can generate different influences. Therefore, the findings from the literature demonstrate certain guidelines for designing the user interface for an eBook reader. For different tasks, those software-related factors should be carefully designed according to different tasks.

4.3 Research Limitations

At first, traditional Chinese was used in most of the previous studies for evaluating the Chinese reading performance. However, simplified Chinese has deployed its application in mainland China with a population about 1.4 billion. In comparison to traditional Chinese characters, simplified Chinese characters are converted from traditional Chinese characters, and have less number of strokes, especially for some very complex characters. The simplification decreases the spatial complexity of traditional Chinese, and it might have some potential influence on the readability and legibility of Chinese languages.

Secondly, until now, the legibility of only three types of font styles (Ming, Kai, Li) has been evaluated in [19] for traditional Chinese, since those three types are the earliest developed in Chinese calligraphy. Besides those three types of font styles, there are more than dozens of different font styles used for computer display. The other types of font style should be selected further to evaluate their readability and legibility for different reading tasks.

Thirdly, for paper-like displays, only target searching tasks have been carried out for assessing effects from a limited number of variables, such as character size, display type, interline spacing [3, 16, 25-29]. The other type setting factors have not been involved in any experiment evaluation for intensive text reading tasks.

Forth, the standardization of reading content is still missing for evaluating the reading performance. It is believed that different reading content might locate at different difficulty levels for the reading comprehension. In different studies, different reading contents were used for reading performance of the subjects. However, if those reading contents or experiments can not be standardized or normalized, the conclusion from different research studies might be contradictory. Therefore, how to set up a standard experiment procedure with a standardized reading task might be interesting for the further research.

5 Design Suggestions for Chinese e-Readers

After reviewing previous researches on reading Chinese on different displays, we would like to propose several suggestions for designing e-Readers for Chinese readers.

- Classification of design variables. It is admitted that there are lots of factors influencing the final reading performance of the reader. Those design variables should be classified according to their nature. Since the hardware system (display) has already determined lots of hardware related parameters. Much more attention

needs to be paid on other software-related factors. In addition, task dependency should be considered while designing the reading interface.

- Default configuration. Default configuration is necessary for an e-Reader to display the text in a default manner. The default manner should satisfy the common users for intensive reading tasks. The default configuration for reading Chinese on e-Readers is one of possible research directions in the future.
- Free type setting appearance. Although font types and character size might influence the reading performance statistically, each individual user might have his or her reading preference. To respect the individual preference, a free type setting appearance is strongly recommended to allow users to set up their individual e-Readers according to their own preference.

6 Conclusion

E-Book readers, they are mainly used for intensive text reading tasks. In this paper, a comprehensive review was carried out on previous research work on reading Chinese on different displays, since there are only a few papers about reading performance on e-Readers. The factors engaged in previous research are classified and discussed according to their hardware dependency and task dependency. Limitations in previous research and further suggestions were also presented in this paper for guiding the design of e-Reader for Chinese users.

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Service Design about the Recycle System of College Bicycles

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Abstract. Abandoned bicycles on campus may not only occupy the bicycle parking, but also a waste of resource. Green design provides a way to solve this problem. With the college students in Wuxi as survey objects, we designed a bicycle service system which was based on the use of abandoned bicycles, some methods are used in our investigation such as interview method, simulation method, statistical analysis method and questionnaire method. It is a school oriented system with the enterprise's support, and all the students can participate in. Techniques of Internet of Things are adopted to combine the existing the One Card through of the School (OCTOS) Network with banks. Meanwhile, Mobile Communication Technologies are adopted to connect our service system to communication terminal equipment which can help diversify payment query modes to provide real convenience for users. This system consists of some multiple subsystems like recycling system, maintenance system, rental system, interaction system and visual system. We hope that the school resources can be sustainable utilized including the bicycles, and students, school, enterprise, environment will benefit from this system. Also we are trying to give a suggestion to the school about the resources recycling.

Keywords: college bicycle, recycling, service system.

1 Introduction

Today as the environmental problems and the energy problems are increasingly prominent, the idea of sustainable development is widely appreciated. And actually sustainable design is to take the idea of sustainable development into the realm of design. Specifically, sustainable design is different from the general meaning design for the purpose of product output. The ultimate goal of sustainable design is to satisfy consumers' specific needs through the integration of products and services to construct sustainable solutions, instead results and benefit of the consumption of material goods, as well as reducing resources consumption and environmental pollution, changing people's social life quality [1]. In such a situation, products and services system (PSS) become a new idea and a new way to realize the sustainable development [2]. In recent years, many domestic universities move to the suburbs, so bicycles become students' commonly used vehicles. Due to the large bike purchase and use every year, the university campus leaves a lot of graduates' abandoned or

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stateless bike. Such a substantial accumulation not only takes up a limited campus space, more causes a tremendous waste of resources. We conduct the vast thorough investigation and research by interview method, practice method, questionnaire method based on the user experience, then designed a university bicycle rental service system based on the use of old bicycles. This system consists of some multiple subsystems like recycling system, maintenance system, rental system, interaction system and visual system. Techniques of Internet of Things are adopted to combine the existing the One Card through of the School (OCTOS) Network with banks. Meanwhile, Mobile Communication Technologies are adopted to connect our service system to communication terminal equipment which can help diversify payment query modes to provide real convenience for users. We hope that the school resources can be sustainable utilized including the bicycles, and students, college, enterprise, environment will benefit from this system. Also we are trying to give a suggestion to the college about the resources recycling.

2 The Methods and Process of Service Design about the Recycle System of College Bicycles

Bicycle rental green concept early started in Lyon, the second-largest city of France. Nevertheless, our service system is based on the use of waste bicycle on campus, and discussed the interaction of each subsystem and the users' various needs.

2.1 Interview Method

We interviewed some typical students in each of the Wuxi's colleges. From it we know that bicycle is the main vehicle of college students. Bicycles are environmental and convenient, but there are still some problems in use. In general, the problems can be divided into three categories:

1. Purchase problems. The price of new bicycles is so high that some students cannot afford them. Old bicycles are of poor quality and the price is always unreasonable. Students always worry about the fraud activities in the deal.
2. Use problems. The use problems include too many bicycles, inconvenient parking, lack of repairing points, and safety. Many students mentioned their bicycles used to be stolen and second-hand bicycles are of poor quality.
3. Dispose problem.Dispose means the way students deal with their bike when they graduated or no longer need a bike anymore with other reasons. Generally the ways include discard,sale and donation.Direct discard not only causes a tremendous waste of resources,but also takes up a limited campus space. And it is hard to sell the bicycles for lack of transaction platform.

More than half of the interviewed students are interested in bicycle lease, and they said that they are willing to donate their bicycles to our system when they graduate.

2.2 Questionnaire Method

We did some field research by using the questionnaire method, the questionnaire consists of six single choices, one multiple choice, one Jmix and two background

surveys. We sent two hundred and fifty papers in three colleges (Jiangnan University, Taihu college and College of Vocational and Technical) and we got two hundred and forty-seven papers back. Among these, 78% were valid and here we got some result:

61.5% respondents thought the biggest problem is theft, 35.6% people thought the outdoor parking spots are too few, 27.9% thought the indoor parking spots are not enough, 21.9% thought the bicycle repair shops are too few and the rest said the old bicycles are broken easily. Based on the data above, we enhance the vision system for better management and preventing against theft, meanwhile we set up more bicycle shops so that student can easily find one nearby. When the system works normally, the freshmen could buy less new bicycles and the abandoned bikes will be less, therefore we can solve the problems that we find out before.

The following Figure 1 rental model shows that students prefer monthly rental and semester rental most, follow with the daily rental, the last ones are yearly rental and hourly rental. So most bicycles are used to semester rental, monthly rental and daily rental, a few bicycles are used to yearly rental. The new bicycles offered by the enterprise are used to hourly rental, they play a role in the brand-enhancement and system promotion.

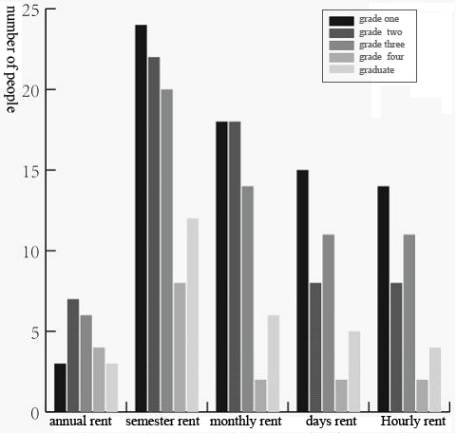

Fig. 1. Rental mode

Fig. 2. Relation between students' focus and sexuality

According to Figure 2 relation between students' focus and sexuality (the taller the rectangle is, the more important they thought it to be). People care more about the bicycles' condition and rental price so how to recycle bikes and get them repaired are critical processes in our service system. Only if we make the bicycles attractive and durable, we can call on more students to take part in our system.

We take semester rental for example to survey the price factor, Figure 3 the interactions between the price of semester and sexuality shows 63% of the students chose the lowest price 38yuan per semester while still 38% chose the price 40yuan per semester or even higher. Consumption capacity of our students is growing but they are still rational consumers. However, funds are important because the service system will last for long, finally we decide to make it at 40yuan per semester.

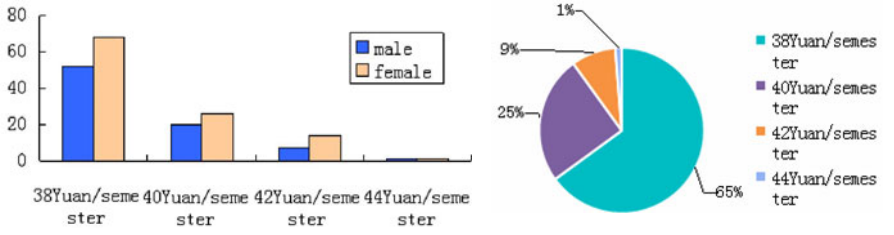

Fig. 3. Interactions between the price of semester and sexuality

2.3 Life Events Method

For sure bicycle recycling service system, we simulate system operation by campus life events method and determine the need to support the system based on the specific campus environmental.

We determined the system operation will use internet of things technologies as technical support. Take example by the "three generations plan" of bike sharing project in European city, we integrate existing campus card network and bank network to realize real name loan and payment. System is subdivided into six subsystems as recovery system, maintenance system, lease system, price system, interactive system and visual identity system, with each system interact and combine therefore sustainable system can operate well.

3 College Bicycle Circulation Service System Design Research Results Report

According to investigation result, College bicycle circulation service system composed by recycling system, maintenance system, lease system, price system, interactive system and visual identity system. Their good operation is the key of the stability of the system.

3.1 Recovery System

We designed three modes to solve the source of bicycle problem.

1. Donate used bicycle: the club through half donation and half feedback or some emotional feedback to recover graduates or other students' bike, and achieve the purpose of increase the bicycles and the transmission of emotion;
2. Compulsory recycling: With the help of the school authority to compulsory recycle the unused bicycle to achieve the purpose of effectively bicycle supply.
3. Add new bicycle: Take dividend return to invite bicycle manufacturers or related enterprise to join in, and through using such as Hangzhou public bicycle service system [5] complete the species of bicycle and enrich the lease way.

3.2 Maintenance System

With the cooperation of garage to classify, renovate the second-hand bicycles and maintenance bicycles in the system.

1. Classification: Put second-hand bikes into three classes as good, medium, poor. Good bikes can directly input use, medium bikes need renovate, poor bikes are as replacement parts or directly sell.
2. Renovation: For recovery bikes repairs, a rational daily maintenance system and maintenance outlets should be established to ensure the safety of bikes.

3.3 Rental System

Lease is one of the main parts in the service system, and is the important condition of the system running smoothly.

1. Lease way: Lease way points to long time rent and short time rent. Most rented bicycles are used for long time rent which is divided into year, semester, and month, the users rent and return by brush card (see interactive system) in the club's nominated site, Short time rent is divided into days and hours, most short time rent bicycles are new, the users rent and return by brush card in the short rent site of universities where has been set.
2. Timing system: Namely records using time. It as fee basis points to long rent and short rent two kinds. If exceed the time long rent will stipulate fee deduction. Short rent take single valuation time from start point to return point, the system automatically changes it into days rent when rent for more than four hours. If bike is lost, it is required to compensation as prime cost.

3.4 Price System

As the Table 3.1 of models and lease price list shows, according to different rental mode and the survey data we have formulated this. Among this, when rent for more than four hours, the price system will automatically change for days rent.

Table 1. Models and lease price list

model / rental way	Annual rent	by semester	monthly rent	daily rent	by hour
New bike				2.2Yuan/day	0.6Yuan/hour
Used bike	65Yuan/year	40Yuan/semester	12Yuan/month		

3.5 Interactive System

Interactive system mainly consists of service terminals, website and mobile phones. Service terminals are equipment for users to borrow and return the bike. As the Figure 4

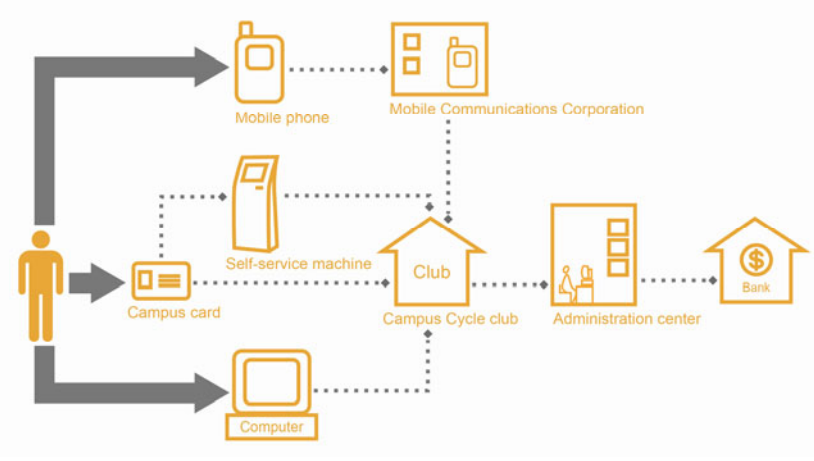

Fig. 4. Interactive ways

"interactive ways" shows, students are able to rent, inquire or pay through the computer, terminating machine and their own mobile phones.

It is divided into central type and lateral type, 16 or above parking pile generally chose the central type. Service terminals should try to use small size and do not exceed 2 m high. They should try to minimize the width and thickness [6].

1. Identity: campus card as lease system identification is the only tools, simultaneously build personal virtual account and individual information service system foundation.
2. Recharge: through club artificially deduct or transfer accounts into personal virtual account through service terminals.
3. Query: the user but inquires the use of records, the information such as the account balance by service terminals system or land the web side by computer or mobile phones.
4. Report the loss: as bicycle lost in use process, user can instantly report the loss in service terminals and mobile phones, terminate fee timing, reduce user loss.
5. Cancellation: when the card is lost or appear other need, user can cancel it at the club or service terminals to terminate the right of rent and protect customer rights.
6. Emotion exchange: it is conducted on the basis of redesign [7] school BBS, use the existing university network, build communication interactive platform, enhance the emotional communication for students, college and enterprise and promote service system development.

3.6 Visual Identity System

In the 'emotional design', Donald. Norman professor put forward by instinct, behavior and reflection on three different dimensions, expounds emotional based in the important position of design [8]. So during logo design process it should be more emotionally to consider the audience to approve environmental protection and the

Fig. 5. Visual identification design

pursuit of living on the concept of sustainable development. In the following Figure 5 “visual identification design” shows:

1. Basic elements system: logo through the club names initials "C" clever processing, blend in circulation concept and bicycle abstraction model, properly shows brand recognition of "name call + visual memory order", endowed with mark natural visual, make brand recognition level rich. Green symbolizes environmental protection and sustainable development idea.
2. Application design system: including card, badges, web site, software on the mobile phones and other office supplies recognition series: club volunteers T-shirt etc dress recognition series, old bicycles recognition series, Posters, terminals and website propaganda recognition series.

Visual identity system design implemented "redesign" concept. For redesign college original “One Card through of the School” and One Card through of the School earmark machine and integrate university bicycle club website with university BBS, made full use of the available hardware resources, promote design value in existing resources.

4 Epilogue

Above all, the main body of the service system consists of recycle system, maintain system and rental system. The price system provides financial support to the whole system, and the interactive system is used on both the website and terminating machine from which students can participate in our system. Our vision system is used as service system identification so it will play a vital roll through the whole program. Among the system, the difficulty lies in how to recycle the old bicycles and repair them, because that will be supported by the school, the enterprise and the student. We try to do something for the college bicycle system under the current conditions, it will never be perfect for every factor in the system is changing. In the following Graphic 3.4 relationships show:

Our system connects the school and the student with the enterprise, all of them will benefit. In addition to this, bicycles are managed so the college environment may be tidier. We hope that the service system can be used in other colleges only if we succeed to apply it to the colleges in Wuxi. It is an exploration to the sustainable design and we are trying to do our best.

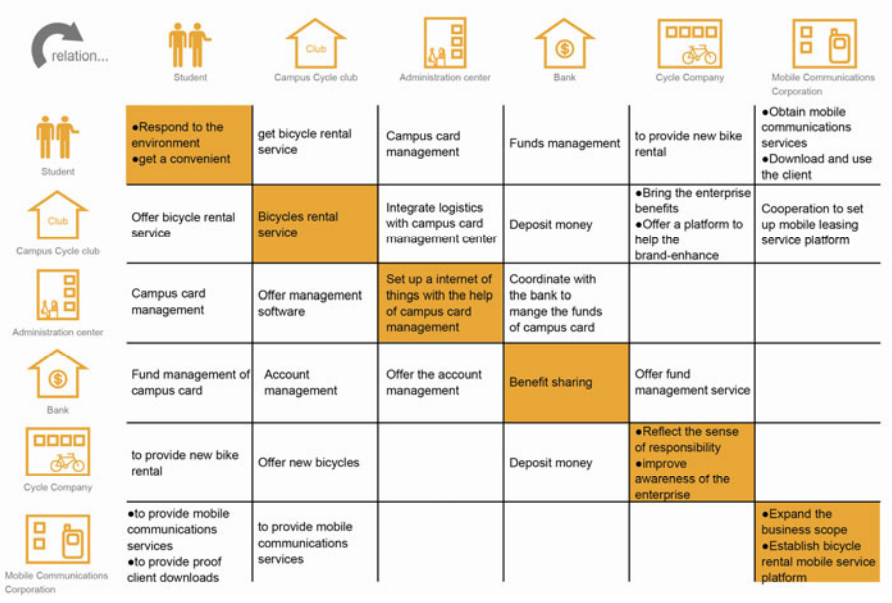

Fig. 6. Relationships

Acknowledgements. In the end, we are extremely grateful to Jiangnan University School of Design professor BinBin Li and Associate professor Miaosen Gong.

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Design and Evaluation of a Novel Trackball Input Device for Middle-Aged Users

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Abstract. This study developed two sets of novel trackball input devices operated by two hands with no space constraints, and required a series of experiments. Besides, the performances of the two newly-developed devices are significantly better than both existing trackball input devices in several tasks. However, the results of stability assessment tests show that the ability of a mouse to control the cursor is still greater than all the other devices. In physical observation part, wrist extension and ulnar deviation were measured while using Jack-1 and Jack-2, and showed apparently slighter than all the other devices.

Keywords: Trackball input device, Two-handed operation, Middle-aged people.

1 Introduction

In the recent years, the development of Graphical User Interface, GUI such as intuitive-operating icon or windows has led to effortless-operation without the use of keyboards. This has increased the operation time of Non-Keyboard Input Devices, NKID. Amongst which, computer mouse is still the most popular device employed by the current computer users [1][2][3][4]. Experiment results from past studies have proved that computer mouse is easier to operate than most other non-keyboard input devices with higher efficiency (including accuracy and speed). However, mouse operation employs the elbow as the fulcrum, integrating the motion of forearm, upper-arm, and fingers, resulting in shoulder abduction, flexion, dorsiflexion, ulnar deviation, radial deviation, and musculoskeletal disorders, the so called Cumulative Trauma Disorders, CTDs [5][6]. Therefore, many researchers make attempts to improve the current input devices or replacement input devices for different user groups to avoid this problem, hoping for a suitable input device in the future that is both comfortable and efficient [7][8].

Aside from computer mouse, the trackball input device is another commonly employed control input device [9]. Because of this, it is often compared to the computer mouse for control efficiency performance and comfort levels. Results of related studies in the past pointed out that operating computer mouse and trackball mouse both lead to dorsiflexion and ulnar deviation. However, in comparison to the computer mouse, the use of the trackball mouse results in less cases of wrist dorsiflextion and shoulder abduction occurrence. As for the comparison between

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different age groups, according to the study of [10][11], user groups of older ages prefer the trackball mouse for its smaller wrist movement range even though it is less efficient than the computer mouse. It is an operational input device suitable for the elders.

The research purpose is to confer and integrate suggestions to improve the trackball input device from past research results in order to investigate possible developments of the trackball input device. The researcher hopes to retain strengths in the current design and improve on the weakness in operation manners to improve on efficiency, hence develop a trackball input device with efficiency and comfort which conforms to human factors. Furthermore, the study specifies the middle-aged user group, run experiments with different operations to assess and observe body motions and compare operation efficiency with the current computer mouse and trackball input devices. In this study, the trackball input device is chosen to be the goal of development and improvement specified for the middle-aged user group of users between 45 and 60 years of age. Furthermore, this study designs operation experiments regarding the common operations such as pointing, clicking, and dragging, in order to assess the efficiency of different input devices and observe body motions and posture of the participants by using the Motion-Capture system.

2 Methods

2.1 Design Development

Through the observation of interview participants (5 participants) operating six current trackball input devices, strengths and weaknesses of each device were found and employed as related design parameters. The results of observations and interviews show that Track Mouse and The Fish, with similar trackball sizes, present the best trackball size. One participant claimed that Iball was the best but would be better if it was flatter. Another participant thought that the best trackball size should be between the size of trackball on the TrackMan and The Fish. All five participants thought the trackball on Pen Mouse was too small. As for the sensitivity of trackballs, all participants thought that Marble Mouse, TrackMan and Iball were the best ones while Pen Mouse was thought to be the least sensitive. Regarding the shape of devices, four participants thought Track Mouse was difficult to hold; three participants thought The Fish was comfortable to hold; and one thought Iball was too big to hold therefore employed both hands. Also, all five participants expressed their fondness for The Fish, Pen Mouse, and Track Mouse for their freedom of space confinement. As a whole, Marble Mouse and The Fish were thought to be the best devices. Integrating past literature and the results of practical observation and interviews, the ideal design objectives and criteria have been planned and shown in Fig. 1. Following the above design objectives and criteria, different operation posture (Fig. 2) and operation manners are integrated to develop a number of different design concepts (shown in fig. 3). Finally, through discussions with professionals, tests, and selections, two final design prototypes were produced (shown in Fig. 3 as Jack-1 and Jack-2).

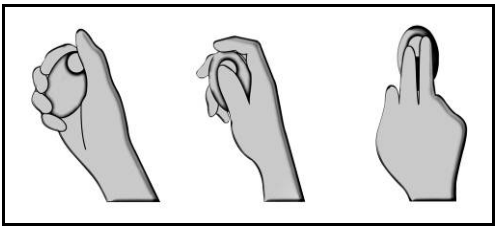

Fig. 1. Different hand posture concepts

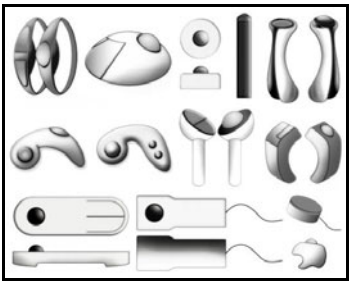

Fig. 2. Design concept development

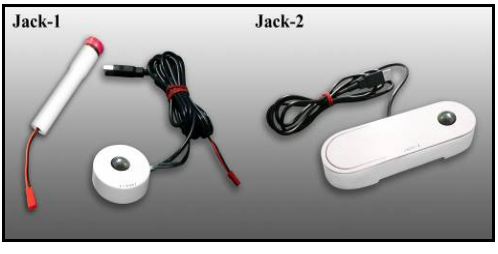

Fig. 3. Final design prototypes

2.2 Experiment Design

Ten healthy participants between ages 45~60 with no muscle or bone injuries were selected to investigate the operation efficiency of middle-aged users operating input devices. Participants were put through different combinations of tests to evaluate the operation efficiency of each device. Each participant were given 5~10 minutes of practice time to get acquainted with the input devices and adjust the working environment according to their own preferences, such as table height, distance between body and table, chair back angle, screen distance, screen angle, and screen brightness etc.

This research is aimed at comparing the operation efficiency of the five input devices when facing different operations. The devices are: a. Optical Mouse by S+ARCK, b. Logitech Marble Mouse, c. The Fish hand-held Trackball Mouse, d. Jack-1, e. Jack-2.

The efficiency evaluation of three combinations of operations is included in this research, such as: Point and Select task assessment test, Dragging task assessment test, and Stability task assessment experiment.

- Point and Select Task Assessment Experiment. This experiment requires participants to move the cursor to the target area for clicking tasks. First, the cursor needs to be at the original point area and the "start" button needs to be pressed to begin the task. At this point, target area 1 would appear on the screen and participants are required to move the cursor to click number 1. Next, target area 0 would appear on the screen and participants are required to move the cursor to

click number 0. This movement is repeated three times and a total of 8 target areas located in different directions are required to be clicked. The distance (D) between the original point to the target area is stable, and the shifting of angles follows a clockwise direction. This point and select task is operated with five different input devices and three different target area sizes. The experiment chart is showing in fig. 4.

- Dragging Task Assessment Experiment. This experiment requires participants to drag target objects in the target areas to the next using the cursor. First, move the cursor to the original point and click on the "Start" button to begin. At this point, participants are required to click and hold the key to move the target object in the original point area (number 0 target area) and drag the object to the number 1 target area, then drop the object by releasing the key. Next, the number 0 target area would reappear on the screen and participants are required to repeat the same dragging movement to bring the target object back to the 0 target area. This movement is repeated three times with 8 target areas in different directions. This task is operated with five different input devices and three different target area sizes. The experiment chart is showing in fig. 5.
- Stability Task Assessment Experiment. This experiment requires participants to drag the cursor from "Start" and follow the given paths clockwise. This task contains three different paths each bordered with two sidelines 10mm apart. Tracks are left after the dragging of cursors for further analysis. In cases where cursors touch the sidelines, the computer gives a warning sound and keeps a record. Since the point of the task is to assess the stability of the input devices, the participants are informed to avoid touching the sidelines. What this means, is that stability is the top priority rather than speed. The experiment chart is showing in fig. 6.

3 Analysis and Results

After the experiment of evaluating the tests (Point and select, Dragging operation and stability) and observing the body movements, all of the data are collected and collated for analysis and discussion. This study includes a total of ten participants. The effective sample is 10. Furthermore, 5 subjects from these 10 are selected to be tested by using interception system test for body observation.

3.1 Point and Select Task Assessment Analysis

After all the data were collected, the researcher ran the One-Way ANOVA by SPSS 13.0 to analyze the data. It is revealed that the average time required was significant ($p<0.05$) when the researcher manipulated different kinds of NKID to process all the achievement evaluation tests. However, with error frequency, it is only significant ($p<0.05$) with different NKID.

In point-and-select test 1,it was suggested that Mouse required the shortest time, which is significantly different from other devices, while The Fish required the longest time, demonstrating a significant difference, as shown in the Table 1. In the aspect of errors, it was absent when with all participants using Jack-2. The researcher analyzed the distribution of errors at different angles with different NIKD.

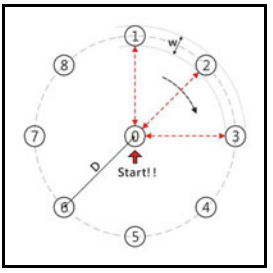

Fig. 4. Point and select task test chart

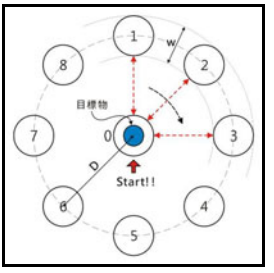

Fig. 5. Dragging task experiment chart

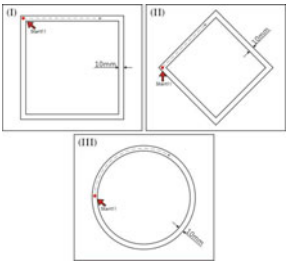

Fig. 6. Stability task assessment chart

In point-and-select test 2, it is suggested that Mouse required the shortest time, which is significantly different from other devices in terms of testing time, while The Fish required the longest time, demonstrating a significant difference, as shown in the Table 2. Mouse and Jack-2 had the least errors amongst all devices.

In point-and-select test 3, it is suggested that Mouse required the shortest time, which is significantly different from other devices in terms of testing time, while The Fish requires the longest time, demonstrating a significant difference, as shown in the Table 3. Jack-2 had the least errors amongst all devices. The researcher analyzed the distribution of errors when every NIKD processed point-and-select test 3 by each angle.

Table 1. Post Hoc – Point and select test 1 experiment time

Duncan		Subset for alpha = .05		
Input Device	Test sample (N)	1	2	3
Mouse	10	35.40		
Jack-1	10		52.70	
Jack-2	10		54.10	
Marble	10		59.30	
The Fish	10			76.70
Sig.		1.000	.195	1.000

Table 2. Post Hoc – Point and select test 2 experiment time

Duncan		Subset for alpha = .05		
Input device	Test samples(N)	1	2	3
Mouse	10	40.10		
Jack-1	10		59.20	
Jack-2	10		60.00	
Marble	10		64.80	
The Fish	10			85.50
Sig.		1.000	.322	1.000

Table 3. Post Hoc – Point and select test 3 experiment time

Duncan		Subset for alpha = .05		
Input device	Test sample (N)	1	2	3
Mouse	10	45.60		
Jack-2	10		69.00	
Jack-1	10		70.10	
Marble	10		83.80	
The Fish	10			101.80
Sig.		1.000	.056	1.000

3.2 Dragging Evaluation Test

In dragging test 1 it is suggested that Mouse required the shortest time, which is significantly different from Marble and The Fish, but not significant in Jack-1 and Jack-2, in terms of testing time. The Fish required the longest time, demonstrating a significant difference from Jack-1 and Jack-2, as shown in the Table 4. Mouse and Jack-2 had the least errors in all devices. The researcher analyzed the distribution of errors from different angles.

Table 4. Post Hoc – Dragging test 1 experiment time

Duncan		Subset for alpha = .05		
Input device	Test samples (N)	1	2	3
Mouse	10	63.90		
Jack-2	10	88.4000		
Jack-1	10	96.6000	96.60	
Marble	10		123.90	123.90
The Fish	10			144.20
Sig.		.065	.103	.223

In dragging test 2, it is suggested that Mouse required the shortest time, which is significantly different from Jack-1 and Jack-2, but these three showed a significant difference in The Fish and Marble. Marble required the longest time in all devices, not significant from The Fish, as shown in the Table 5. In terms of errors, Jack-1 and Jack-2 had the least errors amongst all. The researcher analyzed the distribution of errors from each angle.

In dragging test 3, it is suggested that Mouse required the shortest time, which is significantly different from Jack-1 and Jack-2, but these three showed a significant difference in The Fish and Marble. The Fish required the longest time amongst all devices, not significant from Marble, as shown in Table 6. Jack-1 had the least error frequency amongst all devices. The researcher analyzed the distribution of errors when every NIKD processed dragging test 3 from different angles. It is revealed that the Marble and The Fish had the most errors of 75 and 112 respectively.

Table 5. Post Hoc – Dragging test 2 experiment time

Duncan		Subset for alpha = .05	
Input device	Test samples (N)	1	2
Mouse	10	62.90	
Jack-1	10	88.30	
Jack-2	10	89.30	
The Fish	10		148.30
Marble	10		149.30
Sig.		.106	.948

Table 6. Post Hoc – Dragging test 3 experiment time

Duncan		Subset for alpha = .05	
Input device	Test samples (N)	1	2
Mouse	10	65.90	
Jack-1	10	98.00	
Jack-2	10	100.60	
Marble	10		157.00
The Fish	10		193.50
Sig.		.171	.128

3.3 Stability Task Assessment Analysis

In stability test 1, it is suggested that Mouse required the shortest time, which is significantly different from other devices, while Jack-2 required the longest time, showing an insignificant difference in Marble, Jack-1 and The Fish, as shown in the Table 7.

In stability test 2, it is suggested that Mouse required the shortest time, which is significantly different from other devices, while The Fish required the longest time, showing an insignificant difference in Jack-1 and Jack-2, as shown in the Table 8. In terms of errors, The Fish had the most errors, but Mouse had the least errors, which is not significant from Jack-1, Jack-2 and Marble.

In stability test 3, it is suggested that Mouse required the shortest time, which is significantly different from other devices, while The Fish required the longest time, showing an insignificant difference in Jack-1 and Jack-2, as shown in the Table 9. In terms of errors, The Fish had the most errors, but Mouse had the least errors, which is only significantly different from The Fish, but insignificant different from Jack-1, Jack-2 and Marble.

Table 7. Post Hoc – Stability test 1 experiment time

Duncan		Subset for alpha = .05	
Input device	Test samples (N)	1	2
Mouse	10	14.00	
Marble	10		21.20
Jack-1	10		21.80
The Fish	10		22.10
Jack-2	10		22.30
Sig.		1.000	.733

Table 8. Post Hoc – Stability test 2 experiment time

Duncan		Subset for alpha = .05		
Input device	Test samples (N)	1	2	3
Mouse	10	17.80		
Marble	10		27.30	
Jack-2	10		30.90	30.90
Jack-1	10		31.00	31.00
The Fish	10			37.50
Sig.		1.000	.383	.121

Table 9. Post Hoc – Stability test 3 experiment time

Duncan		Subset for alpha = .05		
Input device	Test samples (N)	1	2	3
Mouse	10	12.50		
Marble	10		21.50	
Jack-1	10		23.90	23.90
Jack-2	10			27.60
The Fish	10			28.80
Sig.		1.000	.390	.100

The test performance assessment results of the research show that Mouse showed outstanding performance on the test of average time. This is particularly evident in the point and select and the stability tests. From the point and select task assessments we can see that the average time for task completion using Mouse is about 20 seconds shorter than the device with the second shortest completion time (Jack-1 or Jack-2). However, the speed of task operation resulted in the lack of outstanding performance in the error rate assessment. In the point and select test 1, the newly developed devices Jack-1 and Jack-2, even Marble with the trackball input device, all performed better than the Mouse in the error rate test. Also, in the point and select test 3, Jack-2 with the lowest error rate amongst all devices also performed better in the average error rate compared to the Mouse. Other than that, there was no significant difference between the error rate in the point and select test for all devices at different angles.

In the dragging task assessment, there was no significant difference between Jack-1, Jack-2 and the Mouse. In dragging test 2 and 3, the average time for Jack-1 and Jack-2 were both significantly shorter than the current trackball input devices Marble and The Fish. In dragging test 1, the average time performance for Jack-2 was significantly shorter than Marble and The Fish. These results show that the appropriate use of both hands does improve the performance of trackball input devices while performing dragging tasks. Also, in the dragging test average error rate, Jack-1 and Jack-2 showed the best and the second best performance. As for the error rate at different angles, all devices resulted in a higher error rate with oblique angles (45°, 135°, 225°, and 315°). In dragging tests 1 and 3, the total error frequency for the Fish at 135° were as high as 25 times.

In the stability assessment tests, since the goal is to assess the stability of devices, the participants were told to put stability as the first priority over speed. Therefore, the average error rate is the item assessed here. From the results of the three stability tests, we can see that the average error rate and average time for the Mouse were both the best. It is clear that Mouse has the best performance in the assessment tests while the other devices show no significant differences amongst them. These results show that even with the improvement of the C/R ratio to increase stability, there was not significant improvement in the stability of trackball control. This means even with the control of trackball over the cursor, there is still a significant difference compared to the stability of using Mouse.

4 Conclusions

This study is designed for middle-aged users and develops new trackball input devices. Therefore, the operation manners and the level of overall comfort are important elements for improvement. By the appropriate use of both hands to adjust the trackball operation and configuration (including the selection of the appropriate size of the trackball, location and height of the spheroid), along with the operation without space confinement, the appropriate size and feedback button, this study allows users to control in a more relaxed posture with the two newly developed devices. The result shows that when the participants use input devices, their wrists conform to different levels of ulnar deviation, distortion, and dorsiflexion. Unlike Mouse and Marble which are limited by the desk top space and the operation posture, Jack-1 and Jack-2 decrease the level of ulnar deviation and dorsiflexion on participants by about half. For the angle of the elbow, when using the Mouse and Marble, due to the limitation of the desk space and posture, the participants were exposed to an unnatural hand position for a long time which easily causes skeletal muscle injury. Because The Fish and these two newly developed devices are not free of space confinement, participants have the freedom to change their posture to reduce fatigue. In addition, as the operation of Mouse requires the use of the entire arm to control the cursor, participants' elbow angle changes constantly. The other four devices are rendered in a steady angle, which reduces the load on elbow joints.

It is found that improving the level of comfort and feasibility of trackball input devices can increase work efficiency and overall performance. In the experiment, Jack-1 and Jack-2 both performed equally well, however, according to the data from physical observation experiments, when the subjects use Jack-1, the dorsiflexion of

the non-preferred wrist is more serious than using Jack-2. Also, in the stability tests, it can be found that the participants are not used to the control of cursor with the trackball. From the results of stability test1, the average number of errors occurred for Jack-2 is even higher than The Fish. It shows that there is no significant improvement in the present trackball input devices. It will be the next part for improvement. Additionally, it is believed that designing and coping with the relationship between the form of non-preferred hand and Keyboard to enhance the overall performance of using computer will also be the direction for future development. Finally, the conclusion of this study and design recommendations are expected to provide the direction for future designers who may develop better alternative input devices to provide middle-aged computer users with more options.

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Common Task-Oriented Communication Tool Applied in Radiology Department of Hospital

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Abstract. The Different roles (Registrar, technician, radiologist, IT admin), often communicate with each other through phone, face to face conversation or SMS. However, existed communication way, especially SMS didn't fully support user communication efficiently. Since most of users in radiology department have big workload, work efficiency are key points they cared about. User dislike to send communication info by manually typing message too much, also, dislike complex operation step using SMS.

Actually, at least 60% communication happened in radiology department refer to common tasks took place in radiology work flow. It lack tailored well communication tools to support different roles quick send common message and give reply ,even to deal with common tasks timely . Based on the issues, we explore to develop a quick communication tools integrated with RIS system which can meet common task-oriented communication well especially.

Keywords: Task-Oriented, Communication, Filed Observation, Hospital Roles.

1 Background

Healthcare is a complex and large-scale service system. Constituting the service system are not only medical products and medical digital products, including institution, policy, condition, social benefit, etc. Of course, human is the most critical factor in the whole healthcare service system, which includes not only patients receiving services, but also services provided by doctors, nurses and hospital staff. Therefore, the people who use services create the whole healthcare service process with the service provider. The largest challenge of the healthcare system is that people are an unpredictable factor of the service process than the controlled product. At the same time, it also provides us with the new innovation and design opportunities.

Based on Live | Work pioneered *Service Thinking*. From Product Design to Service Design, we need to change our dominant mindset.

At First, put people at the heart of service. Delivered from the individual product, the aim of our design service must be to provide valuable service to people, in a way of accepted price they desire with when they need it. Put people at the center of services system, as we need to know who they are. We need work hard to understand them and know what they need, when they need it. Then we can help them and provide them with personalized service. With this potential service opportunity for

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innovation, it not only meets the users' needs, but also to create huge benefits for service provider.

Secondly, create networks that enable services. With the development of communication technology in the information age, it reflects our diverse networked societies and creates new relationships between organizations, people and things.

The third, establish sustainability as the bottom line. Service don't have the limited life span like a product. It is a continuous ongoing process, constantly changing, and then renew a cycle process. Therefore, the services need to constantly improve, and continuous recycling and sustainable development. Product provider make money from the margin on each unit of production. But services create value by meeting customer needs. Because of the important distinction, service providers must put themselves for the sake of users, and reduce unnecessary waste.

The innovation project introduced in this article, it may solve the communication problems in the human social network with health care system and reduce the people's repeated operations, to improve work efficiency around above three points.

2 Research Methods and Process Introduction

The innovation of healthcare service design needs new approach, new design tools and new technical support. In this project, we mainly used two design approach, Filed observation and Quick prototyping.

It is often said "people do not always do what they say they do" and "things are not always as they seem". We can understand the user deeply based on the observation of anthropological principles. Trying to understand user's lifestyle, behavior and attitude, focusing on the user's Journey, and their emotion in some scenarios, it finally found what really happened in the context.

Quick prototyping is a common method used in service design. The most important is to identify problems early and reduce the risk with Quick prototyping. Before the formal implementation of the idea, user can test the service system, identify problems in time and find opportunities for innovation points from the usability, visual perspective and user experience by hand-drawn sketches, scenario simulation and other methods.

3 Communication Tool's Literature Review and Existed Solution

With the development of science and technology, the way of communication and communicating tools have been constantly changing. People have experienced the most primitive period of face-to-face communication, letter, telephone, e-mail, forums, chat room, SMS, video calls, blog, social network, microblog, very popular recently, and gestures and pictures without language or words. Now there are a variety of ways to communicate, people can select the appropriate ways of communication in the context.

Julia Ashley, iCohere analysis and comparison of some of the traditional means of communication in the paper "Synchronous and Asynchronous Communication Tools".

Table 1. Synchronous Tools

Tool	Useful for	Drawbacks
Audio conferencing	Discussions and dialogue	Cost, especially when international participation is involved
Web conferencing	Sharing presentations and information	Cost, bandwidth; may also require audio conferencing to be useful
Video conferencing	In-depth discussions with higher-touch interactions	Cost, limited availability of video conferencing systems
Chat	Information sharing of low-complexity issues	Usually requires typing, "lower touch" experience
Instant messaging	Ad hoc quick communications	All users must use compatible system, usually best for 1:1 interactions
White boarding	Co-development of ideas	Cost, bandwidth; may also require audio conferencing to be useful
Application sharing	Co-development of documents	Cost, bandwidth; may also require audio conferencing to be useful

When confronted with different needs, we can mix with each other, flexible application based on the different characteristics of a variety of communication.

For the internal online chat tools, there have some innovation production now. For example, snapcomms developed **Desktop Alerts - High Cut-through**: Desk top message alerts to ensure message cut through for important employee updates. Video Desktop Alerts and RSVP Desktop Alerts **Staff Quiz Tool** Employee quiz tool. Delivered as a desktop alert or by hyperlink. Automated real time reporting. Reinforce staff learning via research links and display of answers.

And snapcomms summarizes 10 intranet tip and low cost tools for improve intranet usage with Desktop intranet Tools:

- Intranet content notifications on the desktop
- Intranet RSS - without the need for opt-in
- Promote intranet content via targeted screensavers
- Summarize intranet updates in an internal newsletter
- Remove clutter from the intranet home page
- Desktop quizzes with intranet research links
- Share the work / involve every business unit
- Easy ways to add user generated content

- Gather feedback
- Measure intranet effectiveness and continually improve

Baystate Health to Improve Employee Communication Using New Media Tools. Baystate Health's diverse workforce includes over 10,000 nurses, administrators and doctors working in hospitals, medical centers and other facilities. "The solution will allow Baystate Health to display important corporate announcements, updates and other news directly on staff's computer desktops regardless of their physical location,"explains Ray Thomas, Helpdesk Manager, Baystate Health. "We wanted to see increased visibility of effective messaging for all employees, to ensure cut-though for urgent messages, and to be better able to target messages to specific groups based upon business needs."

Baystate Health intends to use:

- Interactive Screensaver Messaging for employee communications which are strategically and operationally important but not necessarily seen as urgent by employees. These are the types of employee communications that often become buried in other internal communications channels such as email and intranet. Interactive Screensaver Messaging increases the visibility and appeal these types of internal communications and individual messages can be targeted to specific employee groups.
- Pop-up Desktop Alerts to ensure that urgent and important internal communications reach employees fast. Message targeting, recurrence and reporting features will ensure that all such messages achieve fast, effective cut-through. Delivery reporting will allow Baystate to measure and monitor message delivery and readership on a minute by minute basis.
- Scrolling Desktop Newsfeeds to deliver relevant news and information updates as scrolling newsfeeds on the computer screens of staff. Targeting options help ensure that employees only receive the information they need.

Therefore, we can recognize that if there is good communication within an organization, not only can improve the efficiency of the sector, reduce the work of staff workload and worker's mood, but also ensure the smooth operation of the service system to meet the needs of the various roles of users.

4 Filed Observation

Different from communication event happened in our daily life, communication event happened in hospital are complex and always happened based on specific tasks.

We launch a field observation at one partner site (Chao Yang hospital of Beijing) to deeply research communication scenario in radiology department.

The research focuses on below factors:

- Why need to communicate
- Who involve in communication
- When to communicate
- How user communicate with each other (specific communication behavior \ existed communication tools)
- Which issues user met during communication

Table 2. Asynchronous Tools

Tool	Useful for	Drawbacks
Discussion boards	Dialogue that takes place over a period of time	May take longer to arrive at decisions or conclusions
Web logs (Blogs)	Sharing ideas and comments	May take longer to arrive at decisions or conclusions
Messaging (e-mail)	One-to-one or one-to-many communications	May be misused as a "collaboration tool" and become overwhelming
Streaming audio	Communicating or teaching	Static and typically does not provide option to answer questions or expand on ideas
Streaming video	Communicating or teaching	Static and typically does not provide option to answer questions or expand on ideas
Narrated slideshows	Communicating or teaching	Static and typically does not provide option to answer questions or expand on ideas
"Learning objects" (Web-based training)	Teaching and training	Typically does not provide option to answer questions or expand on ideas in detail
Document libraries	Managing resources	Version control can be an issue unless check-in / check-out functionality is enabled
Databases	Managing information and knowledge	Requires clear definition and skillful administration
Web books	Teaching and training	Not dynamic and may lose interest of users
Surveys and polls	Capturing information and trends	Requires clear definition and ongoing coordination
Shared Calendars	Coordinating activities	System compatibility
Web site links	Providing resources and references	May become outdated and "broken"

5 Summary of Communication Behavior

Complex communication event happened in radiology department. Different roles communicate with each other to inform other users \ cooperatively deal with some work or share some valuable info …

The major communication types include:

- Daily Task communication (High-priority, frequently)
- Non-normal event communication -Error Control (High-Priority, seldom)
- Collaboration and sharing (Middle-Priority)
- Broadcasting & publishing (Low-Priority)

70% communication case is daily task-oriented communication. In radiology department, Registrator \technician \radiologist are respectively deal with a sub-task based on an integrated workflow. Different role communicate with each other to confirm task is on going well, etc.

Another kind of communication is taken place during "error control", error case is non-normal event, not frequently happened .Once it happened, the responsible person (always system administrator) will communicate with related roles to know the reason fully and should publish the error case to stop error become more seriously.

Except daily tasks, Radiologist should communicate to each other to share study experience and cooperate with each other to deal with scientific research.

Finally, in radiology department, it has a kinds of communication is bulletin publish of one-to-many mode. Such as, administrator or team leader publish a public message.

5.1 Key Findings

F1 Daily Task-oriented communication happened commonly in radiology department. It's most typical communication types at there.

F2 Know from our general communication behavior in life, 70%--80% messages of task-oriented communication in hospital have structured topic and content. Which at least hint us to develop a friendly and efficient message input mechanism to avoid user repeatedly input common message info.

F3 Also, different form our social communication mode, task-oriented communication in hospital always needs to track task' progress. From administrator view, he can easily know overall status through tracking work progress. From end-user view, they can ease to know whether other user check his message and have executed it or not. At least 60% case of TASK– orient communication need track solution status.

F4 It has big workload in radiology department, communication also plays an efficient role to clarify importance level & priorities of all kinds of tasks, which will push different user optimize work emphases. The factor also affects overall efficiency and clinical incident's avoidance to some extent.

4 Concept

Invention points are produced based on common task-oriented communication flow, which include below 5 points.

1. During producing task request, users (radiologist \technician\registration) can select the message from the message lib which gathers the common used message. Know from our general communication behavior in life, >60% messages of task-oriented communication in hospital have structured topic and content… The fact hint us to develop a friendly and efficient message input way to avoid user repeatedly type common message info. At here, common message lib will provide a way to support user quick produce message without need to typing manually.

   It is also flexible enough for user to easy define common message timely .For example, user can typing some message when editing info ,right-click the message to trigger the drop-down menu to select the item of "save the message into common message lib" ,then the system can save the message info the lib.

   User also can maintain their common message lib self-configuration. In default, the system will provide 3 kinds of common messages which are popularly existed in radiology department. The first type is daily task messages (such as the message of unqualified image, which are always send by a radiologist to technician), the second one is high-priority task message (ex, top priority exam for ICU patient), which are always used to remind user to deal with urgent task to avoid potential clinical incidents; the third one is common errors (ex, the message of repeated ID numbers for 2 patient), which are need to be published to remind related users. At there, they can build message type, del or add message through self-configuration.
2. In the same using scenario of producing message, if user select one exam from RIS and triggers the communication tool to produce message, the system will also auto-locate exam \patient info when user produce message. It means user doesn't need to type patient ID\ name info since the info has been auto-located based on info sync between communication tool and RIS system.
3. When user receive message, support receiver reply through "common reply list". Distinguished from daily communication behavior, when receiver captured new message in radiology department, they will give some typical reply quickly for common task-oriented communication. In most situations, if task request is clear, receiver will directly deal with tasks and give reply in easy way, they seldom spent too much time on communicating with the sender repeatedly. So we create a common reply list to support receiver give response easily when they captured message. It to some extent leads to efficiently interaction between the sender and receiver, finally improves communication productivity a lot.
4. After checking task message, the system will support user trigger the related tasks directly. Common message can always be connected to 3 kinds of data level (Fig. 1 Show the Level) .One kind of messages is related to "exam", the second kind of message is connected to "image" and the third one is" patient". When the system automatic judge which kinds of info level the message are related to, the system will help trigger the related info window in RIS or third party system directly. For example, for the common message of "need history disease info" on one patient, the system background will associate it with "patient" level, then the system will help trigger the patient related info window in RIS or third party system directly which will support user quickly deal with the tasks without any complex operation in client mode.

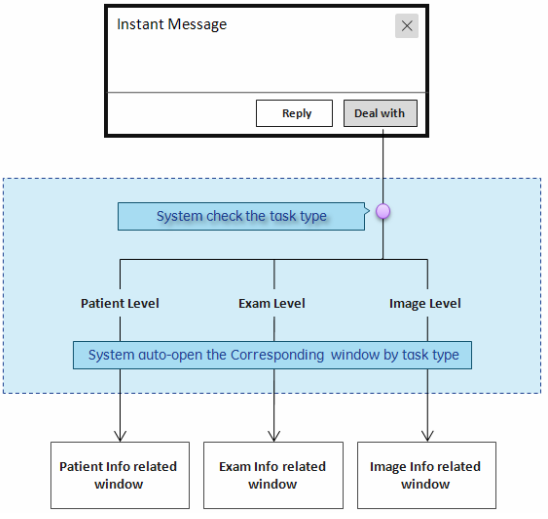

Fig. 1. 3 kinds of data level

5. Most of task message comes down to the specific user. To support user easy and quickly confirm receiver after produce message, we provide "the definition wizard of contact circle" for users in advance define his \her frequently contact person to simple contact list, also guide user build connection between receiver and specific message. Once relationship is set up between the targeted contact people and corresponding message, the message sending process will be simple totally.

When users use the message tool in first time, the system will guide user firstly to define his contacted list. In the default list, it includes all users and user groups in one radiology department, which are always be configured well by IT serviced engineer though "back office" of the system. Generally, it is a long list which affect user quickly selects the contact person. Actually, users in radiology department are always keep regular task-oriented communication with limited users (<10 users). Through self-definition, user can filter out never used contact person, only keep frequently contact person in his contact list. In next step, the system will guide user to build connection between common messages with his contact people. User can add specific message for certain people.

After the definition of contact circle, user can quick select the receiver from the list without too much operation to filter receiver every time, even can skip the step of receiver selection if the message have been connected to certain people.

7 Summary and Future Work

The system mainly has three main parts (Fig. 2 Workflow chart) :

1. Pre-configuration of common task-oriented communication link is to:

- Define **favorites** contact list in user level

- Default common message are provided in system level
- Build the connection between favorite contact person and common message

2. Quick Message sending and replying part

- Support user send message efficiently by applying common message lib.
- System auto-send message to the people who has connection with the message
- Related receiver receive message and check
- Related receiver reply message efficiently by applying common reply options

3. Deal with task…

- Support user locate related exam\image\patient info window in RIS or third party system to deal with tasks directly after user check the common message.

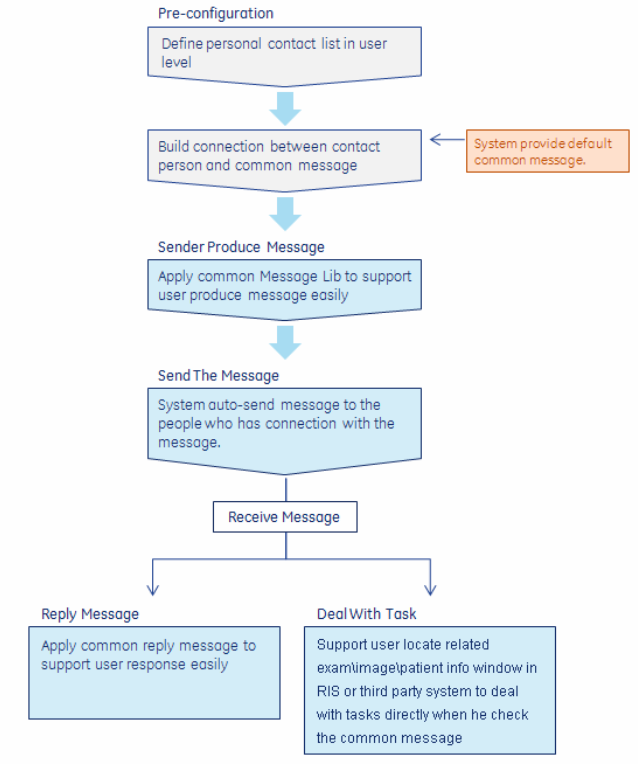

Fig. 2. Workflow Chart

Construct reasonable and run well communication network is one of the important works the design in service system. In the future, we will enhance the personalized design, extend service platform, connect with mobile devices, develop cross-platform and multi-channel communication model. This innovative project will be integrated into the whole healthcare system though the overall planning. And it will coordinate with the communication tools of the other departments and systems complement, to

better solve the problem of interpersonal communication and work efficiency. Ultimately, it will be reflected among the healthcare system, so that both patients and medical staff feel convenient, comfortable and satisfied.

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Motion Control with Intentions for Virtual Assembly

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Abstract. In recent years, motion control has become one of hot topics in virtual assembly and it is an indispensable part in maintenance process simulation. However, motion control still remains at low level based on key-frame or inverse kinematics, which in turn leads to an over complicated modeling. The paper proposes a new method to control the virtual human directly. The method converts the instruction into natural-looking motion sequence so as to simulate maintenance process intuitively. There are two layers in our method: script-parsing layer and primitive layer. In the script-parsing layer, the instructions are expressed with script in python. Our method converts the instructions into several kinds of primitives. The primitive layer converts the primitives with specified parameters into motion sequences. Our method generates natural-looking motions interactively and controls the virtual human intuitively. We view our method as a tool for facilitating the production of animation.

Keywords: Virtual Character; Motion Control; Script-Parsing; Primitive.

1 Introduction

Motion control in virtual assembly has become a hot topic recently. It can drive 3D personnel model to achieve complex task in a computer-generated virtual environment. The maintenance personnel are the most influential in product development activities, because they are not only the executors of the maintenance instructions, but also the objects of the maintainability analysis. There are more than one-third of people undertake the activities related to assembling [1]. The number could be much higher for some complicated production. The motion control affects the efficiency of the whole maintenance process.

However, the traditional human computer interaction system works with the aid of simple control equipment such as key, mouse and some other special operating device. The existing motion control methods cannot meet the needs of the application of virtual maintenance in the following two aspects. Firstly, it lacks high-level control such as instruction of virtual humans' results in the cumbersome modeling process in virtual maintenance [2]. The traditional methods cannot meet the needs of rapid prototyping and flexible application of the assembly process [3]. Secondly, the lack of parameterized motion control and synthesis methods restricts the accurate and flexible controlling of the human motion. The existing virtual maintenance systems adopt

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control method on inverse kinematics, thus the posture will be set iteratively. It remains to be a challenging issue to control the virtual human at high level with intuitive parameters.

Human-computer interaction is concerned with human capabilities to use machines, including the usability of interfaces. So we propose a new method to control motion with intentions in virtual assembly simulation in this paper. Our approach consists of two layers: script-parsing layer and primitive layer. The former is the higher layer. It converts the user input instructions in python into several primitives with parameter lists. The latter is the lower layer. It processes the motion capture data and converts the primitives into natural-looking motion sequences. Once the user input the maintenance instructions with parameters, our system can generate the output motions so as to realize the motion synthesis intuitively.

The remainder of this paper is organized as follows. In Section 2, we review the related work. Section 3 provides an overview of our motion control system. We present how to describe the user input instructions by script and the format of the modules in Section 4. Section 5 presents the construction of primitives from the motion modules with parameter lists. Experiments are given to demonstrate our method in section 6. Finally, we conclude our method and discuss future work in Section 7.

2 Related Work

2.1 Instruction

There are several methods to control the virtual human intuitively as follows.

Parameterized Action Representation (PAR) [4]. It is designed to bridge the gap between natural language instructions and virtual agents. The system is constructed with initial status of the virtual human and its surrounding information as input and the desired human motion as output. However, the understanding of the instruction term is difficult for novice because it contains a large amount of terminology and complicated grammatical analysis.

Smart Object (SO) [5]. Kallmann presented a feature modeling approach to define behavioral information of interactive object in the description. The advantage of this method is to improve the reusability of motion capture data and generate behavioral animation according to the smart object. But this method generates almost the same animation when using the same smart object thus the fidelity of the output motion is low.

The Jack system of [6] is constructed with initial status of the virtual human and its surrounding information as input and the desired human motion as output. It focuses on planning task and biomechanical simulation. The general goal is to produce accurate simulations of biomechanical robots. The generation of the human motion is difficult because forward kinematics and inverse kinematics solvers are used to set the key postures.

2.2 Script Language

Several systems use script language, because it can define a set of behavior rules and the interactive rules of the virtual human and virtual environment [7]. Thus it is intuitive, flexibility and has been widely used in motion control of virtual human.

Improv [8] consists of two subsystems. The first subsystem is an animation engine that uses procedural techniques to enable authors to create layered, continuous, non–repetitive motions and smooth transitions between them. The second subsystem is a behavior engine that enables authors to create sophisticated rules governing how actors communicate, change, and make decisions. It is created for real-time behavior-based animated actors based on natural-language style script with interactive ability. However, the system needs professional knowledge because the semantics of rules require the empirical understanding of the designer about animated models be cast into a textual.

Mansoo Kim proposed a script-driven method [9]. It can generate animation which combines the merit of natural language-style script and the path description based motion synthesis method. They marked the motion capture data with annotations first and then edited the path interactively with visualization method. Finally, they translated it to scripting language by grammatical parser to obtain natural-looking animation sequence automatically. However, the method is only applicable to locomotion, such as walking, running and jumping and doesn't work with other forms of human motions.

Various virtual environment systems, e.g. LIVE [10], Alive [11], Avango [12], Dive [13] and Springer [14], provide scripting language bindings for rapid prototyping support and flexible application development. In these systems most of the application and interaction semantics are implemented using the scripting interface.

In conclusion, the existing motion control methods of virtual human have the following problems. Firstly, the description of the instruction based on the complex grammatical analysis cannot satisfy the need of rapid modeling. Secondly, existing script-based systems are so complicated that users have to possess abundant professional knowledge, which is inapplicable to the novice users. Last but not the least, the synthesized motion is lack of diversity and fail in providing details without meaningful parameters. The great demand on high-lever motion controlling has provided a driving force for continuing research efforts.

3 Overview

This paper proposed a new method to control the virtual character intuitively for assembly simulation. Our method contains two layers: script-parsing layer and primitive layer. The higher script-parsing layer converts the users input instructions expressed with python script into several kinds of primitives, which are called modules. Modules are more general presentation of primitives. Each maintenance instruction can be described as a set of modules. User can set different parameters by user interface and obtain the natural-looking motions. The lower primitive level processes the motion capture data and builds a series of parameterized models, which are called primitives. Primitives are general presentation of human motion units which are indivisible. Each primitive can generate a specific motion sequence given a set of intuitive parameters, such as the step length. The flow chart of the method is shown in figure 1.

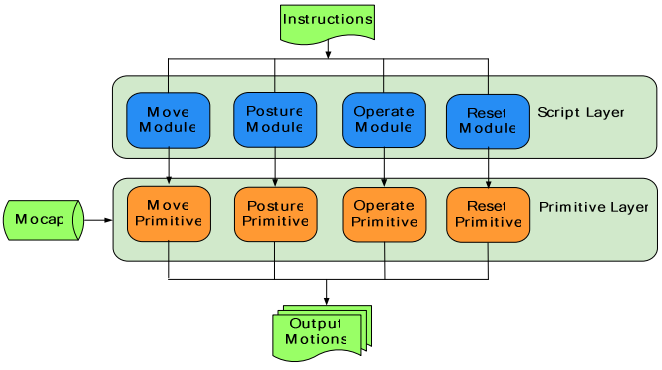


Fig. 1. Flowchart of motion control with intentions for virtual assembly

The features of our method are outlined as follows.

- **Intuitive control.** The system realizes the assembly-oriented motion synthesis with intentions. It gives us high level control over the synthesized motions by maintenance instructions and meaningful parameters intuitively.
- **Natural-looking animation.** We build the parameterized models by using the real motion capture data and generate motions on the basis of these models, thus obtain more realistic animations.
- **Good interaction.** We can set the parameters for each primitive by user interface so as to manipulate the objects in virtual environment interactively.

4 Script-Parsing Layer

Script-parsing layer is mainly responsible for describing the user input maintenance instructions by script. The maintenance instruction defines the procedures that the virtual human should follow when carry out the instruction. When the user input an assemble instructions, the script-parsing layer will describe the high level instruction as a series of modules according to domain knowledge.

4.1 Python Interpreter

Python is a programming language which runs on Windows, Linux/Unix, and has been ported to .NET virtual machines. It is also a powerful interpreted language. Due

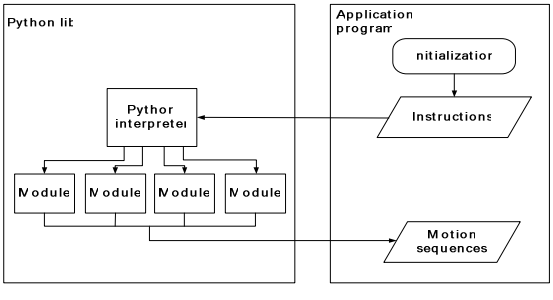


Fig. 2. Flowchart of Python executor

to a highly optimized byte compiler and support libraries, Python code runs more than fast enough for most applications. We have embedded Python modules into C/C++ applications. The API library provides a bunch of C routines to initialize the Python Interpreter. In the Python interpreter, the system first converts the instructions into several modules, and then into several motion clips. Finally we concatenate the clips one by one so as to output the motion sequences which satisfy the user.

4.2 Module

It is intuitive to complete a complex task by implementing several sub-instructions step-by-step. Typical maintenance instruction, such as removing the barrel from the aircraft, can be divided into four sub-instructions: walking approach the barrel, grabbing it, rotating to take it down and finally releasing it. Take the instruction of opening the cover board on aircraft for another example. It can be divided into another four sub-instructions: walking approach the cover board, grabbing it, rotating to open it and finally releasing it. The sub-instructions of “walking approach the barrel" and "walking approach the cover board "are the same kind of motion in that they describe motions of walking approach some objects. In order to convert the high level instruction into sub-instructions in simple way, we abstract the motions as module, which is showed as figure 3.

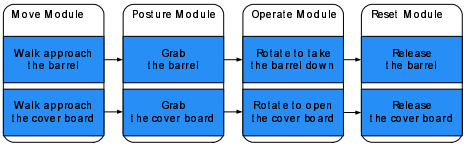


Fig.3. Sketch of move modules

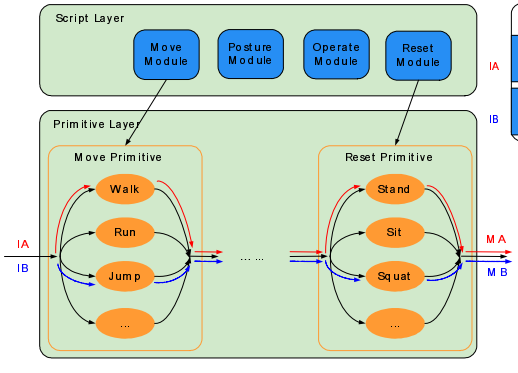


Fig.4. Sketch of script-parsing layer and primitive layer

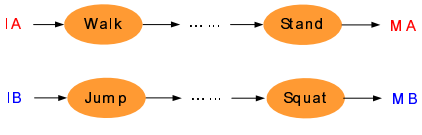


Fig.5. Convert instructions into output motions

As mentioned above, the module can be defined as the collection of motion with the same nature. According to virtual assembly, almost every instruction can be divided into four modules: moving, posture, operate and reset module. Each contains several alternative motion types, as shown in figure 4. The script-parsing layer defines a set of behavior rule to convert an instruction into a set of module with different parameters. The system will translate the given parameters to that in the parameterized models by script and generate animation sequences. A path in figure 4 could guide the maintenance personnel to carry out the desired instruction, which is showed in figure 5. Actually, we could easily extend this graph by adding motion types in every module if necessary.

In script-parsing level, we convert every assembly instructions into modules with parameters. The advantages are obvious. First we can obtain high efficiency. A

module contains several motion types with the similar property. Searching for the exact one in limited modules can be done in real time. Secondly we can get fast parameterized modeling. We can build parameterized models for each motion type respectively, which is more convenient. Last we will achieve good interaction. In our system the transition postures between modules are standard postures, like stand or sit. Motion blending will be much easier.

5 Primitive Layer

Once the user instruction is converted into a set of modules, they can be executed by sequence to obtain the desired animation. In order to synthesis motion in an intuition way, we build the parameterized models of different kind of motion, which are called primitives. Each primitive generates a specific motion sequence given a set of intuitive parameters, such as the step length and the height of stairs. Besides, there are various types of primitive in virtual maintenance. Different primitive has different motion feature. We will decompose a single primitive into several parts and build parameterized models for each part respectively.

5.1 Primitive Decomposition

As noted earlier, different primitives have different motion features. For example, the body part plays an important role in move module, yet most motions in operate module mainly use upper arm. In the task of hoisting the jack, the virtual human is always crouching himself down, holding the jack with left arm and pulling the rod with right arm. If we generate the body motion, the left arm motion and the right arm motion respectively and concatenate them together. By this means, we can get the animation of hoisting the jack. In order to build the parameterized models easily and create various motions, we decompose the virtual human motion into 3 parts: the partial motion of body, left hand and right hand, and then build parameterized models for each part respectively.

The advantages are as follows. First, building parameterized models for each part respectively is easier than for the whole body. Second, we can generate animation sequences by combining motions of each part, which can make the output motions more diversified.

5.2 Parameterized Motion

We are now in a position to consider the problem of modeling the parameterized motion for each part of the human body so as to synthesis motion in an intuitive way. Different motions have different motion features. For example, the control parameter of walking motion can be step-length, and stair-height is proper in the upstairs motion. We extract the control parameters of daily motions as shown in table 1.

Table 1. Parameterized motion

Type	Parameterization
Catch	Position of the object
Walk	Step length
Turn	Turn angle
Sit	Height of the seat

On the basis of parameterized models, the system generates the animations by using kinematics method. Several kinematics algorithms are in the literature; we use the one suggested by Li [15] to solve the IK problem by using the inverse of Jacobian matrix learned from examples. The method contains two phases: the learning phase and the synthesis phase. A set of matrices is extracted from the motion data using an extended SOM in learning phase. The synthesis process is very efficient because there is no time consuming calculation and produce natural-looking poses in real-time.

As for complex instructions, the virtual human always have to execute several primitives sequentially. Motion synthesis refers to selecting the transition points and creating transitions which is time-consuming. But in our method, as shown in figure 4, the graph transforms the motion synthesis problem into one of selecting sequences of nodes, which stand for some standards postures. So the only thing we need to do is concatenate the segments of the movement sequentially, so as to obtain the natural-looking sequences by instructions.

6 Experiments

Our tests ran on ordinary PC with Intel Core2 Duo E8400 (3.00GHz), 3.25GB RAM, 512MB video Memory. We have developed a simulation system using .net 2008 / Python based on Windows XP operate system. All the motion capture data was obtained by Vicon with sampling frequency of 120Hz.

6.1 Script-Parsing

We have defined several instructions in Python. Take the behavior of moving ladder for example, which is shown as below. We initialize the behavior and the parameter list, and then generate the move and operate primitive respectively. Finally return the motion sequence of moving ladder.

```
class bMoveLadder(Behavior):
  def __init__(self, human):
          Behavior.__init__(self,human);
  def InitializeParameterList(self,paraList):
        paraList.Add("InitialPosition", Matrix4F);
  def GenerateMoveMotion(self):
  #human moves from place to place
  def GenerateOperateMotion(self):
  #human operates the object
```

When the motion of each module is obtained, we can get the finally sequence by concatenating the motion separately.

6.2 Primitive

We used several assembly-oriented maintenance instructions to test our system. Some of the resulting animations are shown in the accompanying videos.

Once the motion capture data was obtained, we build parameterized models for different types of motion in primitive level. Type of move module is always concrete

into the following type: walk, run, jump, sidewalk, and crawl, which is shown in table 2. Posture module can be concrete into stand, squat, sit and so on, as shown in table 3. Operation module can be divided into rotate, push, pull, lift, press and so on, which is shown in table 4.

Table 2. Motion Type of move module

#	Type	Description
1	Walk	Walk, go, move
2	Run	Run, crow hop, scamper
3	Jump	Jump, Skip, Leap, Hop
4	Sidewalk	Sidewalk, Sidle
5	Crawl	Crawl, creep, grovel

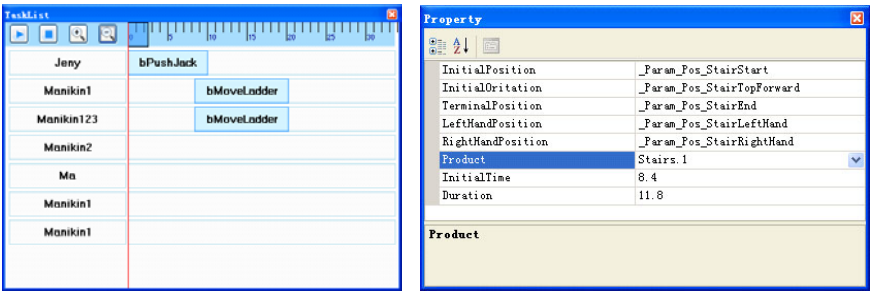
Table 3. Motion Type of posture module

#	Type	Description
1	Stand	Stand, halt
2	Sit	Sit, take a seat
3	Squat	Squat, crouch, hunker

Table 4. Motion Type of reset module

#	Type	Description
1	Rotate	Rotate, wring, rotate to open/close, revolve to in/out
2	Push	Push, insert, squeeze in
3	Pull	Pull out, draw out, pump
4	Lift	Lift, hold, carry, take-up
5	Press	Press, push down, pat

Now we will explain how to assign the parameters for each primitive. Taking the instruction of moving the ladder for example, we can specify the humanID by dragging the module of moving ladder to the task line of the human as shown in fig 6(a). Then we choose the parameters from the pull-down menu as shown in fig 6(b).



(a) (b)

Fig. 6. Assign the parameters for primitive

6.3 Motion Synthesis

Our method can generate motion sequences by giving instructions and some necessary parameters. As a result, it is possible to make motion simulation, like maintenance simulation, in some non-immerse system. Figure 7 shows the animation

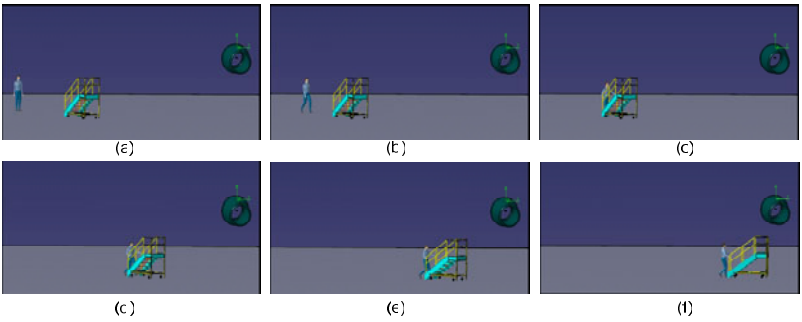


Fig. 7. Synthesized motions from the instruction of “moving the ladder to some destination”

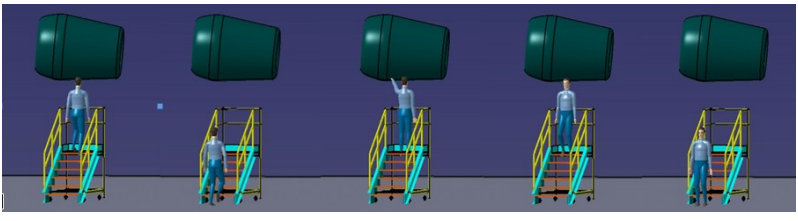


Fig. 8. Synthesized motions from the instruction of “changing the oil filter”

sequence of "moving the ladder", which is 10 seconds long. Similarly, figure 8 shows the animation sequence of "changing the oil filter" last approximately 10 seconds generated by our system.

7 Conclusion and Future Work

This paper presents a method that synthesis assembly-oriented motion at instruction level in an intuitive manner. This method convert the user’s input maintenance instructions into final natural-looking animation motions. The experiments show our method can generate motions with interactive ability, as well as give us the high level control over the synthesized motions and the rapid modeling of assembly process.

For future work, we should be interested in the following aspects. In the motion synthesis phase, the physical simulation can be considered on the basis of our method. For example, body balance and eye view can be added while the virtual human is moving to generate more realistic animation. Besides, the study of the intelligent virtual human should be continued in order to avoid obstacle autonomously and have path planning ability. Additionally, more applications based on our method, e.g. synthesizing the collaborative assembly sequences, should be explored in the future.

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Driving Distraction Analysis by ECG Signals: An Entropy Analysis

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Abstract. This paper presents a novel method in driving distraction analysis: entropy analysis of ECG signals. ECG signals were recorded continuously while 15 drivers were driving with a simulator. Mental computation task was employed as driving distraction. Sample entropy and power spectrum entropy of drivers. ECG signals while they were driving with and without distraction were derived. The result indicated that entropy of drivers ECG signals was sensitive to driving distraction and were potential significant metrics in driving distraction measurement.

Keywords: Entropy, Driving distraction, ECG signal.

1 Introduction

The increasing use of on-board electronics and in-vehicle information systems has made driving distraction a major concern in the driving safety field [1]. When drivers manage another task while driving, e.g. listening to the radio, holding a cell-phone conversation, employing on-board navigation system, the distraction of attention will decrease their performance, even causes traffic accident.

The analysis and recognition of driving distraction is significant to safety since it is the basis of avoiding distraction and the design of in-vehicle information system (IVIS) and other driving aided devices. Most of the studies focused on driving behavior and performance related to distraction. Eye movement and driving performance were investigated to analyze and identify the distraction in driving [2][3]. D'Orazioa et.al. established a visual framework to estimate the drivers' inattention while driving with secondary task [4]. Reaction Time on secondary task along with driving performance was recorded to explore driving distraction activity also [5].

Model for inferring psychological significance from physiological signals has been built since 20 years ago [6]. Physiological signals have been widely used in emotion recognition [7] [8] [9] [10]. However, to the limit of our knowledge, only a few study investigated drivers' functional state associated with driving workload by physiological indices. Jennifer, Healey and Rosalind monitored drivers' physiologic reactions during real-world driving situations using physiological sensors [11]. Electrocardiogram (ECG), Electromyogram (EMG), Electrodermal activation (EDA) and respiration were

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recorded and were used to evaluate the stress of drivers in different driving task. Collet, Clarion and Morel et.al. evaluated the strain undergone by drivers when they managed the secondary task while driving. Electrodermal activity and instantaneous Heart Rate (HR) were recorded [12]. ECG is one of the widely used tools to explore cognitive requirements of complex task performance [13][14]. Most of the studies employed Heart Rate (HR) and Heart Rate Variability (HRV) to evaluate mental workload [11][12]. Few studies had explored the correlation between the original ECG signal and mental workload.

In the present research, we explored drivers' distraction by the original ECG signals through entropy analysis. In our experiments, drivers drove with and without secondary task respectively in a driving simulator. ECG signals were recorded while operation and performance data were recorded either. The ECG signals were analyzed in time domain and spectrum domain. Sample entropy can describe the complexity of a time series. Our hypothesis was that the complexity of the ECG signals of drivers with and without distraction would be different significantly. Therefore, we calculated the sample entropy in different time scales of the original ECG signals and compared the values in the two situations. Power spectrum entropy is often used in biomedical engineering, e.g. cerebral ischemia detection [15], sleep stages [16], myocardial infarction patients diagnosis [17]. In the present research, we derived the power spectrum entropy of the original ECG signals and tried to make it one of the metrics of drivers' distraction. The result indicated that the sample entropy and the power spectrum entropy of the original ECG signal were sensitive to driving distraction.

2 Material and Methods

2.1 Participants

The participants were 15 licensed drivers aged from 18 to 50 years (mean 25, SD 5.2). There were 7 males and 8 females. All the participants were healthy and not receiving medication. They gave their informed consent after having been informed about the main contents of the experiment and were paid for their participation.

2.2 Procedure

The experiment took place in a driving simulator. The driving environment was a one-way driving, three lanes highway scene in the simulated driving task. The driving task was car following. Drivers were required to follow the head car while it changed lanes, stepped on the accelerator or brake. They should operate the steering wheel, accelerator or brake of the simulator so that the following car can close to the head car as near as possible while avoiding collision. The management of the dual-task was made under driving conditions. The secondary task was double-digital addition mental computation. After 20 minutes exercises which made drivers familiar to the operation of driving simulator, the drivers performed the experiment included two sessions: driving without secondary task and driving with secondary task. The mental

computation problems were presented to the drivers by a clear female voice through earphones while they were driving. Each problem was presented for 10 seconds. Participants spoke the result of their computation to the microphone. The number of mental computation problems was 60. Each session lasted 10 minutes.

2.3 Apparatus

The driving simulator consisted of two parts: first, simulated car operation device including control stick, accelerator and brake pedal. Second, driving behavior surveillance system based on computer consisted of driving task presentation, recording of driver's reaction, data management, feedback of driving state and alarming modules. ECG signal was recorded by KF2 dynamic multi-parametric physiological detector. This kind of wireless wearable physiological detector can record multiple physiological indices include ECG with 3 leads, respiration and body temperature. The data can be analyzed by a data processing software. Figure 1 shows the physiological detector and the driving simulator.

Fig. 1. The KF2 dynamic multi-parametric physiological detector and driving simulator

2.4 Data Collection

Driving performance and ECG data were collected. The driving performance data was recorded by the computer integrated with the simulator. Participants wore the physiological detector before the start of the experiments and began to record ECG signal until the end of the experiments. The ECG signal was sampled at the rate of 250 Hz.

3 Data Analysis

Physiological parameters were related to the Autonomic Nervous System (ANS) functioning. The ANS is known to give a close estimation of subjects' arousal especially through the orthosympathetic branch [18] specialized in mobilizing energy resources in response to internal and external milieu demands [19]**.** The energy resources needed in driving with and without secondary task should be different. Thus the physiological features should be different in the two situations. We derived sample entropy and power spectrum entropy of the original ECG signals in the two cases and tried to explore the effect of driving distraction in ECG signal. Original ECG signals were first denoised by discrete wavelet coif4. Sample entropy and power spectrum entropy were calculated consequently.

Sample Entropy is a statistic representing the self similarity of a time series [20]. The more complex the time series is, the larger the sample entropy is. In other words, the more self-similar the time series is, the fewer the sample entropy is. Fewer data is needed to derive robust estimation of sample entropy compared to some other statistics such as approximate entropy, kolmogorov entropy. Thus sample entropy is widely used in the study of experimental clinical cardiovascular and other biological time series. The calculation of sample entropy can be seen in [20]. Furthermore, on account of the multiple time scales inherent in healthy physiologic dynamics, Costa et.al. introduced multi-scale sample entropy [21]. We calculated the multi-scale entropy of the ECG signals in the two experiment sessions respectively. The scales lasted from 1 to 10.

Power Spectrum Entropy (PSE) is the entropy of the power spectrum of a time series. It describes uncertainty of the energy distribution of the time series in each frequency. The larger the PSE is, the more uniform the energy distribution is. The power spectrum entropy of the ECG signals in 6 frequency bands which corresponded to the main components of ECG signal were calculated.

4 Result

First, the multi-scale entropy of drivers with and without distraction are significant different. The univariate repeated measures F-test of the multi-scale entropy showed that significant levels in all the scales are less than 0.05 except for scale 1 ($F(1,14)=3.641$, $p=0.077$). Figure 2 describes the difference between the two cases. Sample entropy with distraction in each scale was larger than that without distraction which indicated that distraction would increase the complexity of ECG signal.

Table 1 is the PSE of the drivers' ECG signals with and without distraction. Line 4 and 5 are the result of univariate repeated measure which indicated the significant effect of distraction in the PSE of the critical bands of ECG signal.

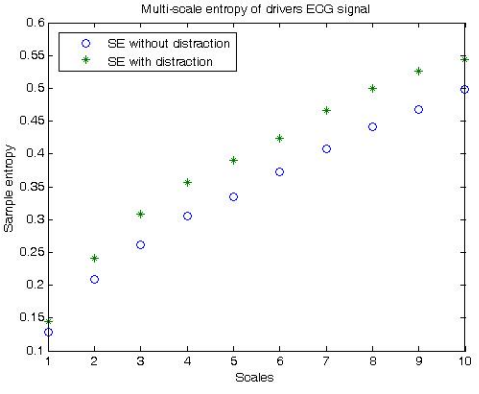

Fig. 2. Multi-scale entropy of drivers' ECG signal with and without distraction

Table 1. Power Spectrum Entropy of drivers' ECG signals

	Whole band	0~1.5Hz	0~4Hz	0~8Hz	0~20Hz
PSE_driving without distraction	4.0600(0.6283)	0.2332(0.1423)	0.5677(0.2934)	1.5585(0.7053)	3.5558(0.6945)
PSE_driving with distraction	4.1270(0.5965)	0.3169(0.2432)	0.6455(0.3528)	1.6213(0.7164)	3.6239(0.8727)
Univariant repeated measure	F(1,14)=4.5	F(1,14)=3.592	F(1,14)=3.913	F(1,14)=5.142	F(1,14)=5.694
p	0.052	0.079	0.068	0.040	0.032

The value of PSE in table 1 is mean and standard deviation (in the bracket) .

5 Discussion

Entropy analysis is a non-linear dynamic method. ECG signal is a kind of complex non-linear signal. Result of our experiments indicated that entropy analysis of ECG signal was meaningful to the analysis of drivers' functional state in driving distraction. Sample entropy can describe the complexity of a time series. Figure 2 showed that the sample entropy with distraction was larger than that without distraction. We tried to

give a possible explanation that the distraction increased the mental workload which changed the functional state of the drivers. The change increased the complexity of the ECG signals. Similarly, we found that the power spectrum entropy of ECG signals which described the uncertainty of the energy distraction in spectrum domain was different in the two situations. The PSE in driving with distraction was larger than that in driving without distraction also. The results of the entropy in time domain and in spectrum domain are consistent.

6 Conclusion

The results of our experiment indicate that entropy analysis of ECG signals in driving is meaningful. The significant difference of entropy of driving with and without distraction shows that entropy of ECG signals is sensitive to driving distraction. This make entropy of ECG signals, either in time domain or in spectrum domain, be potential significant metrics in driving distraction measurement. Consequently, this implies that we can get benefit from the entropy of ECG signals in the recognition of driving distraction which is significant in some engineering psychology studies.

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Menu Design of Digital Photo Frame for Older Users

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Abstract. The advancement of image technology has escalated the development of digital camera devices and shifted the way people view and store photos. Touch screen digital photo frame, as a marginal product with the digitalization, also becomes commonly and widely accepted. With the senior citizens on the rapid increase that structurally changed with the aging society, unignorable attentions should be paid to methods for more friendly and user-centered design of digital devices for improving elder users' experience. This study set out to examine elders' performance and preferences for menu design of digital photo frame. Research data was collected from 24 subjects using the paper prototyping method. Results of this study show the preference toward exhaustive but not burden display, habitually perceivable message structure, and slightly magnified size for both the display and icons. This study concludes with the suggestions to future research and design practices of digital photo frame.

Keywords: Menu design, Icon design, Digital photo frame, Paper prototype, Gerontology.

1 Introduction

Information and communication technology is of crucial importance for daily life in the modern era. It affects living convenience and contentment, and contributes to one's perception on their living quality. For the elderly population in specific, ICT has been considered as powerful to facilitate and improve their feelings of connectedness with their families and the society as well (Davies & Nolan, 2006). Taking photowork (Kirk, Sellen, Rother, & Wood, 2006) as an example, the flow of photograph capture, storage and display has been significantly engaged with digital devices (Choi, Lee, & Koo, 2010). However, while a large number of related works focused on innovations of image technology (Apted, Kay, & Quigley, 2006; De Voegt, et al., 2010; Frohlich, Kuchinsky, Pering, Don, & Ariss, 2002), research on the needs and experiences of the users is not exhaustive.

On the other hand, in response to the current structure change in global population, the world in general and developed countries in specific have been predicted to suffer rapid aging problems in the near future. Additionally, value of families and family bond has shaped a relatively unique social connectedness between senior citizens and their offspring in asian countries. The needs to enrich and enhance the quality of life

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grow along with the increasing number of aging population. In Taiwan, Council for Economic Planning and Development of Taiwan (2010) addressed the coming of aging society with the predictive ratio of senior citizenship grown up from 10.7% in 2010 to 45.6% in 2060. This projection not only suggests that gerontogocial products would be then the major merchandize for the society, but also implies emerging needs and possibilities of ICT to be involved in elder appliances in the future. In order to meet these future needs, understanding of the users now is necessarily important.

This study focuses on photograph display as a symbolic phonomenon that reflects social life of the elder people. Photo frames are usually considered to be part of the furiture or decorative objects that blend in the home environment, which serve as constant reminders of the emotional feelings and mark those significant family events. Photo frames highlight the value and importance of the static images, which is evident while the elders initiate and manage a conversation with a photograph. Consequently, it is important to provide suggestions for forthcoming designing digital product that will offer engaging content combined with an interface that seniors can easily and pleasurably use. In this vein, this study takes touch screen digital photo frame as the benchmark product to examine its usability from a set of criteria including elders' perceptions, needs, preferences and interactions with the interface.

2 Interface Design for Older Users

The aging of population and increasing societal reliance on computers are two prominent trends (Saunders, 2004). With the lower technology affordance elder users usually bare, the learning barrier of digital products for them is generally high due to the degeneration of sight, memory and cognitive ability (Miller, 1956; Zajicek, 2001). As a result, in design for elders, the well documented effects of aging should be taken into account carefully due to the disability and illness increased as we aged, especially in losses in vision, cognition, and motor skills (Apted, Kay, & Quigley, 2006; Morimoto et al., 2001).

Previous studies have suggested several differences on interface preferences between elder and general users. Opalinski (2001) found that senior users claimed several features of computer and digital products, including the simplicity of instruction or tutorials, less expensiveness, adaptability, and ease of repairing. Studies regarding touch technologies advocate the intuitiveness and ease of operations for elder and novice users to directly manipulate virtual objects in natural ways (Albinsson & Zhai, 2003; Apted et al., 2006; Jin, Plocher, & Kiff, 2007; Shneiderman, 1991). On the other hand, control mechanism and interface have also been of enthusiastic discussion in related research works. Sears (1991) believed that user performance and preference will be influenced by the size of keyboards, and the larger size leads to better performance (Sears, Revis, Swatski, Crittenden & Shneiderman, 1993). A key or icon designed to be touched easily will attribute to low error rates for novice users. For elder users who are not familiar with the digital products, a similar design with clear and immediate reacting icon may decrease the anxiety and change their attitudes to more positive views on the products. Regarding the controlling accuracy, Hall, Cunningham, Roache, and Cox (1988) claimed that icon of 26mm per side results in highest accuracy on touch screen panel. Recent studies on mobile technologies indicated that older users preferred larger icons

(20 mm) in contrast to younger participants in the research on physical interaction with PDAs (Pease & Pease, 2001; Siek, Rogers, and Connelly, 2005). It is noticeable that in spite of the general preferences reflected by varied user groups, user performances are, on the other hand, greatly influenced and interfered by the format of the digital products and the major tasks they perform with the products. For elder users who work on capturing, archiving, searching, browsing, sharing and framing (Frohlich, Kuchinsky, Pering, Don, & Ariss, 2002; Kirk, Sellen, Rother, & Wood, 2006; Rodden & Wood, 2003), to design and develop suitable and efficient user interface still call for empirical and specific research efforts.

In sum, this study sought to testify the optimal icon size of digital photo frame for elder users based on their preferences. Specific user features such as degenerating sights, memory and cognitive abilities are taken into design considerations when developing the prototypes to cope with the general limitations and individual differences reported above.

3 Experiment Design

3.1 Subjects and Instruments

According to the purposes of study, 24 elder users ranged from 55 to 75 years old who had experiences with digital products are recruited by judgment sampling and pearl growing techniques (Narayanan, Bailey, Tendulkar & Daley, 2002). The sample of 24 users is proportioned to user gender and age.

This study adopts Liddle's (1996) paper prototyping technique in the experiment. The experimenter manipulates the paper prototype in response to the elder users' immediate feedback. User preferences toward the physically functional attributes including display size, icon size and numbers are measured and analyzed to inform the design of the digital photo frame.

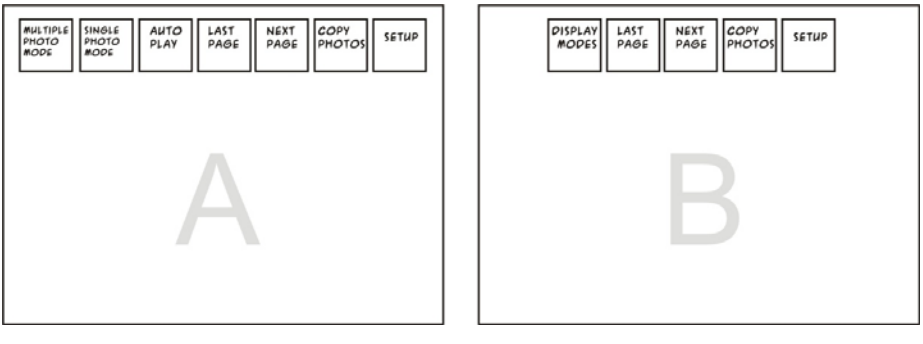

Fig. 1. Design A and Design B

Two designed layouts are tested in the experiment. The sizes of both displays are 17.78cm x 12.70cm as shown in Figure 1, while Design A is distinguished from Design B in the number of icons. There are seven icons in Design A: multiple photo mode, single photo mode, auto play, last page, next page, copy photos from memory

card, and setup. Five icons in Design B are display modes, last page, next page, copy photos from memory card, and setup. Design A adopts flat menu by presenting 3 peculiar functional icons for display on the first-level. Design B adopts cascading menu design by dispensing functional icons to secondary levels.

3.2 Procedures

All participants are required to fill out the questionnaire in which personal background, experiences and computer literacy are inquired. The researcher gives an instruction of the paper prototype of photo frame, and the following tasks users will be undertaking. Second, with the instruction given ahead, every single user is assigned to conduct four tasks of copying, deleting, searching and displaying with the paper prototype during the experiment. The order of the tasks is pre-determined according to user proportion in order to leverage order effects.

Copy: Copy the photos from memory card.
Delete: Delete the appointed photo.
Search: Find the appointed photo.
Display: Set photos play automatically.

Thirdly, every participant is then interviewed individually for their preference over different layouts and functions. By the size of the display and the number of icons, this study composed 6 sets of experimental panels. Users are asked to rank the six sets and three different icon sizes respectively during the interview. Lastly, every participant is asked to sort the substantial icons and arrange selected icons freely on assigned paper photo frame which sized 17.78cm x 12.70cm.

There are two researchers accompanied the subjects constantly in each experiment. One sits behind the paper prototype of digital photo frame to interact with the participants. The other monitors the experiment in the observation room with one-way mirror and records users' reaction time and logs by digital camera. User reaction time refers to the time of completing each task after the given task instruction. It is measured and recorded in this study to note the reaction process of each participant to understand work efficiency of operating the prototype.

4 Results

The participants of this study are 24 elders aged from 55 to 75 ($M = 63.38$, $SD = 6.52$) in the northern part of Taiwan. Male and female participants are of equal number. According to their experiences of digital camera, male and female groups were then divided into two sub-groups of 6 for each. The participants are asked to evaluate their self abilities to use digital products. Most of the participants regard their abilities as lower than the general average.

Of each assignment for both Design A and B, mean reaction time (RT) was recorded. Specifically, participants reacted faster with Design A than with B over the tasks of deleting ($M = 77.75$ sec < 104.5 sec) and displaying ($M = 3.63$ sec < 13.63 sec) photos. Based on the observation logs, most of the participants failed the tasks of deleting photos while they reflected difficulty to recall, recognize and manipulate the menu.

After operating the paper prototype with assigned tasks, the participants were asked to choose which design they preferred most from Design A and B. Of the 24 participants, 5 persons reported a general preference of Design B, despite that much time was spent in deleting the appointed photo and setting photos play automatically.

Table 1 shows participants' preferences for the size of display and the numbers of icon. Design 6 was the most satisfied interface design and the Design 1 was the least satisfied design. The result showed the participants preferred larger size of digital photo frame since the average scores from Design 3 to 6 were all higher than the average. It is notable that mean of Design 2 was higher than Design 1, and so did the comparison between Design 3 and 4, and between Design 5 and 6. The results suggested that under the same display size, elder users preferred more icons on the menu, which is also identical when 19/24 of the users like Design A more than Design B.

Table 1. User Preference for Display Size and Icon Numbers

Design	1	2	3	4	5	6
Size of the Display	S	S	M	M	L	L
Number of Icons	5	7	5	7	5	7
M	2.25	2.38	3.46	4.29	3.88	4.75
SD	1.72	1.31	1.25	1.36	1.42	1.64

Note. N=-24. Scores (1-6) were transformed from the ranking results.

The ranking result of the preferred icon sizes was transformed into weighted scores. While the participants ranked the three sizes of the icon, the most preferred one gets 3 points and the least preferred one gets 1 point. According to the result, the medium size (2 cm x 2 cm) is most liked by elder users (M=2.62, SD=0.49), followed by the large size of 3 cm x 3 cm (M=1.96, SD=0.80), and the small size (1 cm x 1 cm) was considered least preferred (M=1.42, SD=0.65).

5 Discussions

The results of this preliminary study supported the questions of older people's preference for digital photo frame. In general, Design A with more keys was generally perceived as easier to manipulate for its flat presentation of all functions. This result was corresponded to the recommended DoF (degree of freedom) of input devices cause efficient operation (Miller, 1956; Nakata, 1998) since Design A was designed with 7 keys. According to the participants in this study, Design B with only 5 keys looked simple before they interact with, however, after the experiment they found insufficient information provided on Design B that made them confused and therefore resulted in spending more time to search to complete assigned tasks. It was common that participants experienced failures of recall, recognition and manipulation during the task of deleting photos in which most error occurred by researchers' observation. Likewise, it was notable that elder users made fewer mistakes while operating the interface with more function keys; instead, more mistakes were made by interacting with fewer icons, which echoed Sears's previous studies (1991; 1993). To sum up, the sufficiency of recognition significantly impacted elder users' preference. In addition,

the result of this research indicated that the elders preferred medium key size (2 cm x 2 cm) which was quite close to the research of Siek et al. (2005). They claimed that elders preferred larger icons in comparison with the younger participants because it was easier to see the details.

As shown in Figure 1, visualizing with self-related images led to higher evaluations for the incremental products (Dahl and Hoeffler, 2004). This research supported the result that the experience of digital camera will probably have influence on the preferred layout of digital photo frame in this study. Moreover, the participants in this study experienced the utilizing process with the designed paper prototype. It is speculated here that the intuitive operation might help the participants learn from the experiments thereby changed their initial experience. Consequently, it can be inferred that for the participants without experience of using digital camera, the arranged layouts were identical to the paper prototype designed in this study was influenced by the experience built up during the experiments. This was relevant to the research of Hoeffler and Ariely (1999) that the initial experience was shown to influence the participants' preference.

Although the senior generation, 55-75 years old in this study, has reported different needs and preferences from other age groups, generally they were not conservative to use digital photo frames. The results have shown that exhaustive interfaces, flat menu structures and moderate key size were favored even with more searching time, which were evident for the recognizable design of gerontological interface. Larger samples with different age groups of elders could be taken into consideration in the future studies to reveal more preferable and specific needs. And the user testing with the genuine product of digital photo frame is also suggested for empirical studies if possible to confirm the effects of computer anxiety over the elder users. While the majority of the current digital photo frames is of similar size, it is suggested by this study that alternative sizes of the display should be taken into consideration for the use of different target users. Also, the customized menu for elder users to manage and arrange is preferable for the panel design of digital photo frames.

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Effects of Different Visual Feedback Forms on Eye Cursor's Stabilities

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Abstract. In this paper, we present an attention task experiment that investigated the effects of different visual feedback forms on the eye cursor's stability to find out the well-formed visual feedback. The different feedback forms were designed for dwell time, the eye cursor, and the center of the target (marked as a focus area). Our experimental findings can provide useful implications for the design of eye-controlled interfaces.

Keywords: Gaze input, visual feedback, eye cursor, stability.

1 Introduction

In recent years, the advancement of eye tracking technologies facilitates the applications of gaze-based interaction in different circumstances. Monitored by an eye tracker, the user's eye gaze can be used as an independent input channel to control the computer, or it also can be used as an augmented input channel in the process of human-computer interaction (HCI) to provide the user with additional assistances. However, human eyes inherently are not control but perception organs. This situation results in two typical problems of gaze input. One is that there is a lack of command activation mechanism, leading to the so-called "Midas Touch" problem of gaze input. To avoid this well-known problem, the mainstream solution requires the user to dwell on the desired target for a given time threshold.

Unfortunately, the use of dwell time as the indicator of the user's real intention can probably lead to the other problem. When the eyes are unnaturally used as control organs, they serve as both input and output channels at the same time, probably causing some inevitable conflicts. For example, the user's attention will be distracted when he/she is focusing on a target for a short while to activate the corresponding command but an accidental feedback of the system is suddenly presented on the screen. This kind of distractions will interrupt the progress of gaze-based interactions, such as the typical task of dwell-based eye pointing. Because the cursor is located at the user's gaze point on the screen and simultaneously moves with the gaze. In other

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words, the gaze input device (eye tracker) can detect the user's eye gaze in real time and the application system can synchronize the cursor with the gaze position.

Unlike the manually controlled cursor, the eye-controlled cursor is unstable and cannot be exactly fixed on the desired point. This situation is related to three factors as follows:

- Eye jitters. There is a kind of unconscious eye movements, i.e. inherent eye microtremors, even when the user is intentionally staring at a steady target. This is one of the physiological features of human eyes. This feature makes the corresponding data flow of the user's gaze points appear to be noisy.
- Performance limitations of eye tracking technology. The tracking accuracy limitation and the random errors produced by the specific algorithm of estimating gaze point also result in noises in the data flow.
- Changes in user interface. As the eyes are a kind of perception organs, the user, in general, moves his/her eyes to detect what is happening around. In graphical user interfaces, the changes, such as dynamic visual feedback, can attract the user's attention with the shift of his/her point of view.

Recently, Zhang et al. proposed a new performance model for gaze-based interactions [23] as expressed in Equation1 as follows:

$$T = a + b \times \frac{e^{\lambda A}}{W - \mu} \tag{1}$$

where A and W denote the movement distance of the eye cursor and the target size, respectively, both of a and b are regression coefficients, and the symbols λ and μ are two empirical constants. λ is a very small decimal (in the level of 0.0005), directly reflecting the feature of saccadic eye movements, i.e. the lower contribution rate of A to target selection time (T). μ is a measurable parameter, denoting the average diameter of the areas where the unstable eye cursor is dwelling for target acquisitions (i.e. command activations). This parameter probably can vary in different situations, e.g. different gaze input devices. The fraction term is defined as the index of difficulty (ID_{eye}) for dwell-based eye pointing like the well-known logarithm term in Fitts' law for hand pointing. Pointing task is the dominant task type in different graphical user interfaces. As Zhang et al.'s experiments revealed, the correlation between ID_{eye} and T was strong enough ($R^2 > 0.9$). One of the implications of the model is that the eye cursor's stability can significantly affect the user's capability of dwell-based eye pointing. According to the aforementioned factors causing the eye cursor to be unstable, besides designing feasible underlying algorithms to alleviate the effect of the signal noises [15, 22], it is also very necessary to carefully take account of the design of visual feedback because in graphical user interfaces (GUI), visual feedback is a useful form to inform the user whether or not the system is under control as expected, regardless of the possibility that visual feedback can disturb, frustrate and even defeat the process of gaze input.

In this paper, therefore, we present an attention task experiment that investigated the effects of different visual feedback forms on the eye cursor's stability. In our experiment, the visual feedback was designed for the elapse of dwell time, the visibility of the eye cursor, and the center of the target (marked as a focus area or not).

Our purpose is to find out the well-formed visual feedback that can benefit gaze input without significantly distracting the user so as to avoid the deterioration of the stability of the eye cursor. Our experimental findings can provide useful implications for the design of eye-controlled interfaces.

2 Related Work

The stability of the eye cursor is a significant factor that can affect the human performance in gaze-based interactions [22]. In order to improve the eye cursor's stability, Zhang et al. proposed several simple but effective algorithms to constrain the noises of eye gaze input signals. Unlike Kumar et al.'s efforts of filtering the noises using different algorithms [15], such as a Kalman filter with saccade detection, the key of Zhang et al.'s solutions was to make the signal noise "recessive", without the need of a specific algorithm to detect saccadic eye movements. Therefore, there was no predetermined time window required for the detection of saccades or the other types of eye movements. In this situation, the gaze input signals almost can be synchronous with the user's eye movements, without damping the speed of eye movements.

Zhang et al.'s work as well as that of Kumar et al. processed the raw data of gaze input using underlying algorithms. It was coincident with the observation of Majaranta et al. that the majority of the research on eye tracking applications did not concentrate on the UI design issues but on the basic technical aspects in the past of the last decade [17, 18]. With the advancement of eye tracking techniques, there had been a number of applications of gaze input, such as the traditional application of text entry (i.e. eye typing) [21, 17] and the novel applications of reading assistant [9, 19], coordination of multiple applications or systems [4, 1], game entertainments [20], mobile environment [2], virtual reality [11, 8] and even personal privacy and information security [13]. Therefore, it is necessary to carefully take account of the design issues in gaze input user interfaces, especially the use of visual feedback because an improper visual feedback can probably affect the user's gaze behavior so as to frustrate the process of gaze input.

The necessity of visual feedback for HCI is well-known. Visual feedback is a meaningful cue for the user to know the current state of interactive systems and infer whether they are responding to the user's action as the anticipation or not. In gaze-based interaction systems, visual feedback is also often used for different purposes [17]. Istance et al. pointed out that the user could be explicitly aware of which target on the screen was "captured" by his/her gaze, avoiding the accidental activation of undesired commands, when given a clear feedback [10]. Unlike hands, there is no explicit command activation mechanism for human eyes, resulting in the well-known "Midas Touch" problem of gaze based interactions [12]. Requiring the user to continuously stare at the desired target for a predetermined amount of time (e.g. 900 ms, called dwell time), rather than to consciously blink during the stare, is still the dominant means to activate command and avoid the "Midas Touch" problem in the situation of hand free gaze input. In order to indicate the progress of dwell time, Lankford designed a red shrinking rectangle to highlight the key, on which the user fixated in the on-screen keyboard of the ERCIA eye typing system [16]. At the end of

the dynamic shrinking, the corresponding character was entered just like that the key was hit. This form of visual feedback provided a continuous feedback when the user is waiting for the activation of the key. Regardless of the tedious prolonged dwell time, Lankford also employed different forms of visual feedback at different stages during the progress of dwell time for the user to perform the equivalent actions of click, drag and drop, double click.

Majaranta et al. refined the shrinking form of visual feedback in their eye typing system [18]. They directly shrank the centered caption letter of the key instead of an additional rectangle. Their evaluation experiment indicated that shrinking the letter could help the user steadily focus on the center of the key until successfully "hitting" the key. That is to say, this visual feedback form could partly prevent the common phenomenon of eye typing that the user often glances at the next key before entering the current letter. As the improved gaze behavior they reported, the occurrences of refocusing to repair the unsuccessful keystroke can be decreased, leading to the increase of typing speed. Note that, however, the drift of the user's gaze from the current key to the next is mainly due to his/her clear consciousness about the letter sequence of the word that the user is inputting. This subconsciousness gives the user an impulse to move the eyes to the next "target" before satisfying the criterion of dwell time. It appears that the user generates a trained reflex from the visual feedback to counteract the subconsciousness. In other words, the events of refocusing can be consciously reduced by the user. Majaranta et al.'s experiment revealed this fact. It did not yet sufficiently expose the impacts of only visual feedback itself on the user's gaze behavior in the situation without the impulse of subconsciousness.

Using a traditional progress bar in the *GazeTalk* eye typing system [6, 7], Hansen et al. also provided a dynamic visual feedback to inform the user the remaining time before the activation of the key. In this system, they did not employ a standard QWERTY layout for the on-screen keyboard, thus the keys presented in the dynamical layout were big enough to compensate for the low accuracy of gaze input. They were aware of that the highlighted progress bar likely could lead the user's eyes to follow the move of the bar, but they did not provide a detailed experimental analysis like the work of Majaranta et al. to support this point.

As introduced in the beginning of this section, Zhang et al. addressed the issue of unstable eye cursor from the perspective of signal processing [22]. They carried out an attention task experiment to evaluate the effectiveness of their methods. In their previous experiment, they also took account of the factor of visual feedback. They designed a semi-transparent red "bubble" covering on the target as the medium of visual feedback. The bubble had two modes to indicate the elapse of trial time in the attention task. One mode was that the bubble expands from the center of the target at the beginning of trials to the edge of the target at the end, the other was that the bubble, fully filling the target at the beginning, contrarily shrinks to the center during each trial. Since Zhang et al. just needed to confirm that the visual feedback they used in the other pointing task experiment would not bias the effectiveness of the gaze signal processing algorithms; their attention task experiment did not carefully considered the effects of different visual feedback forms on the cursor's stability. Nevertheless, their previous work provided some useful insights for our current work,

such as the measures from both temporal and spatial perspectives to describe the cursor's stability.

3 Attention Task Experiment

The eye cursor's stability is directly related to the user's gaze behaviour (i.e. the data flow of gaze points), while the gaze behaviour can be affected by the visual communication from the computer to the user. Therefore, it is necessary to reveal the specific effects of visual feedback on eye cursor's stability. We carried out a similar attention task experiment to that in Zhang et al.'s previous work [22], but we deliberately considered the forms of visual feedback for different aspects of gaze input interfaces, including the elapse of invisible dwell time, the visibility of eye cursor and the use of focus area in the target.

3.1 Apparatus and Participants

The software and hardware configurations of the experiment were similar to those in Zhang et al.'s work [22]. We employed a head mounted eye tracker, *EyeLink* II, as the gaze input device. It worked in pupil only mode at the sampling rate of 250 *Hz*. The tasks were presented on a 19-inch CRT display at 1024×768 resolution. Sixteen able-bodied participants (8 females and 8 males), with the average age of 24, successfully completed this experiment. They had normal or corrected-to-normal vision.

3.2 Task and Procedure

Before the beginning of the experiment, the experimenter seated the subject in front of the display. There was a table, of which the width is about 70 cm, between the subject and the screen to maintain a fixed distance. The subject was permitted to adjust the chair to suitable position and height, and she/he also could place the hands on the table to support her/his head. After giving a brief introduction about the task, the experimenter launched and calibrated the gaze input device, and then formally started the experiment. There was no training since the task was intuitive and simple for the subject to perform.

As Figure 1a shows, at the very onset of the experiment, a trial-start button, without being enabled, was displayed at the center of the screen. The experimenter pressed the 'S' key to enable the trial-start button, and then the button could be moved among the nine predefined positions in turn. The trial-start button was rendered as a 24-pixel-diameter round, but its effective diameter was 100 pixels. Once the subject focused on the trial-start button for a very short time (450 ms), it disappeared with the target displayed at the same position and the trial started. The subject was explicitly asked to fixate on the center of the target for 2.5 seconds until the end of the trial. At the same time the subject was also instructed not to chase the visible eye cursor. When the trial ended, the target disappeared and the trial-start button was redisplayed at the next position to repeat the process above.

During the trial, the experimenter was able to suspend the experiment and perform a recalibration if the calibration deteriorated. When resuming the experiment, the

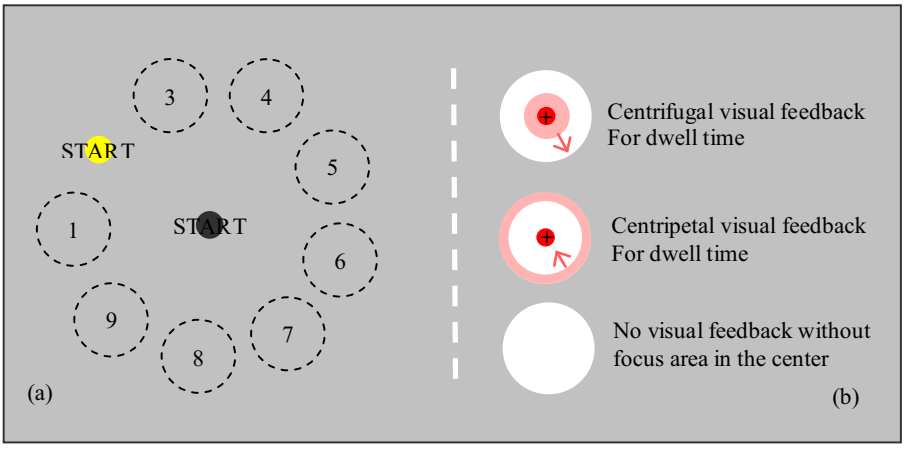

Fig. 1. (a) The experiment interface, the dashed circles just illustrate the positions of the target. (b) The target with different visual feedback modes

experimenter was also able to reset the position of the trial-start button. This provided a chance to undo and redo the trials when affected by the deterioration of calibration.

3.3 Design

This experiment investigated the effects of the following factors at different levels:

- *Visual feedback mode of dwell time (VF)*: As Figure 1b depicts, one mode was that the semi-transparent red color spread from the center of target (*VF1*), while the other spread from the edge (*VF2*). Both of the modes had the same end state that the target was fully covered. The mode of no feedback was treated as a baseline for comparisons (*VF0*).
- *Target diameter (TD)*: The size of the target was at four levels of 36, 46, 60, and 78 pixels.
- *Focus area in target (FA)*: The center of the target was marked using a red small round to help the user focus on the target.
- *Eye cursor's style (CS)*: Three cursor styles, including cross cursor, arrow cursor and invisible cursor, were took into account.

Consequently, the experiment was a (3×4×2) × 3 repeated measures within-subject design. The first three factors resulted in 24 combinations. These combinations presented in a random order during the experiment. For each combination, there were 9 trials resulted from three repetitions for each of the eye cursor conditions. Those trials were performed at the 9 positions as indicated in Figure 1a, respectively, but the order of the visual feedback modes was counterbalanced among the positions. All the 24 combinations, totally including 216 trials, composed a block. The subject needed to finish 4 blocks of trials within one session of about an hour.

3.3 Results

In order to analyze the stability of the eye cursor, we used three dependent variables as Zhang et al. previously used [22, 23].

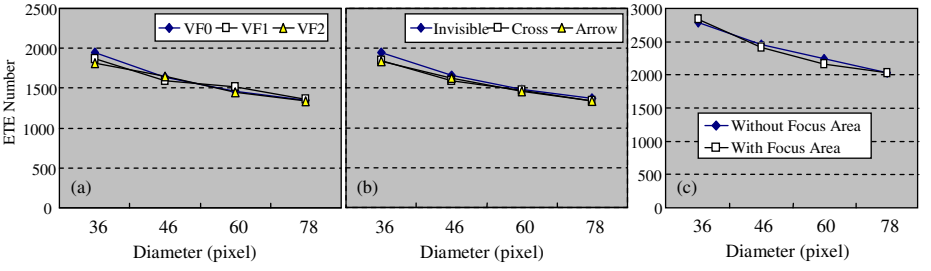

Fig. 2. ETE number by diameter under different (a) visual feedback conditions of dwell time, (b) eye cursor styles, and (c) focus area conditions

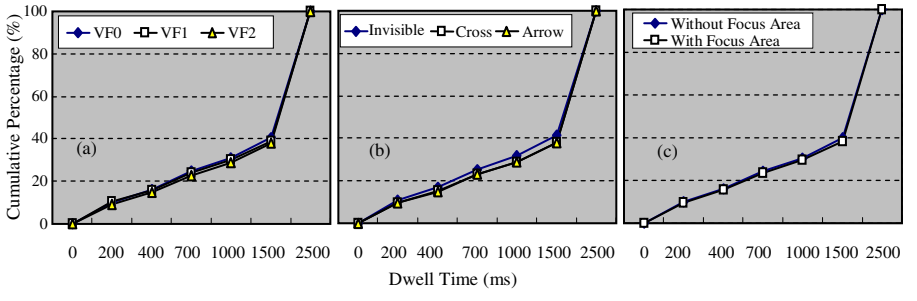

Fig. 3. Cumulative percentage of dwell times under different visual feedback conditions

Eye Cursor's Entering Target Event (ETE). The unstable eye cursor can probably repeatedly enter and leave the effective area of the target. We recorded this kind of event when it happened. We found that there was no significant main effect for the three factors of visual feedback on ETE but only a significant interaction effect VF × TD ($F_{6,90} = 2.43$, $p < .05$). As Figure 2 shows, the different forms of visual feedback did not lead to obvious differences.

Frequency Distribution of Eye Cursor's Dwell Time. Corresponding to ETE, we also recorded the durations when the cursor was inside of the target and count the frequencies of the durations in different ranges as Figure 3 illustrates. Therefore, this is a multivariate measures. It was revealed that there was no significant main effect for all the factors but target size (TD) on this multivariate measure. Univariate test for each dimension also did not observe significant main effect except for the statistically significant effect of the factor CS ($F_{2,30} = 3.50$, $p = .043$) in the first range. Figure 3 plots the total cumulative percentage of dwell times under different visual feedback conditions, without showing obvious differences.

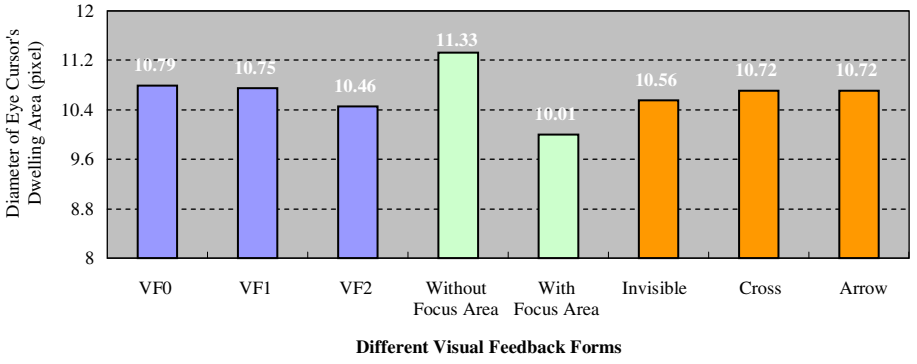

Fig. 4. Average diameter of dwelling areas under different visual feedback conditions

Diameter of Eye Cursor's Dwelling Area. For each trial, when the eye cursor entered the target, its positions were sampled at the rate of 25 points per second. Totally, we collected about five hundred thousand points. According to the sampled points, the average diameter of the cursor's dwelling area in each trial was calculated. We found that there was significant effect for the factor VF ($F_{2,30} = 5.87$, $p < .01$) as well as FA ($F_{1,15} = 85.97$, $p < .001$) on this measure. As Figure 4 shows, it was useful for stabilizing the eye cursor to mark the center of the target as a focus area or to use a centripetal visual feedback, while it did not deteriorate the stability to present a visible cursor because the factor CS had no significant main effect ($F_{2,30} = 0.57$, $p = .571$).

4 Discussion

Although a cursor, following the user's eye gaze, was rendered in some gaze-based interactive systems [14], some researchers [12, 5] argued that a visible cursor was unsuitable for gaze-based interactions because they believed that the user's attention would be distracted especially when the cursor was not accurately located at the user's real gaze point due to errors. However, our experimental results indicated that a visible cursor did not distract the user attention even if there was no focus area in the target. In other words, the user was able to avoid chasing the visible cursor when given an explicit instruction. Furthermore, another study indicated that the human performance could be improved when a visible eye cursor was used [3]. Therefore, presenting the cursor will not damage the usability of gaze-based interactive systems.

Kumar et al. investigated the use of focus points [14, 15], but unfortunately they did not observed a significant effect. Our experiment indicated that using a relatively big area to mark the center of the target, in stead of a grid of small focus points covered on the whole interface, could make the user's gaze points more concentrated, i.e. could stabilize the eye cursor.

Compared with the similar task in Zhang et al.'s experiment [22], of which the trial time was 7 seconds, the time we currently used was shorter. Note that we human beings blink about 12 times every minute in general [24]. The experiment's trial time, 2.5 seconds, did not exceed the average interval of natural blinks. This could largely prevent the experimental results from being biased by the subjects' blinks.

5 Conclusions

Visual sense is the main channel that we human beings perceive the world. When the visual channel is unnaturally used for input (control) in HCI, some potential problems probably could be raised. In this paper, we present an attention task experiment to investigate the effects of different visual feedback forms. Based on a large number of data, our experimental findings clarify that a visible eye cursor will not degrade the usability of gaze-based interactions. Our experiment also indicates that a proper dynamic visual feedback for dwell time and a static focus area in the target can benefit gaze input.

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Usability Evaluation Factors Research in Network Database System

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Abstract. Based on the analysis and summary about the domestic and international network database usability evaluation, this paper hold an idea that the database usability evaluation is one kind of evaluation based on the relationship among three factors like the database system, the content of database and the user. On this basis, this paper built a new set of network database usability evaluation factors, and suggested that we should make an usability evaluation from the following aspects like database effectiveness, efficiency, system performance, 4 level indicators of users' satisfaction and 24 secondary indicators so that the evaluation can be well-targeted and highly practical. Finally, this paper took the case of WANGFA as an example to make an application exploration. Network database is mainly engaged in academic research for researchers. WANGFAN, CNKI, VIP and the National Library & Documentation Centre are top 4 datebases in China that continuously shared by people. Continues to digital and network resource sharing, improving the efficiency of users of digital resources is the main goal of excellent network database. However, in the construction of the database, if simply to pursue advanced automation technology, not care about the user's needs ,convenience, efficiency and other point of usability view, it will not improve the customer satisfaction index and not reach the expect result of the system. Therefore, Usability evaluation for network databases is particularly important. In the perspective of usability, this article created a set of network database usability factors combined with a case.

Keywords: Network database, Usability evaluation, User satisfaction, Chinese Database.

1 Definition of Usability

The definitions of usability in ISO9241/11 and GB/T3187-97 are relatively practical while the evaluation factors proposed by some scholars are much more suitable for research. These researches mainly include three kinds of studies. The first is the evaluation of contents and services provided by system, such as effectiveness (Booth 1989; Shackel 1986, 1991; ISO 1994; Kengeri 1999); usefulness (Booth 1989), ease of use (Shackel 1981; Furtado 2003) and functionally correct (Brinck et al. 2002). The second is the evaluation of user's using system, such as efficiency (Oulanov & Pajarillo 2002; Nielsen 1993), learnability (Hix&hartson1993) and errors (Nielsen 1993). The

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third is the evaluation of the user's subjective feelings, such as the attitude (Booth 1989; Shackel 1986, 1991), satisfaction (Nielsen1993; ISO 1994) and subjectively pleasing (Brinck et al. 2002). Table 1 compares various perspectives on the attributes of usability [1].

Table 1. Attributes of Usability

Autors (time)	Attributes
Shackel (1981)	ease of use, effectiveness
Shackel (1986,1991)	effectiveness, learnability, flexibility, user attitude
Booth (1989)	usefulness, effectiveness, learnability, attitude
Hix&hartson (1993)	initial performance, long-term performance, learnability, retainability, advanced feature usage, first impression, and long-term user satisfaction
Nielsen (1993)	learnability, efficiency, memorability, errors, satisfaction
Dumas&Redish (1993)	perform tasks quickly and easily
Guillemette (1995)	effectively used by target users to perform tasks
Gluck (1997)	useableness, usefulness
Kengeri et al.(1999)	effectiveness, likeability, learnability, usefulness
Clairmont et.al (1999)	successfully learn and use a product to achieve a goal
Outlanov&Pajarillo (2002)	affect, efficiency, control, helpfulness, adaptability
Kim (2002)	interface effectiveness
Brinck et al.(2002)	functionally correct, efficient to use, easy to learn, easy to remember, error tolerant, and subjectively pleasing
Furtado et.al(2003)	ease of use and learning

2 Related Research in Network Database

2.1 Research Abroad on this Topic

Oulanov and Pajarillo (2003) took a two-stage study, compared to two availability which one based on text and the other one based on the availability of New York University Library website. Their standards of the evaluation is impaction, efficiency, control, help and adaption [2]. Sueli Mara Ferrira and Denise NunesPithan (2005) evaluated the InfoHab (the Center of Reference and Information in Habitation) digital libraries, got data from six users which are different from academic background and experience. Their study used some methods including personal interview, library model, direct observation, audio and video. Meanwhile, the study used Usability evaluation criteria such as easy to learn, efficiency, error rate, effectiveness and user satisfaction [3].

Giannis Tsakonas and Christos Papatheodorou (2005) proposed a triple interaction model for digital libraries, electronic journal platform, portals, e-prints and some complex web information service system which required some interaction behavior. This model analyzed the web information services elements of the system(system, content, user), and the relationship between the availability and usefulness [4]. In 2008, combined with other researcher's results, some secondary indicators were added to this model [5].

2.2 Domestic Research on this Topic

At present, the evaluation of network database focused on the following points.

The Evaluation of the Network Database System. As one of the research results of the national social science foundation project "The Establishment and Application of Evaluation Criteria System for Networked Information Resources", WANG Huizhi, YUE Quan (2008) aims to take usage of the Evaluation Criteria System for Networked Databases, nine network databases are investigated and evaluated [6]. TIAN Qing, CHE Yao (2008) launched a series of elaboration on the meaning, the content and the method of the evaluation standard of network database in university libraries [7]. LIANG Lijun, HUANG Xiaoli (2008) used a Fuzzy Comprehensive Evaluation and established a system of network database evaluation which have six-level indicators and 30 second evaluation index [8]; YE Peizhen (2007); YU Xiaochong, HU Manggu (2007); WANG Yuan, LAI Maosheng (2006); ZHAO Wei (2006); ZHANG Liyi (2004) etc. researched the database evaluation in the perspective of database content, search system function, the situation of usage, cost-effective, service.

In these assessments, most of the evaluation is from the overall point of view in the database, the evaluation covers all the aspects of network database; the evaluation factors they selected is lack of a theoretical foundation; the evaluation method is single except the questionnaire.

Research on Evaluation Factors of Customer Satisfaction. GAN Liren, LI Li (2010) identifies key dimensions of information product and service quality provided by library website and develops user satisfaction index model for library website (ICSI-L) with its own characteristics based on American Customer Satisfaction model [9]. LI Li, GAN Liren (2009) explores the perceived quality of information user, identifies the key dimensions of information products and services quality provided by academic database website, and develops the assessment model of information user satisfaction [10]. XIE Zhaoxia, LI Li (2007) proposed ICSI-D model based on the customer satisfaction in scientific literature network database research [11]. GAN Liren, MA Biao (2004), An ACSI-based evaluation framework for the database websites is presented and multi-layer fuzzy integrative evaluation system is applied in database, Then the user satisfaction level of four famous database websites is evaluated.

Usability Evaluation Research in Network Database. LIN Haohui test the three major networks including the homepage, search interface, search performance, page of results and help documentation based on the usability can be understand as five different parts ,efficient, easy to learn, easy to remember, fewer mistakes and user satisfaction [13]. HU Xiaoqing, ZHANG Jianyong (2009) put forward a new set of evaluation indicators of usability on the basis of the traditional evaluation theory of usability, including intelligibility, operability, information accessing, identifying information, errors, efficiency and user satisfaction [14].

At present, the usability evaluation of network database has just started, the related research papers is also less. The existing evaluation is lack of theory, poor in systematic, less in some new availability method, less research in the potential demand, it is not conducive to improve the existing products and services.

2.3 Usability Evaluation Methods

Foreign scholars integrated with a variety of methods during the network database usability evaluation, such as Jones and Sumner (2002), taking web log analyse, collective evaluation, survey instruments, semi-structured interviews and other methods evaluate the national science, technology, engineering and mathematics digital libraries [15]. Dickstein and Mills (2000) research the usability of Arizona State University Library Web site, using the heuristic evaluation, cognitive walkthrough, card sorting, and formal usability methods [16].

MA Cuichang [17], a domestic scholars, supposed that usability test methods in network database contained three parts: investigation, verification and testing-related. we should choose different methods applied the different goals in different steps, look at the Table 2 shows .

Table 2. Network Database Usability Evaluation Methods

Step	Task or Goal	Method
investigation	Understanding the user' needs ,habits and the level of understanding the system through conversation or observation the process of using the system	Ethnography, Contextual observation, Focus Group, Questionnaires、Web Log Analyse and Interview
verification	Usability experts, software developers, users and other experts associated with usability testing	Heuristic evaluation and Cognitive walkthrougn
Testing-related	The evaluators understand the system's availability through operating systems or prototype to perform a specific task by users.	Cognitive walkthrough, Sound thinking
others	Card Sort, Category Membership Expectation, Claims Analysis, Concept-based Analysis of Surface and Structural Misfits, CASSM, Paper Prototyping	

3 Usability Evaluation Model

As mentioned above, the researches of usability evaluation of networking database have poor operability without outstanding secondary indicators of evaluation system. Using Giannis Tsakonas and Christos Papatheodorou's interaction triptych framework model, this article has built a new model, as the Figure 1 shows.

This new model considers that the main point of usability evaluation network database is focus on the relationship between database system, content and users .the system refers to the hardware and software components; content refers to all the database resources; user refers to people who using the resources. System manifested the content (data resources) through the hardware, software; users hope getting the information quickly and effectively, on the other hand, the system should respond appropriately towards the user's behavior. However, the main purpose of the user still hope to get exactly information they need. This mainly reflected in the content on the effectiveness. Therefore, the usability of database system focused on database performance, efficiency, effectiveness evaluation.

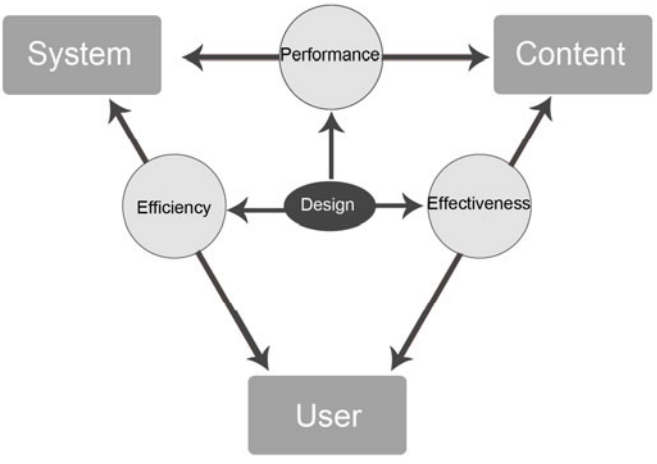

Fig. 1. Usability Evaluation Model

More importantly, this model emphasizes the importance of design. With the help of design, the performance of system can be improved, the content validity can be enhanced, the efficiency of system can be increased and the customers' satisfaction can also be promoted. Such as function planning, information architecture and interface design.

With the network database usability relational factors model and take ICSI-D model supposed by XIA Zhaoixa, LI Li (2007)and ICSI-L model proposed by GAN Liren, LI Li (2010) as reference, adding the user satisfaction index factor, we create the sets of network database usability evaluation factors, as is shown in Table 3.

Table 3. Network Database Usability Evaluation Factors

first-level indicators	effectiveness	efficiency	Performance	user satisfaction
Secondary indicators	related content document classification content authority precision update frequency	navigation category retrieval methods feedback aesthetic glossary level learnability	download speed accuracy memory response time error correction	the possibility of finding anticipated information help function personalized service feedback reasonable charges, is it the best database user complain whether it is worthwhile to continue to use

4 Case Study

4.2 Test Method

In this user test, we choose three key usability research methods. First, heuristic evaluation , 2-3 usability experts was invited to evaluate WANFANG database(The major reason is that our school have bought the all data resources);Second, task walkthrough, we set some representative tasks, invited some users to finish this tasks, use screen recording software to record the user's operation during their operation. In order to find more potential customers demand we combined with contextual interview, sound thinking method and semi-structured interview. Third, satisfaction questionnaires were used after the users finished the tasks.

4.2 Subjects Selected

We take the study from University of Freiburg, choosing four different types of people, because the web searching experience by past is a great impact factor when using the database. In order to find more usability problems, during this user test, we choose four separate users with different experience.

Table 4. Subjects Selected

Types	Introduction	Subject
Web+Usability+	familiar with Web use and "usability" issue	Our team members,3 person
Web+ Usability -	familiar with Web use , unfamiliar with "usability" issue	Out of our team, more familiar with the network database ,5 person
Web-Usability +	unfamiliar with Web use , familiar with "usability" issue	Department of Mechanical Engineering Graduate ,4 person
Web-Usability -	unfamiliar with Web use , unfamiliar with "usability" issue	Freshman,5 person

4.3 Task Design

According to the characteristic of WANGFAN database, five main functional modules were tested, including homepage, simple search interface, advanced search interface, search results and details of the interface. We set 2-3 tasks in each module, covering the main functions. To ensure react the common problem, each subject was required to do the same tasks, but specific to the search conditions (such as author, title, nominations, etc.) were different.

4.4 Discussion

Most users only use simple function of the database system, they input a few keywords; Most users expect search results output in relevant; In the handing of search results, most users visit only a few front pages; the click on the relevant link is less; When the search results can not satisfy the information needs, firstly, users will check the

accuracy of the keywords and different ways of expression, then, choose different types of database, if it is still not satisfied, users will replace other Databse, what's worse, they will give up the research behavior.

When customer use the network database, the goal is so strong, rarely concerned with other non-relative content. The motivation is different from surfing on the net, the former is targeted, while the later purpose is weak and vulnerable to other attractive content.

Correlation analysis is not enough, the current analysis including references, cited documents and related blog posts, it is not fully satisfy the needs of users. Poor in error correction, after the user input a wrong keyword especially the English keywords, the system will not give the right correction keywords.

Primary user is unclear in some terminology. Such as "Classic essay firstly" "Related BOWEN" "Knowledge context", some users can not understanding the meaning. Out of this, in the literature category, lack of some fund categories, users can not retrieve some funds contents.

5 Conclusion

The purpose of usability evaluation is finding more potential needs though a variety of combination methods. To do this, the system availability will be increased, the user experience will be enhanced, customer satisfaction and loyalty will be increased. This study build a set of usability evaluation factors based on the availability of domestic and foreign research results. We suppose that the usability evaluation in network database is focused on the relationship among database system, content and user. The outstanding performance of three aspects is 4 first-level indicators which are efficiency, effective, performance and user satisfaction and corresponding 24 secondary indicators. Through refining the usability evaluation factors, it has a better operability and a good foundation of implementation in the future usability evaluation.

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Part III
Design, Emotion, Trust and Aesthetics

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

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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, Subsitutivity, 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
	Sense-of-Achievement Experience	Input and Output
Reliability	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

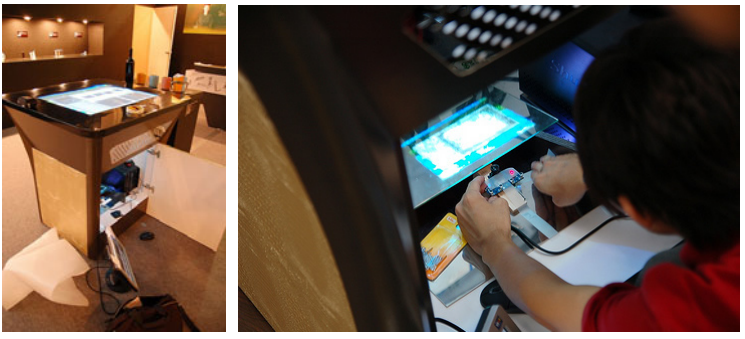

Fig. 2. Maintenance state of the multi-touch table

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*)

	(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;
Tolerance	(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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Seeing the World in 5 Dimensions – More or Less?

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Abstract. The use of computers and mobile technologies challenges conventional experiences of place and ideas about the stability of culture and gives us more choices. We can experience locations in 3-dimensions (face-to-face), 2-dimensions (on-the-screen), or 5-dimensions (mediated through our smartphones). This paper considers some elements of place, space, and geography and suggests the need to consider the values of being lost, knowingly experiencing danger, travelling blind, coming together, putting our bodies on the line, and dealing with change. Ultimately, we should consider what we lose as well as what we gain by moving more of our lives online.

Keywords: Human-computer interaction, sociology of mobility, geography, culture.

1 Introduction

Places shape us. For a start, our birthplace is imprinted in our bones. Forensic scientists have developed analyses to identify the isotopes of common elements found in the food and water that we consumed in childhood. We may move to another continent but we can be traced to our original home [1].

More importantly, geography has long been considered one of the key determinants of culture. Geert Hofstede [2] lists geographical latitude as one of the three predictors[1] of power distance – higher latitudes are associated with lower power distance (more egalitarian) cultures. Hofstede speculates that the relationship between latitude and power distance is historically due to the abundance of nature. At more equatorial latitudes, people were able to organize themselves into farming communities, had a surplus of food to eat, built cities, and confronted enemies who wanted to move into their territory. They needed strong leaders to defend them so they tolerated and soon admired kings and emperors. At higher latitudes, nature was less generous. In temperate climates, people put their energies into industry rather than agriculture, which shifted the social focus to innovation and individualism; farther north (or south), people continued to live in small co-operative groups practicing hunting, herding, or transhumance. Both industrial and hunter-gatherer

[1] The second and third factors are larger population (more power distance) and wealth (less power distance).

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type societies had more need for cooperative relationships and less need for authoritarian leadership.

But today nature and natural abundance are no longer the direct influences on lifestyle that they once were. People in the Middle East "farm" oil; people in Iceland grow tasty tomatoes and carrots in geothermally-heated greenhouses. Tunisians and Egyptians living in an equatorial latitude have forced their dictators to flee; Libyans continue to mobilize against their authoritarian leader as I write this article.

Hofstede further notes that collectivism (which has a positive association with higher power distance) breaks down with economic development and greater personal wealth. Agrarian societies that relied on extended families working together in tight webs of kinship are being replaced by conurbations that attract (and reward) educated, self-motivated individualists willing to take risks. Failure once brought shame to all; those who failed would leave their communities to build new lives in places where they were unknown. Relocation for such a reason is not longer needed – nor possible. As societies become more individualistic, failure has become an often-essential "learning experience." In addition, anyone can find you on Google, and you can find out almost everything about anyone if you are persistent.

Our sense of place is changing; in many ways, we have entered an era of placelessness. Digital natives have inhabited this utopia[2] since birth and the rest of us digital immigrants are slowly looking around and realizing that we are no longer rooted in a geography. If we are over 30, we grew up in a 3 dimensional world; we went outside to play and we shopped "downtown" or at the local mall. We still enjoy going to our local coffee house (or pub) to meet our friends and observe the passing scene. We are not averse to the 2-dimensional world. We work "with" computers. We waste time playing online games, seek out amusing You-Tube videos, vicariously experience travel, or watch breaking news. We send interesting links to our friends by email or text. We may not have the time for a shared coffee but we can share a laugh. But increasingly the world is being experienced in 5 dimensions – our 3-D reality mixes with 2-D representations on our smartphones. We chat face to face with friends while reviewing someone's Facebook page. Our phones tell us where we are and show us messages, photos, and advertisements associated with a variety of geotags.

What happens to the rigidity of place as the boundaries between space and cyberspace dissolve? For a start, the immediacy of the 3-D world tends to be diminished. Transcending physical boundaries and adding practically unlimited connectivity is often surprisingly underwhelming. Further, we may come to believe the place "is" its visual, video, and text representations.

What are the effects on culture as all the world comes together on a small screen?

As we develop better tools to augment and mediate place, we need to consider the advantages we may be losing in a 5-dimensional world. Place is a valuable resource for human experience – and a generative force for human culture and creativity. I argue that six elements of space, place, and geography need to be sustained in both our offline and online worlds:

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[2] Thomas More (1516) named his imaginary island Utopia from the Greek *ou* not + *tóp(os)* a place + *-ia*.

- Being lost
- Knowingly experiencing danger
- Travelling blind
- Coming together
- Putting our bodies on the line
- Dealing with change

2 Being Lost

We can no longer get lost in the 5-dimensional world – except when we are. I keep a poem next to my desk to remind me that being lost is a very advantageous state:

Lost [3]

Stand still. The trees ahead and bushes beside you
Are not lost. Wherever you are is called Here,
And you must treat it as a powerful stranger,
Must ask permission to know it and be known.
The forest breathes. Listen. It answers,
I have made this place around you.
If you leave it, you may come back again, saying Here.
No two trees are the same to Raven.
No two branches are the same to Wren.
If what a tree or a bush does is lost on you,
You are surely lost. Stand still. The forest knows
Where you are. You must let it find you.

Being lost can be frightening, but finding yourself elsewhere can be incredibly liberating. Disorientation forces us to rely more on our senses and be open to the world. Time slows down and we notice details that would normally pass below conscious awareness. Travel famously moves us to reexamine our assumptions about self and other. As we make sense of our surroundings, we discover new aspects of our own personalities, social assumptions, and cultures. We may find ourselves experiencing that sense of "flow" that Mihaly Csikszentmihalyi [4] described as the state of optimal experience.

Flow is found both offline and online. An admirable sense of adventure and discovery fuels many online games and most web surfing. Massively multiplayer games like *War of Warcraft* provide an immersive 2-D experience in a persistent virtual space that removes players from 3-D reality. Constance Steinkuehler [5] claims "big G Games" are social simulations with their own emergent cultures that should be studied to understand broader psychological and social phenomena like cognition, problem solving, production, consumption, learning, apprenticeship, gender, and collaboration.

But how do these cultures stack up against the real world? Before he died, Randy Pausch [6] talked about the challenge of motivating students to build immersive games and environments without sex and violence. It is difficult to imagine that which you have not experienced. Our technologies capture some types of experience well but filter out others. What elements of human relationships, personality, place,

and culture don't make it into 5-D worlds? People no longer complain about being "lost in cyberspace." But is it still possible for us to find the intangible – and for the intangible to find us?

3 Knowingly Experiencing Danger

Being lost also exposes you to elements of risk – boredom at minimum but, sometimes, real danger. The attraction and horror of Aron Ralston's 127 hour ordeal in the desert comes from our knowledge that he would have died had he not cut off his own arm. Because missing children are advertised on milk cartons, children stay home after school, play online games, eat too much, and exercise too little. Eight-year olds are given cell phones to stay safe; twenty-year old college students still phone their parents two or three times a day.

The real world can be dangerous, but what kind of danger comes from exposure to the 2-D and 5-D worlds? It's a mixed bag. Media give us cautionary tales of sexual predators lurking in teen chat rooms; retirees are cautioned to be skeptical of Nigerian bank account frauds and criminals working through Craig's List. But much of the time, we rely on our online worlds to protect us from real-world harm.

How valid is that information – do we recognize when we are deceived? Can we rely on crowdsourcing for verification? How can we measure what is truer and falser? In 1999, Johnston and Johal defined the Internet as a "virtual cultural region" whose individualistic inhabitants had low uncertainty avoidance[3], low power distance, and strong masculinity [7]. Their description still sounds apt. Such residents are willing to take risks, see all sorts of sources as authoritative, and embrace definitive answers. Shades of grey are not welcome.

Many people in the United States continue to believe Saddam Hussein was linked to al-Qaeda because they can point to websites that say he was involved in the attack on New York. Others assert President Barrack Hussein Obama is a Muslim born outside the United States. The history tabs for Wikipedia pages on topics like war, abortion, and politics reveal a never-ending battle between sectarian points of view. When you logon determines the truth you will find that day.

Other material on the web is simply odd. I grew up next to an abandoned cemetery that was haunted by kids making out and occasionally getting high. Today, Weird NY [8] says, "No one ever wants to discuss Troy's Pinewoods Cemetery (a.k.a. Forest Park), because this one is so haunted that some say you can never leave once you enter." Other sites describe it as one of the ten most haunted places in the United States. I've been asked by people from Virginia if I have seen the spirits.

Decoding urls, looking for authorship, checking history (when available), trying to determine the currency of information, looking for internal inconsistency, and recognizing skewed statistics are all fairly advanced information skills that are hard to master. Yet the web has become our principal tool for avoiding danger. Movies, restaurants, and professors are ranked on the web. If you look deeper, those ratings often display bias. But who has the time to analyze them? Whole parts of the

[3] Hofstede [2] described high uncertainty avoidance as "what is different is dangerous" and low uncertainty avoidance as "what is different is curious."

world – the places, faces, and ideas attached to sections of the web – can be placed off-limits without real understanding of the risks, while other parts may be unmarked but dangerous.

Eight years ago, I interviewed groups of Malaysian students to discover how they learned to use the Internet. I was surprised when they told me that they became comfortable using computers by spending time in cybercafés chatting online with strangers. Face-to-face, these students tended to be conservative and private, but they were taking risks in the cyberworld that United States students are strongly warned against. Why?

One of the students told me that she didn't see the Internet as a site for serious research before coming to the United States:

> *I did not use much for. I don't know, how they… I don't believe (both students laugh) Ah, because the Internet is like, you know is, like on the air, like. How do you say it? So, I just cannot believe everything I see through the net. But, from when I came here, then I use much, I use the Internet very much. And I guess my belief was (all laugh) it was something like that.*

We become socialized into the online world, just as we are taught the limits of physical space. BJ Fogg [9] developed a typology of web credibility:

Presumed	– General assumptions
Reputed	– Endorsements, reports, referrals
Surface	– Inspection, first-hand experience
Earned	– Experience over time

My Malaysian informants became proficient users as they went through a conversion process – first, developing trust in the web itself (presumed credibility); then, gathering information from others (reputed credibility); next, inspecting certain websites themselves for surface credibility; and, finally, coming back to them over time (earned credibility) [10]. However, once you learn to trust the web, you may no longer be able to recognize its risks.

4 Travelling Blind

Geographies are composed of inhabited places, roads, and countryside; networks are composed of nodes, lines, and interstitial voids. However, the two systems do not perfectly overlap. The old adage states that "getting there is half the fun." At least half the half comes from discovering what exists in the intermediate spaces.

Physical travel tends to be linear. When we drive, roads constrain our choices. When we take a train, the railway line appears to take us directly from station to destination. When we fly, the duration of a feature film brings us from coast to coast. However, there is often more to these experiences. On the highway, we glimpse one or a hundred and one vignettes – a little girl on a swing, an immature red-tailed hawk on the limb of a dead tree, the play of light on a passing pond. On the train, we see

into the backyards of homes, farms, and factories. On the plane, those in the window seats view the world from 30,000 feet. (Before Google Earth, flying was the nearest you could come to god-like omniscience).

By contrast, search engines and hypertext jump us from node to node. We lose the context of these points because we never actually pass through their surroundings to get to them. Every once in a while, on the original Star Trek, the Enterprise team would beam down and discover themselves in a hostile world. They could either beam back (but something always went wrong) or tough it out. Those tend to be our choices too.

Context is important in the 3-D world but even more important in the 2- and 5-D worlds. Is our information embedded in a larger document, database, or site? Where did it come from? What element of Google (and our) search strategy brought Glastonbury Abbey, Massachusetts, to the surface 6 places ahead of Glastonbury Abbey, England? Is the software actually working correctly? When I look for St. Paul's Church in Greenwich, Washington County, New York, it takes me a moment to realize that the search has brought me to St. Paul's Church, Greenwich Village, New York City. There's a bug in Google Earth but I know it only because I was already planning to go to a concert in Greenwich at 3 pm.

Twenty years ago, Bill McKibben [11] critiqued the world we can know from television in *The Age of Missing Information.* He compared two experiences of a day – 1000 hours of videotape broadcast on cable on May 3, 1990, with a "conventional" summer day in the Adirondack Mountains of northern New York State.

> *I'm not interested in deciding which of these ways of spending time is 'better.' Both are caricatures, and neither strikes me as a model for a full and happy life. But caricatures have their uses – they draw attention to what is important about the familiar. Our society is moving steadily from natural sources of information toward electronic ones, from the mountain and the field toward the television; this great transition is nearly complete. And so we need to understand the two extremes. One is the target of our drift. The other an anchor that might tug us gently back, a source of information that once spoke clearly to us and now hardly even whispers.* [11: 10]

Imagine yourself multitasking your way through 1000 hours of Twitter, You-Tube, Facebook, phone apps, and websites. What would you find and what would you miss?

5 Coming Together

John Urry [12] talks about the sociology of mobility in terms of three types of co-presence:

- "Face-to-face"
- "Face-to-place"
- "Facing the moment"

We'll start with the first two.

When we actually get to our destination, meeting people face to face provides "rich, thick co-presence, where trust is an ongoing accomplishment and which sometimes permits disembedded relations to straddle the globe" [12: 261]. As HCI

practitioners know from innumerable studies of telework and virtual teams, good teamwork often requires an initial face to face meeting. Without it, the group has difficulty coming together and agreeing on a plan of action [13]. Other times, the problem isn't that we have negative ideas about people from first meeting them online; instead we may have "hyperpersonal" [14] impressions that are unreasonably positive. With time, we exchange enough information to develop more realistic appraisals of the other person; unfortunately, we may have elected them to office (or given them their own reality show) in the meantime.

Experiencing a location "face-to-place" is a different issue. "To be there for oneself is critical…. There is a further sense of co-presence, physically walking or seeing or touching or hearing or smelling a place [12: 261]. Urry comments that physical experience is the essence of adventure. McKibben believes we need direct contact with nature for complete information. Marion Bowman [15] explains how certain events, like pilgrimage, require physical effort to achieve meaning.

Glastonbury in Southwest England was a pilgrimage site in medieval times and has become one again for a variety of religions and spiritualities. One can follow the Goddess, walk the leylines emanating from the Tor, see the thorn trees that sprouted from the staff of St. Joseph of Arimathea (and mourn at the stump of the tree on Wearyall Hill), explore the ruined Abbey, drink at the Holy Well, and wander throughout the Glastonbury Zodiac. Once, pilgrims walked to Glastonbury; today, they drive or logon. At the website of the Roman Catholic Shrine of Our Lady of Glastonbury [16], you can find information about the summer pilgrimage or make an immediate petition. However, as Bowman found, the website is less a virtual pilgrimage than a postbox. When she spoke to the shrine authorities, she was told that a petition has no power until printed and placed in a book at the foot of the statue. You must come yourself or allow another to transfer your petition to Our Lady. There is no substitute for the "real thing."

Avi Friedman also examines our sense of place:

> *What do I mean by 'place'? Places give the people who inhabit, visit, and use them an identity. Those with an authentic atmosphere inspire people and draw them into some kind of relationship. They are characterized by signs and symbols unique to each.* [17: 10]

Throughout his book, *A Place in Mind*, Friedman discusses the power of the built environment to welcome us or distance us from ourselves, others, and nature. Each chapter discusses an issue like historic preservation, roads, playgrounds, or food in the context of a specific locale. An outdoor teahouse in Istanbul welcomes the tired tourist and reveals itself through its layered sights, sounds, and smells. The Osteria Acquacheta in Montepulciano meets Ray Oldenberg's criteria for a "third place":

> *…a typical third place may be plain and unimpressive looking. You will rarely find them advertised or posting a flashy sign, because the locals know where they are. They are often independently operated, mom-and-pop businesses. Their interiors may be worn or even shabby, yet they are kept clean by owners who are devoted to the comfort of their patrons. The mood tends to be playful. Walk in and you feel at home. …. Memorable third places feed their patrons with a plate full of simplicity with an open heart and good will.* [17: 34]

In the 5-D world, a third place might suffer one of two fates – overwhelming popularity and implosion or withering-away as the next third place went viral. Could Friedman write a series of vignettes on the power of place in websites, blogs, databases, Facebook pages, or You-Tube videos? Certainly not yet.

6 Putting Our Bodies on the Line

John Urry says that time and place may coincide in "facing the moment" – the experience of a specific event at a specific time in a specific place. The Egyptian protestors in Tahrir Square made history in a way that their avatars could not; men and boys slept on tank treads to prevent the military from moving against the crowd. They could have died, as did Chinese protestors in a different square in 1989, but the people won. Although the protestors relied on Facebook[4] to assemble, they will be marked forever by their corporeal experiences.

When we experience the intense immediacy of being face-to-face, face to place, and facing the moment, we build "social capital" – meaningful relationships with people and places that reflect dense webs of interaction. We can apply those memories to mediated 5-D experiences but, as Urry suggests, that leaves less time to sustain those webs of mutual meaning-making. Even as we collaborate with others through our smartphones, iPads, and labtops, the immediacy of our experiences is attenuated – reduced to the small screen. Events like conferences, in tourism centers like Orlando, are important because they provide the intermittent renewal of small social worlds inhabited by globally-distributed members. Some memory of actual physical travel through space and time – with ungrudging attention to "being there" – seems essential to maximizing all forms of virtual proximity.

Perhaps as we grow more skillful, we will be able to move in and out of our 3, 2, and 5-D worlds with more grace. Right now, these worlds are often in conflict. The student holding her smartphone to monitor the latest texts speaks disjointedly to me about the paper she is trying to write. The information, that the movie I want to attend has been cancelled due to a snow storm, is false. But, the mobilization of the Libyan diaspora in Canada through Facebook to send medical supplies to Tripoli is enthralling. Residents of the city send video footage and messages of resistance as bullets fly over their heads. One may not need to be personally present for effective co-presence and coordination. But it seems that someone must be "there" for you to find your own voice "here."

7 Dealing with Change

Finally we come to the experience of time, the hidden 4th dimension[5] in our 5-dimensional world. I married three years ago and my stepson emailed me when Google StreetView went live for our suburb, "I know when they photographed your

[4] Howard Rheingold [18], who has been following the emergent properties of "smart mobs" and "flash mobs" for years, must be pleased.

[5] With apologies to Einstein, my concern is more prosaic than spacetime or 4-D Euclidean space.

house!" Sure enough, it must have been early on the morning of our wedding; the rented tent could plainly be seen. You can see it still – and we're still married. But, given the average duration of marriages in the United States is a bit less than 8 years, that image could easily become an embarrassing token of a divorce.

Change can be dramatic or subtle. Dramatic changes tend to be easier to recognize. The last time I visited Rochester, New York, my husband showed me his boyhood home. A year later, we could not find it on Google Earth, just a vacant lot. Subtle changes are harder to recognize. An out-of-date schedule. Incorrect prices. Businesses that have moved or failed. Unfortunately, an image does not age.

The 5-D world relies on each one of us to monitor change and made updates. But you may not be authorized to update my page. Or you may geotag the wrong building. Four years ago, Wikipedia had 54,000 contributors; today, it has 35,000 [19]. Jimmy Wales claims that the decline is natural, "The project is more complete." But others say an inner circle of editors discourages new contributions and puts its own spin on entries. As the novelty of crowd-sourcing passes, there is legitimate concern that 3-D change will not be mapped onto the 2-D and 5-D worlds.

8 Conclusion

I am not a techno-skeptic but I am curious about what is happening to notions of culture and geography as we spend more time experiencing the world through technology. Culture is holistic; growing up in particular cultures, we are taught what is valid and what is not. By exploring our boundaries, we decide how much of our tradition to fully embrace. Even when we reject culture, we are marked by it. Our behavior is grounded on attitudes that, in turn, rest on sets of cultural values. Geographic metaphors pervade our discussions of culture. Where we have lived influences our notions of ourselves, our families, our in-groups, and others. We define ourselves as the product of specific places and times.

At the same time, we are mobile and increasingly connected. Although the number of people who change their residences has dropped due to the recession, around 14% of the United States population still moves each year. [20] Our mobility may disconnect us from our past, but Facebook helps us find old friends and keep up to date with trusted organizations. Technology helps us find continuity in our personal diasporas.

It makes no sense to reject the merger of online and offline information. Even the Amish have come to terms with cell phones – they may not keep them in their homes but they will use them to speak to family. Rather, we need to think about our repertoire. When is the 3-dimensional world more truthful than the 2-dimensional world? When do smartphones and apps enhance our 3-dimensional experience of places and people? Have we begun to see the emergence of long-lasting online communities that engender persistent cultural values?

Digital natives inhabit a world vastly different from that of their elders. But is it one world – with one culture – or many worlds with a wide range of opportunities for personal expression and community inclusion? Thinking about the 3, 2, 5 – and 4^{th} – dimensions may help us find a better future.

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The Importance of "Feel" in Product Design Feel, the Neglected Aesthetic "DO NOT TOUCH"

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Abstract. The urge to touch and feel objects is universal and powerful but focused scientific attention to understanding and enhancing the aesthetic portion of the total "feel" of a product in order to increase user satisfaction has been noticeably under emphasized in consumer product design and thus in the products themselves. Although the tactile, proprioceptive and kinesthetic senses are vital to life, in their larger context of "feel", they have been largely ignored compared to the senses of vision, hearing, taste and even smell. And while courses, institutions, and venues are dedicated to these latter senses, comparable ones for the former are decidedly absent. Recent interest in the haptic senses may be a sign of change. This paper explores several aspects of "feel" and offers suggestions for research areas.

Keywords: Touch, feel, aesthetics, moment-of-inertia, haptics.

1 Introduction

"**DO NOT TOUCH**" is a commonly encountered prohibition in museums, shops, factories and other places throughout the world suggesting that the desire to touch and feel objects is universal as well as powerful. The reasons for the prohibition are fairly obvious – to prevent object deterioration and damage, to prevent breakage or theft, and to prevent injury. (There are also the strong cultural prohibitions on touching another person, particularly a stranger.) On the other hand, reasons for the initial desire to touch are not so clear. Try to answer two simple questions. Why do I want (or not want) to touch an object? What satisfactions (or dissatisfactions) do I derive from "touching"? The images in Figure 1 can serve as targets for the answers. Sometimes curiosity overrides the prohibition such as the urge to touch wet paint or a hot surface – "just to see" or a child's natural and learning curiosity. For sighed people, vision precedes the urge to touch (or not) and tactilely explore an object suggesting that there is an imagined "feel" we want to confirm or enjoy.

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Fig. 1. DO NOT TOUCH!

Fig. 2. This LOOKS like it would be pleasant to hold and FEEL

The object in Fig. 2 for example can suggest a form that would "feel good" in the hand. However its polished surface suggests that it may be easily slip from the hand.

We may have no clear mental idea what the target may actually feel like and we want to know – a curiosity factor. In the case of desiring not to touch, discomfort or damage to self or object likely covers most reasons. Prohibitions on touching persons abound.

Although "DO NOT TOUCH" signs abound, "PLEASE TOUCH" signs seem only found in exploration museums or venues primarily for children's educational reasons.

"*Haptic*", derived from the Greek *haptikos*, from *haptesthai*, meaning to touch or grasp, is a relatively recent interest in science and design. According to Wikpedia [1], "Gibson [2] defines the haptic system as 'The sensibility of the individual to the world adjacent to his body by use of his body'. The haptic perceptual system is unusual in that it can include the sensory receptors from the whole body and is closely linked to the movement of the body so can have a direct effect on the world being perceived. The concept of haptic perception is closely allied to the concept of active touch that realizes that more information is gathered when a motor plan (movement) is associated with the sensory system, and that of extended physiological proprioception a realization that when using a tool such as a stick, the perception is transparently transferred to the end of the tool."

According to Gabriel Robles-De-La-Torre [3]: "Haptics is commonly used today to refer to the science of touch in real and virtual environments." This would include not only the study of touch capabilities in different organisms, including humans, but also the development of engineering systems to create haptic virtual environments. The latter subfield is commonly known as computer haptics. "This technology does for touch what computer graphics does for vision."

However, haptic literature seems centered mainly on such worthy goals as developing virtual objects to feel and for interface design such as touch screens, hand controls, etc. This paper however wishes to address the largely unconsidered area of haptic aesthetics particularly for product design. Because of the very underdeveloped state of haptic aesthetics, we can only begin such discussion but with the hope that it will generate more of the same leading to research and development of this neglected area for product design.

Consumer products, many of which are held in the hand for use, are generally designed with careful attention to their function and visual appearance and increasingly some ergonomic aspects. One may think of iPods, pens, pencils, razors, golf clubs, tennis racquets, lighters, CD players, knives, forks, drum sticks, hammers, computer mice and many others from a near endless list. Attention has been paid to the "feel" of buttons and keys in interface design. Similarly, the safety razor has had designs influenced by the "feel" of the razor in the hand [4, 5] and which has been found to have a decided influence on the *perceived* quality of the resultant shave. We emphasize *perceived* because in consumer products, perception can be critical in terms of purchase, use and judged performance of the product. In fact, the single most challenging aspect of consumer product design is addressing the user's multi-dimensional, multi-attribute *satisfaction* with a product.

But generally, an object's entire "feel" as an aesthetic is rarely discussed or thought about. Little thought seems to have been paid to designing a product so that by its visual appearance alone, a person *wants* to feel it or attends particularly to the aesthetic aspects of its feel or expresses satisfaction with how it feels. Merchants who position their products behind barriers so they cannot be touched may lose sales for this reason. Or conversely, if potential purchasers are permitted to handle and feel a properly designed object, the probability of its purchase may be significantly increased. At a deeper level, designing a product so that it *looks* like it would be pleasant to hold and feel may precede the desire to hold it in the first place. Faithful but otherwise functionless models of objects may be provided for sales purposes so that potential customers can experience how they feel.

What is this urge to touch an object and derive pleasure from it? Fig. 3 shows a medicine horn carved from an animal leg by the Bahau people of Borneo. It is pleasing to look at but also to feel with the hand and fingers as they explore the polished surface, curvatures and detailed carving. Holding and caressing it generates distinct pleasures and the consequent desire to possess it in some people. In fact, simply looking at it generates mental haptic aesthetics. As in Fig. 2, it *looks* like it would be pleasant to touch and if the mental impressions are attended to, one can almost feel it in the mind.

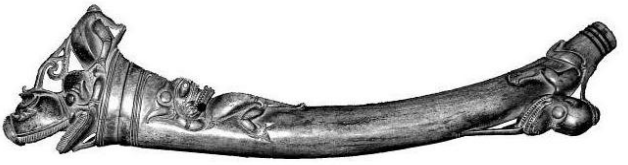

Fig. 3. Carved Medicine Horn of Bone. Bahau people, Borneo

Product designers need to explore more deeply the "feel" aspect. Not just texture but actual shape. Several simple questions are: Why do people want to touch and feel it?

What haptic sensations does the *appearance* of the object of the object evoke? What vocabulary would people use to describe their haptic sensations? These are basic design questions. Further questions are: how can the designer purposefully create an object to produce desirable haptic sensations. How can the designer create an object that mentally evokes haptic pleasures so that people want to hold and touch an object? The design question is: *how can one design an object that someone actually wants to touch*, or its complement: how can one design an object that someone does NOT want to touch. Sometimes the negation of a position can illuminate the positive.

Fig. 4. Brancusi's "Sculpture for the Blind" ca. 1920, Veined Marble, Philadelphia Museum of Art, The Louise and Walter Arensberg Collection, 1950

In investigating such questions, the blind who rely so largely on their haptic senses could likely provide useful information and hints for answering such questions. Sculptors, potters, weavers, etc., who work directly with three dimensional forms under their hands should also be a source of help. The artist Constantin Brancusi [6] for example sculpted a series of "sculptures for the blind" in the first quarter of the 20th century which supposedly the blind were to touch, feel, and caress to impart aesthetic sensations. Figure 4 is such a form.

Several museums attempted to give the blind an appreciation of visual art by making a simulacrum of a painting through raising outlines of its forms so that they may be felt. However, this would seem to be like providing pictures such as in Fig. 3 and 4 to the sighted so that they may derive the same pleasurable sensations as do

those fortunate enough to actually feel them. Both attempts would seem to miss the point. Figure 5 shows a highly efficient as well as pleasant feeling (and looking) tool from a tribal people of Borneo.

Fig. 5. Hand Conforming Padi Cutting Tool From Borneo

Beautifully carved from a deer horn, its natural shape is used to advantage so that tool-grips-hand rather than the usual hand-grips-tool.

This frees all of the fingers and reduces the finger forces otherwise needed to hold and stabilize the tool. In use, the index finger (and perhaps middle finger) above the blade gather in a stalk of padi and pull it naturally against the blade severing it for harvesting. Such designs suggest that perhaps products should be designed to "hold the hand" rather designed for the hand to hold them.

But deep problems revolve around the "feel" of an object. For example, Hill, et al. [4, 5], have explored aspects of an object's moment-of-inertia as a contributor to its "feel" and established among other things that even though subjects had little understanding or even conscious awareness of this basic physical property, they had definite preferences for specific values of it and could distinguish (unknowingly) between an object's moment-of-inertia and its weight (which can be independent properties). A problem that plagues designers, and one which may be typical, is that even though subjects did have such preferences for moment-of-inertia as opposed to weight, they were actually unaware of it and so would not be able to communicate these to designers who themselves might be of this fundamental property.

Furthermore when subjects did try to describe the difference in "feel" between two objects of exactly the same weigh and balance, but different moments-of-inertia, they used words most appropriate to weight because they lacked any design useful words for the sensations evoked by the moment-of-inertia – a property only "felt" when the subject imparts some rotation to the object.

This can lead to frustrations and ultimately misdirected design because the designer, implicitly trusting the subject's inappropriate vocabulary, e.g., "too heavy" when it should really be "too great a moment-of-inertia", can addresses the wrong design parameters.

2 Existing Research

The Integrated Media Systems Center of the University of Southern California in Los Angeles proposed a Haptic Museum in which virtual objects would exist for touching. Jessica Persdotter Isaksson [7], in industrial design and engineering at Chalmers University of Technology proposed what seems to be a directed research program for "the study of the human haptic sense and interaction with products and environments".

The sensitivity of subjects to the moment-of-inertia of handheld objects such as razors and tennis racquets and the ability to distinguish weight from moment-of-inertia has received some attention.

In one study [4, 5], subjects were allowed to change the center of gravity (CG) of a mocked-up but realistic and functional razor by sliding an interior weight up or down its handle by a small protruding button while shaving until they "liked the feel" of it. This was done for different razor weights. Changing the CG in the experiments also changed the moment-of-inertia (I) of the razor. The moment-of-inertia is a measure of how much the weight is spread out using the CG as its center. The higher the value of the moment-of-inertia, the farther out from the CG the weight is "smeared". It is similar to the notion of the variance of a weight distribution. A related measure of how the weight is spread out is the radius-of-gyration (RG) which is akin to the standard deviation of a weight distribution.

The results in Figure 6 show that the lighter the razor weight, the higher the preferred CG measured from the end of the razor and the greater the preferred RG. That is, the preferred RG increases with the preferred CG. Alternatively, the moment-of-inertia (I) decreases with increasing preferred CG. Psychophysical experiments made clear that subjects were sensitive to moment-of-inertia without knowing what it was. Moreover they commonly used words descriptive of weight in describing the difference in "feel" of objects with the same weight and balance (CG)

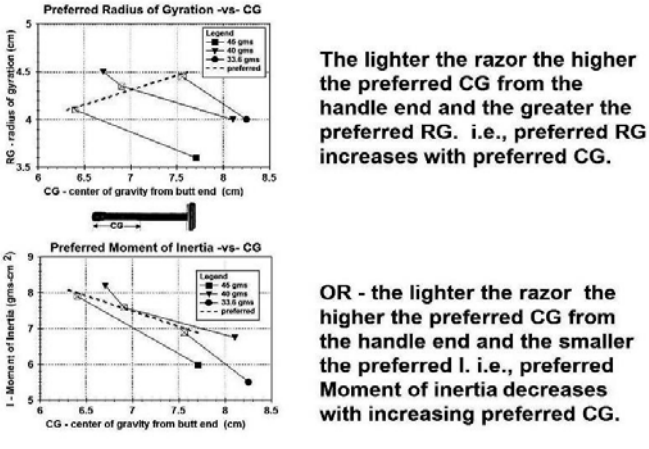

Fig. 6. Preferences in Razor Design

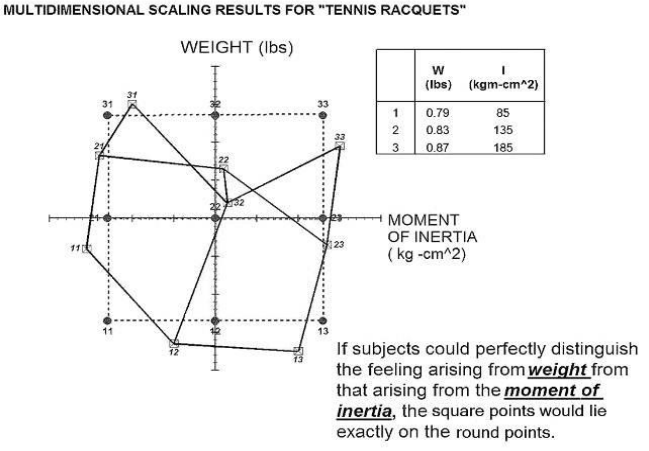

Fig. 7. Ability to Distinguish Subjective Feelings of Weight (W) and Moment-of-inertia (I)

but different moments-of- inertia. The problem is that the vocabulary for describing the "feeling" of moment-of-inertia does not exist for all practical purposes. Moment-of-inertia can be described as the resistance felt when an object held in the hand receives some rotation either alone or in addition to translation.

Kreifeldt and Chuang [7] established the psychophysical sensitivity to moment-of-inertia. Chuang [8] investigated the ability of subjects to distinguish, even unknowingly, weight from moment-of-inertia using 9 baton like stimuli in which weights and moments-of-inertia varied independently. Subjects held and swung them somewhat like tennis racquets in pairs. Using multidimensional scaling techniques, Chuang found that based on nothing more than a "feeling of similarity" between any two batons on a scale ranging from "identical" to "not at all", subjects were basing their responses on subjective distinctions between the two physical variables. Figure 7 shows the subjects' "perceptual" space in which the two physical variables [W,I] are plotted together with their perceptual equivalents. If subjects could perceptually distinguish weight from moment-of-inertia perfectly, the solid grid would overlay the dotted one exactly. What is clear is that even though the batons of any pair might "feel different", subjects were in fact perceptually aware that weight "felt" differently from moment-of-inertia even though they were unaware of the latter as a physical property of a body. Moreover, Fig. 8 shows that when subjects were asked which of a pair they liked the "feel" of better, they clearly had preferences such that a perpendicular to the arrow would rank the 9 stimuli on this criterion such that preference for the feel increases along the arrow's direction. Based on Figure 8, a designer could design, say, a 10^{th} similar stimulus so that its "feel" would be preferred to any of the other 9 by locating is W and I on the arrow and outside of the subjective configuration. And again, even though the subjects were not aware of I as a property and certainly not able to vocalize about it. - i.e., while they might be able to say "make the weight lighter" - they had no vocabulary such as to say "make the moment-of-inertia less.

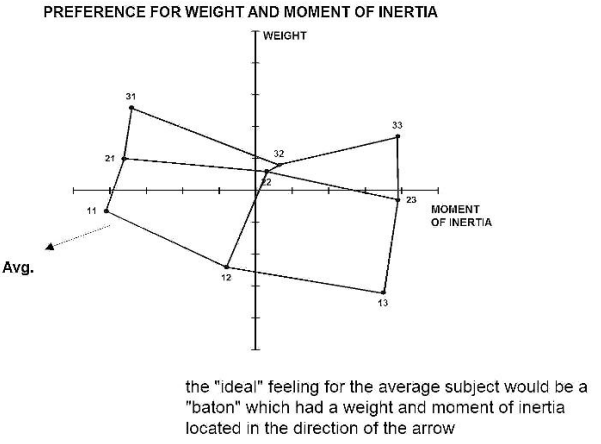

Fig. 8. Subjects Can Express a Preference for I Despite Not Knowing of Its Existence

So why the neglect of the haptic sense?

Perhaps feel is largely a utility sense necessary for survival and not suited to delivering aesthetic pleasure as do the other senses. But that can't be correct when we think of the pleasure we get from holding our new baby or a loved one or being touched by a mother's cooling hand when we are distressed. There is "the tactual luxury of stroking silky hair" of humans or pets or even clothing.

Or on the opposite pole, it is unpleasant to be touched by someone we dislike. We don't like strangers touching us particularly on purpose. In fact most societies have an unconscious distance to maintain between people if possible.

Many people derive pleasure from movement as in dancing or sports which includes the sense of proprioception and kinesthesia – the awareness of the position and movement of our limbs. Watching dance or ballet can be very pleasurable and spiritually engaging because of the dancers' movements as perceived and perhaps translated into an interior feeling by the spectator. Many of us also enjoy the feel (perhaps coupled with the sound) of "popping" those air bubbles used in packing materials. There certainly are moral and immoral connotations to feel. The immoral ones we can imagine. Moral sensations from touch could be evoked in religious ceremonies such as by the "laying on of hands" and clasping the hands together in prayer.

If we were all blind, would we have developed haptic art? And would it have developed as the other arts have?

The first use of haptic devices in entertainment may have appeared in Aldous Huxley's 1932 novel *Brave New World*. He described an entertainment theater of the future in which devices in the arm rests could deliver haptic sensations to the hands.

These theaters provided" *feelies"* rather than *movies*. Rather unimaginatively, the "feelies" were of an erotic nature. Which, however, may be a main reason why the haptic sense is so "ignored" or skirted around because it is uncontestable that sexual arousal is strongly related arguably more to the haptic sense than to any of the others.

3 Suggested Haptic Aesthetics Research Areas

As mentioned, the worthy ongoing haptic area studies appear devoted to interface design and virtual object perception. However, for the purposes of product design several research areas suggest themselves as pertaining to haptic aesthetics.

1. Multidimensional (MDS) studies of object shapes for **similarity** and **preferences** in shape "feel".
2. The attributes of shape which are the underlying dimensions in the MDS studies. Is it possible for example to construct shapes from primitives? The artist Leger painted forms by breaking them down into geometric solids such as cones, spheres, etc. Perhaps something similar exists for shapes based on feel such as 3-dimensional primitives like spheres, cones, cubes, wedges, etc.
3. Development of a vocabulary for "feel". E.g., what words do we have to describe an object's "feel"? The word "feel' is not very precise. Vocabulary for the haptic sense is a particularly barren area. As mentioned previously, there does not seem to be any common word to describe the feeling associated with an object's moment-of-inertia. Our vocabulary for describing "feel" sensations is particularly limited and may be counter to the underlying physics.
4. More attention to the psychophysics of "feel".
5. Convene a panel of sculptors, blind people, crafts people who work with their hands etc., to discuss the role of "feel" in their work and life.
6. Synthesize a product form from fundamentals that "feels good" to hold.
7. List the design parameters needed to be considered such as: weight, balance, moment-of-inertia, shape, texture, resilience.
8. Design a form from fundamentals which looks as though it would "feel good" to hold.

4 Conclusion

This paper can only be considered a plea for scientific and design attention being paid to haptic aesthetics. The "feel" of an object is an important aspect of the pleasure it can give a user and as such a legitimate and important aspect of product design. We will know progress is being made toward a scientific and design understanding and implementation when we can design an object to "feel" as we want it to. That is, when we can articulate how we want it to "feel" and then construct the object from design "feel" primitives. Haptic aesthetics may be the last frontier of design.

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Design for Aesthetic Experience

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Abstract. Taiwanese government has been aggressively promoting culture creative industries in recent years. To achieve the goals of industry transformation and to better the living environment, it further propels the innovative concept of "creative life industry".

Demonstrating a new economy model, creative life industry intends to attain experience economy through attracting consumers with life aesthetics. In human life, craft creation comes with multi-values in various aspects. Craft is creative activities humans employ to solve their everyday problems in food, clothing, residing and transportation. It has served two functions in practical objects and art works in human history. In the process of creation, exchange, possession, usage, and appreciation, craft enriches human life and becomes the most valued aesthetic experience for promoting creative life industry.

The purpose of this study is to investigate daily crafts, concerning both industry management and product design, and to establish an appropriate model to promote consumers' aesthetic experiences on daily crafts. The methods of data collection are survey questionnaires and in-depth interviews. With literature review, four experience factors of sense, think, act and relate are defined for writing up the survey questions. Results of data collected from the survey responses and interviews could provide concrete suggestions for artists, designers and business managers who plan for experience activities.

Keywords: Daily crafts, Life aesthetics, Experience economy.

1 Introduction

With changes in economy and consuming styles, Taiwan has moved along from agriculture economy in the past to industry economy, then service economy and recently experience economy [19]. This trend has also completely echoed the four levels of economy proposed by Pine II and Gilmore—commodities, goods, services and experiences. [12]

Taiwanese government has been aggressively promoting culture creative industries in recent years. To achieve the goals of industry transformation and to better the living environment, it further propels the innovative concept of "creative life industry".

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Industrial Development Bureau of the Ministry of Economic Affairs, the planner and executive of the industry has set up the“ Developments plan for creative life industry” in 2003 and divided the plan into six major areas of food culture experience, life educational experience, natural ecology experience, fashion furniture experience, specific experience with cultural or historical relics, and craft culture experience. [12]

Lin [7] suggested that, to enhance its creative power for competition, Taiwan has to actively develop its creative life industry, with the means of applying culture and technology for living styles and life creativity. Among all creative life industries, creative craft is an activity with multi-values. It has served two functions in practical objects and art works in human history. In the process of creation, exchange, possession, usage, and appreciation, craft enriches human life and becomes the most valued aesthetic experience for promoting creative life industry.

2 Purpose of the Study

The purpose of this study is to investigate daily crafts, concerning both industry management and product design, and to establish an appropriate model to promote consumers' aesthetic experiences on daily crafts. Through investigation on cultural and aesthetic elements, successful creative life industry and product design policies can thus be established to attract consumption and promote industry development.

The significance of this study can be briefed as follows. For business management, this study can help achieve the goal of promoting creative life industry through the investigation of daily crafts and aesthetics as well as the establishment of experience models based on service purpose. On product design, this study targets at evaluation of the aesthetic experience provided by daily craft and thus would provide valuable referential information for future product development and marketing of creative life industry in Taiwan.

3 Literature Review

3.1 Aesthetic Quality of Crafts

Generally speaking, crafts possess two attributes practical and artistic. In early western world, the concepts of craft and art had been identical. Plato has indicated that “everything that is responsible for creating something out of nothing is a kind of poetry; and everyone who practices a craft is a poet.” [13] The differentiation of the two was made after the eighteenth century. Kant, the German philosopher, considers art a different concept from craft; that the former is a liberal play while the latter a remunerative activity. [6] German philosopher Heidegger indicates that the nature of crafts is based on its usefulness and reliability while art is “one way in which truth occurs as unconcealedness.” [2]

Modern crafts pay more attention to present their uniqueness. Products with high craft aesthetic values become more and more well-received to consumers, craft

products with high aesthetic values prevail in our daily life. The well-known Norman indicates that a successful design has to take into consideration all the facets of usability, practicality and aesthetics, appealing to emotion is the key threshold for success. [10] The appeal to design for emotions in the twenty-first century can now be realized through using crafts' aesthetic values.

3.2 What Is Life Aesthetics?

Aesthetics, a branch of philosophy, is a term coined by German philosopher Baumgarten (1714-1762) in the eighteenth century. It explores the area of emotion, one that goes beyond ration and morality in human mental faculty. As defined by Townsend and Santayana, aesthetics is a study of institution, feeling and emotion, in contrast to epistemology and ethics. [15, 18]

What is life aesthetics? Liu states that it is a specific life style manifested when people meaning to symbolize their life experiences. [9] Featherstone suggests that, due to the vague distinction between reality and image in modern society, "life aesthetics" thus rises as a result when people try to make their daily life aesthetical. [1] Liu states that lifestyles and the aesthetics of everyday life are two major operational device for constructing the world of consuming culture life; lifestyles is the concrete living style expressed as a result of the interaction of consuming and culture, while life aesthetics is the decisive threshold in interacting with consuming culture. In sum, lifestyles is the living mode in presenting image and aesthetic experience. Life aesthetics, integrated with art and recreational culture, is prevailing in modern human life and becomes the foundation for finding and constructing personal lifestyles. [8]

3.3 Approaching Experience Economy

Futurist Toffler has predicted, in early 1970s, that the development of human culture is moving from stages of agricultural, industrial towards service economy and that the pressure from both consumers and those who expecting a growing economy has accelerated the shift of a technology society towards a future experience economy. [17] Pine II and Gilmore indicate that experiencing is an activity which creates unforgettable memory while consuming is only a process; even though the process ends, the memory in experiencing lasts. [11] Holbrook further classifies experiencing with four elements—experience, recreation, expression, and transmitting pleasure. Featherstone proposes that what leads modern humans to first desire of possession and then consumption is not only the functions of the commodities but more importantly, its add-on values, or the pleasure brought along with consumption. Consequently Featherstone considers aesthetics or art the best means in arising consumers' desire to consume, and terms such behavior as "aesthetic consumption." [1]

Pine II and Gilmore has set up the Experience Realms with absorption-immersion, active participation-passive participation as its two axes to construct the four experience realms of entertainment, educational, esthetic and escapist. [11]

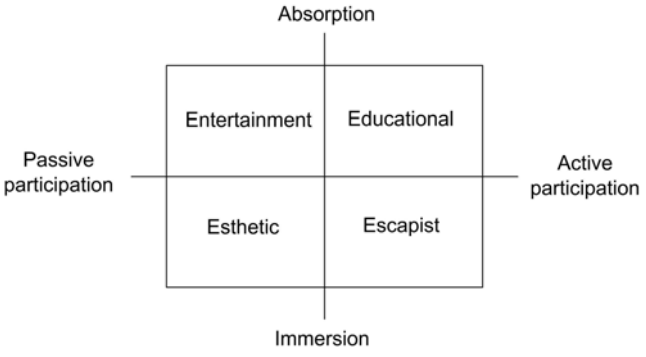


Fig. 1. The Experience Realms (Pine II & Gilmore, 1999: 30)

In his book *Experiential Marketing* Schmitt defines five experience types: [16]

(1) Sense—stimuli experienced through seeing, hearing, tasting, smelling and touching and lead to aesthetic pleasure, excitement, beauty and satisfaction
(2) Feel—composed by positive and negative feelings and emotions. Interactive emotions are the strongest.
(3) Think—through creating surprise to attract consumers' attention and curiosity
(4) Act—induced by the interaction of creation, behavior modes and lifestyles, consumers show their self-esteem and values through action.
(5) Relate—concerns cultural values, social status and community belongingness, creates culture or communities consumers like to join, and establishes a unique social identity for the consumers.

Huang suggests that the more versatile experiences a cultural creative industry can provide, the more cultural messages consumers would receive from what they experience. [4] That is to say, aesthetics brings about consumption and the sense of pleasure and beauty attributed to the add-on values. This process is "aesthetics experience", the core concept of the governmental initiate for creative life industry.

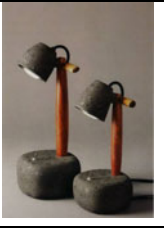
4 Research Methods

The methods of data collection are survey questionnaires and in-depth interviews. With literature review on relevant theories, we set up the general research plans for the study. On the one hand, we interviewed experts in the industry to depict how the mangers plan their experience activities for the consumers and the status of the art. We then analyzed data collected from two different groups of the consumers and the managers so as to identify the experience elements and modes for daily crafts. Furthermore, we also reviewed previous studies on aesthetic experiences for the collection and construction of our research tools.

The questionnaire was developed based on the five experience types Schmitt proposed for constructing the factors of aesthetic experience. Fifteen questions were written based on the five experience types. The targets for evaluation were eight pieces of prized craft work which outperformed in the two contests of "Taiwan Craft Contest"

and "OTOP (One Town One Product) Design Contest" in 2007 and 2008 (Table 1). The items, taking the Likert scale, were graded as 5 points for "strongly agree", 4 for "agree", 3 for "neutral", 2 for "disagree", and 1 point for "strongly disagree."

Table 1. Eight Selected Products Used in the Questionnaire

			
Easy tea set	Glass chess	Zen flavor teacup	Pencil sharpeners
			
Twin-pen	Honeycomb panels furnitures	Zen flavor stationery set	Ceramic table lights

To provide further analysis of the subjects, this study also took socio-demographic descriptors, such as gender, age, and educational background (design majors and non-design majors) as independent variables. Then five factors of aesthetic experience were used as dependent variables so as to investigate the relationship between these two dimensions (Fig. 2).

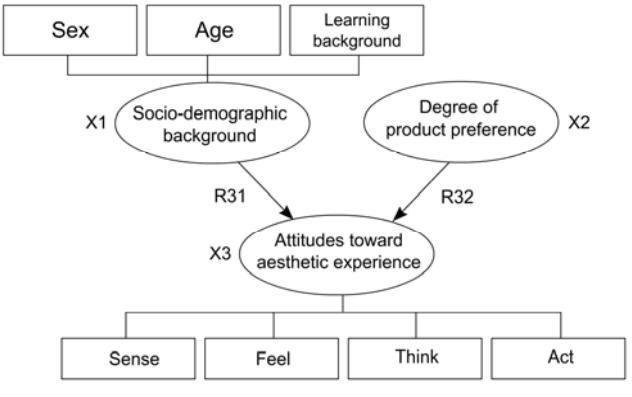


Fig. 2. Framework of the Research Design

A pilot study was conducted to test the questionnaire for the analysis of validity and reliability. After the factor analysis of the fifteen questions, four factors of aesthetic experience—sense, think, act and relate—were reconstructed considering their eigenvalue were greater than 1. The four factors and their corresponding questions are listed in Table 2.

Table 2. The Questions under the Four Factors of Aesthetic Experience

Factors	Questions
sense	1. The product evokes your sensational pleasure
	2. The form the product is beautiful
	3. The product is fashionable
think	4. You are touched by the cunning design of the product
	5. The product evokes your curiosity
	6. The product seems to tell you a story
	7. The product evokes your eagerness to explore its connotation
act	8. You feel fascinated by the product
	9. You are willing to adapt yourself to this new product
	10. You are willing to recommend the product to your friends
	11. You want to possess the product
relate	12. You could express your taste through the product
	13. The product reflect you life experience
	14. The product reflect your personal values
	15. Possessing the product helps to raise your social status

5 Data Analysis

5.1 Test of Socio-demographic Descriptors to the Factors of Aesthetic Experience

There were 100 valid questionnaire used for data analyses. The fours factors of aesthetic experience—the gender, educational background and age were used T-test and correlation to analyze their effects on aesthetic experience.

(1) Among the four aesthetic experience factors, the factor of "think" presents significant differences on gender ($t=2.19$, $p < .01$), female subjects score significantly higher than males.
(2) There is a significant difference between participants who are design majors and participants who are non-design majors, regarding their opinions on the factor of

"sense" (t=2.53, p < .01). Non-design majors' scores are significantly higher than design majors.

(3) There is no significant relationship between participants' age and the factors of aesthetic experience.

5.2 Multiple Regression Analysis of the Degree of Products Preference and Aesthetic Experience

This study employs four aesthetic experience factors as predicting variables and the participants' degree of products preference as dependent variables for multiple regression analysis. The result of the analysis is shown in Table 3.

(1) The participants' degree of products preference is positively correlated with the four factors of aesthetic experience (p <.001).

(2) The F value for the overall multiple regression equation is 51.42 (p <.001). Each standardized regression coefficient is listed according to the significance. They are respectively "act" (β=.52), "sense" (β=.30), "think" (β=.15) and "relate" (β=-0.7).

Table 3. Four Factors of Aesthetic Experience to Predict the Degree of Products Preference

Independent Variable	r	B	β	t	sig
Sense	.706***	.34	.30	3.64***	.000
Think	.694***	.18	.15	1.64	.104
Act	.778***	.56	.52	5.24***	.000
Relate	.571***	-.07	-.07	-.90	.370

***p<.001

6 Results and Discussion

6.1 Findings

This study constructed an aesthetic experience model based on four experience factors of sense, think, act and relate. Fifteen questions were written based on the experience types. The result of our statistical analyses presents the following major findings:

(1) The evaluative index of four factors of sense, think, act and relate is constructed

With multiple regression analysis, this study justifies the feasibility of using the four for evaluating the effectiveness of aesthetic experience activities; act and sense are the most significant predictors among them.

(2) The main factor of consumers' willingness for such experience is the sensational pleasure they receive
Outside appearance is one of the essential factors for the decision to purchase, the main factor for consumers' willingness for such experience is the sense pleasure they receive. The more attractive the product looks, the more willing are the consumers to further appreciate the product and thus be involved in experiencing the product. Among all subjects, consumers with design background is significantly much higher in their expectation of the product –sense attraction—

(3) A product with stories is easier in alluring consumers for experiencing
If a product could reach consumers' emotion, refresh memory or bring reflection, then the consumers will be further involved for greater sense exposure. It is especially easier for female consumers to relate product historical background or development process to their personal experience.

6.2 Suggestions

Some suggestions are generalized from the results of the study:

(4) Successful life craft experience activities should be able to attract consumers for action
Successful life craft experience activities should be able to attract consumers for immediate action. When consumers are touched with the product, there should be products ready for consumers to be able and willing to possess immediately. This is also the goal for promoting aesthetic experience and thus life craft industry.

(5) Attend to relevant effects in the experience activity
Although outstanding one's status and identity is not a critical factor in experiencing life craft products, it is an effect worth attending since aesthetic experience could bring about unique style and taste as well as reflect the consumer's individual values.

(6) Duplicating experience
A successful experience model should be able to rise consumers' curiosity and sensual pleasure, and it is also demanded in packaging the product with a storyline. Among the four aesthetic experience factors in the multiple regression analysis, however, act is the most crucial. A business manager should devote himself to rise consumers' potential energy so as to shift their emotion into actual action. For instance, small duplicated products could be developed form the authentic master piece, so that there is a flexible distinction between the products' price range and thus provides consumers the possibility to enjoy immediate possession within their financial ability. This way, experiences could be duplicated, memory extended, better product circulation achieved, and more influential the products to the society.

7 Conclusion

Taiwan is now entering a new era of culture creatives followed by aesthetic economy; with the pursuit of culture creatives, a new group of consumers, titled the LOHAS by

Anderson and Ray, is now newly coming into existence. The LOHAS, in addition to topics of organics, environmental conservation and health, heeds more to the integration of body, mind and spirit. [14] As culture seeks after emotional inspiration towards life, and aesthetic economy stresses the actual experience of life, the LOHAS consumption emphasizes exploration of life values. A good product is a craft which carries discourse with people by brings inspiration to them. As Norman states, emotion is the ultimate critical issue of a successful product design. [10] The strongest power which can touch people originates from the reflection of each person's life experiences, the objective condition—is actually the sensual responses the product induces--. Consequently, a successful cultural creative industry would be one that allows consumers to actively take part in the process, and duplicate, extend, as well as enlarge the experience activities and results. This is undoubtedly also the direction and goals to which each craft product designer, and business managers, when promoting life craft aesthetic experiences and developing creative life industry, should make their best efforts for.

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The User's Emotional Elements Research of Mobile Network Products Development Guided by User Experience

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Abstract. In the whole products process of enterprise-class, the product definition decides the product's "gene". By way of in-depth research on user experience and behavior, our brand strategy, product planning and product definition would be more accurate and reasonable. Along with the level of product and brand homogeneity increase, the consumers more rely on perceptual understanding and intuitive when buying. Usability is just the underlying objective of humanism design view. The "perceptual demand" is the product of profession maturity and full competition. In order to capture the users' hearts and target to the users at first sight, it is must needed to give products enough emotional appeal and more latter symbol to meet higher levels of people's spiritual needs.

Keywords: User's Emotional Elements, User Experience guide, Mobile Network Products.

1 Introduction

In the whole products process of enterprise-class, the strategic planning and development of production and the final sales maintenance are so interlocked that any part of problems may lead to failure. The planning and definition are the source and precondition, which decide the product's "gene" and destiny, so this part of the work is to put things to do a good. And design development to the final sales maintenance belongs to the end. We just need to follow the established policy in the right way and ensure the smooth flow of product on (Fig. 1 shows an example). Of which the product definition is the role of the connecting. Suitable products definition can carry out product planning and offer guarantee to products development. On the contrary, it will make the products in the development process in an embarrassing position. By way of in-depth research on user experience and behavior, our brand strategy, product planning and product definition would be more accurate and reasonable, namely "do the right thing".

Because of industrial design's inherent sensitivity to demand, it has played a more and more active role in enterprises. And the industrial design's pilot action by user experience research has been played in more and more enterprises and projects.

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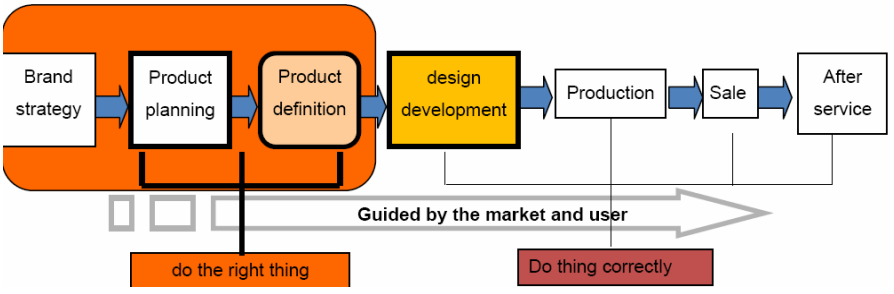

Fig. 1. Product policy guided by the market and user

2 The Process of Preliminary Concept Producing

Both domestic and international design companies, universities have studied the methods and procedures of preliminary concept producing, and the angles are different. After a period of practice and research, by referenced the past operation, we have advanced the user-centered concept producing methods and process guided by user experience. In which we emphasize the market and users basis to concern on competitors dynamic and dealers attitude, improve the team cooperation and coordination to a higher level, in the way of preparing fully market research and competitor, supply chain, data analysis and team brainstorming. Thus project team members can have a consensus and a clear design direction and reduce the disorder. This is a good security to carry out design smoothly.

The process of preliminary concept producing is divided into 5 steps.

First, team members should collect and discuss the second-hand information. Through this work, they can locate a preliminary assessment to project positioning, including online resource collections, obtain the relevant products , finished products and marketing information from the Internal, the industry trends data and competition situation from market consultancy. Secondly, they should do structural and nonstructural user research, to test the target customers' preset targets reaction, and do a user usability test if necessarily. After above operations, we can get a preliminary conclusion.

By the market research in the earlier stage of design, team members have a more in-depth understanding to the market demand of project itself. Then they need to sort out of a product definition. Now, we need a collective discussion to show team members' initiative, and discuss to determine the crowd and their demand characteristics and get elements a product has to express, from which good ideas and creative produce. If the element is difficult to determine, we can confirm the feasibility of a validation feature by quantitative user study.

After so many collective discussions, the product veins began to surface. Now, we need to organize and summarize them to preserve by document form.

From a comprehensive document and consider to the attributes of product definition, we need to fill the various aspects of definition content which the staff members of relevant business assess and modify, then publish.

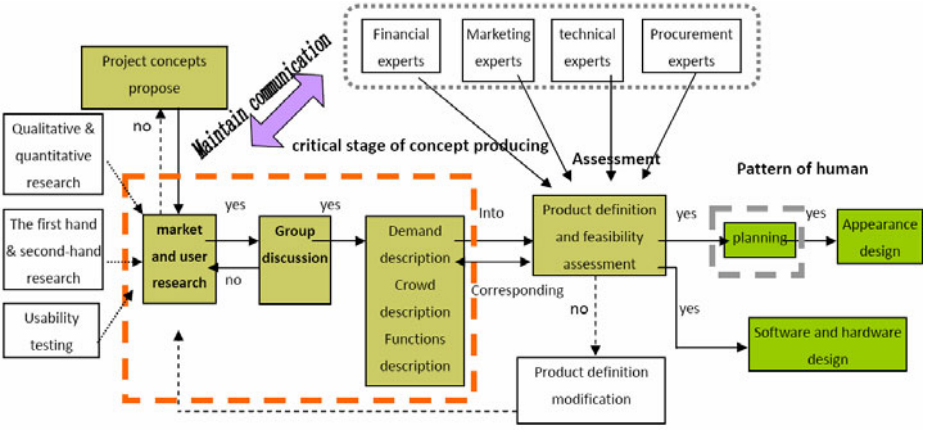

Fig. 2. Product definition mode guided by user experience

Design planning is to open the designer's innovation and provide for their reference. Through the conversion the product definition to design language, we can use the sensitive and visual language and thinking expanding to inspire designers' the creation and helps designers into create conditions as soon as possible.

If we make the design target more clearly in the earlier stage of design, it will be more able to promote the development efficiency. When a design language converted, we can determine a class of consumers as the main subjects by product definition, and then determine the products' elements to express by the group's characteristics (Fig. 3 shows an example).

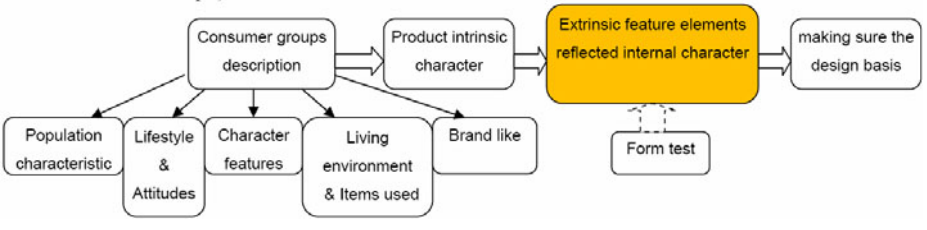

Fig. 3. The design conversion process of product emotions

When operating we need to do the following first, we should ascertain consumer preference by design direction representation. Then we should use the semantic meter to get the feature elements, and take a look at the identity degree of target groups. Through these, we can get a general preference toward of target groups, and modify the feature elements, which is more ideal effect with innovative work in the earlier stage of design.

3 Consumers' Perception Mental Experience to Product and Brand

Along with the level of product and brand homogeneity increase in mobile communications, the consumers more rely on perceptual understanding and intuitive when buying. Therefore, enterprises must let the products have an advocacy and a way of life apart from the function in the product promotion, which is the brand identity. For example, the iPhone, when it early is unique in the market, can be on its own functional and use experience. But when a large manufacturer is follow-up, it should associate unique product with brand value and emotional element (Fig. 4 shows an example).

Consumers to branding direct source is the product, this means that forming brand not only depend on its own characteristics, but also depends on consumers' understanding and knowledge about the product characteristics. The last is relevant to the subjective elements, as customer interest and personality. On the understanding process, consumers have some complex mental activity to brands and products, just as attention, discrimination, understanding and thinking. The objective characteristic of product is important, but the consumers just recognize and accept the characteristics what they experience. The characteristics not been realized and experienced were not existed.

Fig. 4. Apple iPhone4 and its followers

4 The "Perceptual Demand" Is the Product of Profession Maturity and Full Completion

If the product definition focused on all customers, this would reduce their satisfaction (Fig. 5 shows an example). To customers on, there must be a pointed market subdivides. We should appropriate product to the right person by different tactics to different levels of consumption. Only continuing satisfactory can make real loyalty.

For holding fast to the users, in addition to market segmentation and position aim to user needs and desires, we must let them have a sense of belonging.

In the short product life cycle and the fierce market competition field of consumption, Vendors' concern is how quickly to seize consumers' eye and conduct them a shopping. Behind endless variety of sales-promotion, the main things consumers buy or the product and its sense. So whether the product itself from external features and semantic connotations (include metaphor way of life and culture, attitudes, character, etc.) can quickly attract consumers, which is the most important. And in a number of elements such as brand, price, function, quality, performance, and appearance etc, the product design is a crucial role of customers' "surprise", and tempt users' a weak level of sensitivity

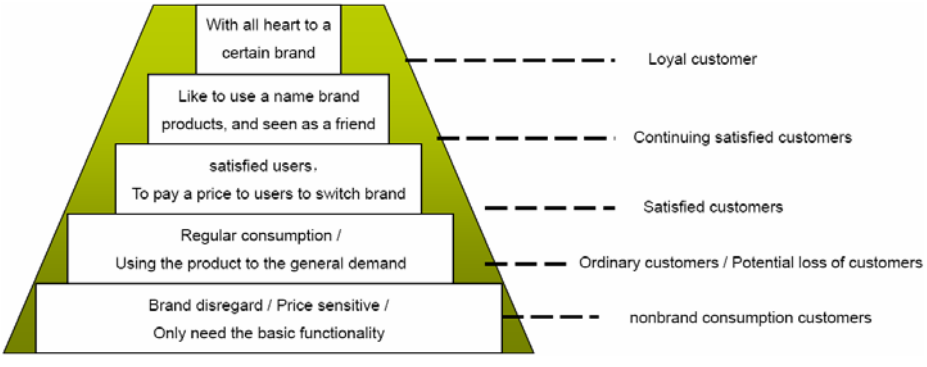

Fig. 5. The consumer level of brand products

5 Usability Is Just the Underlying Objective of Humanism Design View

For users, whether the goods he has purchased are reliable performance and quality, convenient and simple to use, the operating comfortably, the reasonable price, these are all a must. In a very mature, competitive and open market, when the basic material level needs are met, the competition will be promoted to the social, psychological level. These growth and competition are graded up with the "hierarchy of needs" theory of Maslow.

After decomposing consumers' demand to products, we could see that in the three product attributes, consumers' essemtiality demand for products is a constant function - the most fundamental demand for products, which are essential. Function demand is a linear increase function, the function better the evaluation higher. Satisfaction demand is an exponential function, namely the additional value, which the consumers' evaluation to is an exponential increasing.

From fig. 6, we can get the following conclusions: The price of a product is not based on the cost by the manufacturer, but the consumers. The psychological assessment to product value by consumers is the decision of the product prices. When

the goods in short supply, the dealers would prices. When the goods overstocked, the dealers will reduce the price.

The product itself is the consumers' psychological inspire, which decides the assessing value of product. Higher inspire has a higher assessing value, and gets more profits.

Based on the "hierarchy of needs" theory of Maslow, after the low level of basic needs met, its motivation will be lower. Higher level needs will replace it and become the main cause. A higher level needs will have greater value than lower level. The basic psychological inspire (the "hierarchy of needs" theory of Maslow) is equally applicable to product design. These five levels are able to correspond various levels of consumer demand for mobile phones.

If a certain level of product adds some higher level of elements, it can stimulate the consumers to enhance the value assessment of products and the purchase enthusiasm. When the assessing value is greater than the increase in costs, companies will get Additional profits.

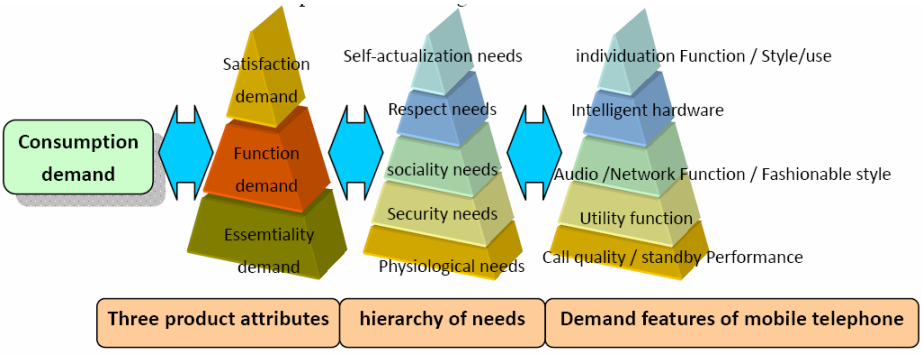

Fig. 6. Mobile telephone consumption - a mode of product demand interaction

Humanism design, human-relationship design, and inter-personal design form collectively the three layers of view from the inside to outside and down to up. In the humanized design, designers' main concern is the coordinating relations of product form, function and human. And the emphasis of the product is personality, and usability. The theory is mainly the ergonomics, whose point is product design required to comply with the physical and used. After the solution of the basic material level design elements, design idea is from a humanized design to human relationship design, and elements emerge (Fig. 7 shows an example).

How we meet people's spiritual need? Consumers need to be more emotionally moved and they are willing to buy their enjoyment. At the time, not only the product is full of lure, but enterprises and businesses also provide services to be full of human. Both the customer feels comfortable shopping convenience, and is prejudiced in his favour of the enterprise from inside, finally realize their loyalty. In inter-personalization design, the designer is asked to prioritize consumer groups and groups within the interactive relationship, and the communication channels, communication way and points of interest etc. Also the designer is asked to consider if product

elements can bring consumers together and interacting, and if the interaction is positive or negative, the relationship between a new or old, even how How to adjust the relationship between man and society, man and nature. So his design is not a product, but a relationship or lifestyle. [3]

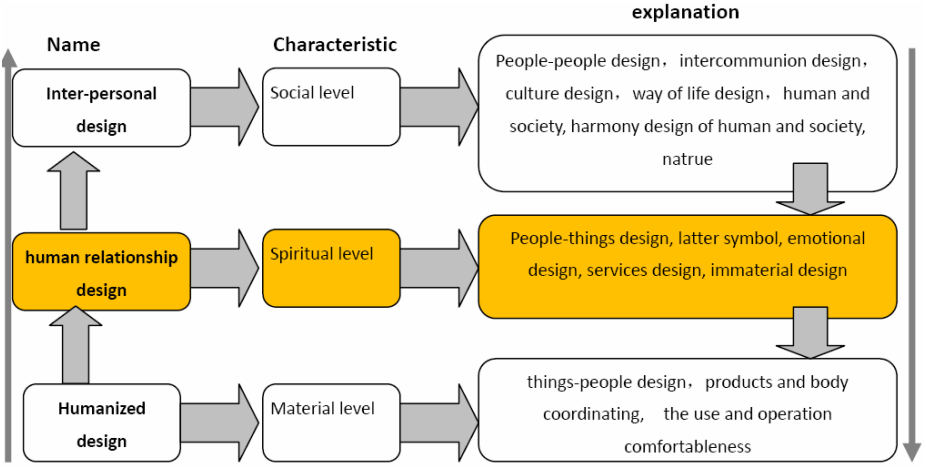

Fig. 7. Humanism design view expanding

6 Firstly, Finding Demand and Design Is Effective to Solve Demand

When consumers in psychological or physical condition are in short, it would produce demand. Demand will not directly result on action. Only when the demand awakes up, that will make individual a move.

As the point of the demand often has no definite goal and direction, it brings a greater difficulty to design. Meeting the demand may have different ways and means, but it cannot be explained why consumers take this one. For example, a people's "need" is only a solution to the enemy when he wants to go outside, but by walk or cycle, a taxi, take the subway or drive? It will be explained by "motive". Because of the multiple, intensity and direction of motive, therefore it can be better than demand to explain the consumer behavior and phenomenon.

Actually, designs are often confused with a problem that even they found the user not yet been satisfied requirements, design products suitable for the ergonomics, but the product sales not so desirable, especially in fierce market competition. For example, from 2004, although we have established the database of shape and size of lots of mobile telephones for the china mobile communications market by the research on gender differences and ethnology and ergonomic, we still cannot be guaranteed each product will be successful. It indicates in many cases that the consumers will be deeply affected by product emotion, from need to like, like to love. Only having a positive, clear and strong motive, their expected purchase behavior may occur rapidly.

Table 1. Gender-form match of the folding mobile phone (2004)

Types of product					Long (no external antenna) -mm	Wide (no side button) -mm	length to width	Thick -mm		Weight -g
								Thickness Except decorated part	Overal l thickn ess	
Female phone	Slender shape			single display	L≤80	W≤40	2	H≤18		W≤70
				dual display				H≤18	H≤22	
	Short shape			single display	L≤75	W≤45	1.67	H≤18		
				dual display				H≤18	H≤22	
Normal phone	With cameras	In A surface	For male	single display	L≤90	W≤45	2	H≤23		W≤85
				dual display				H≤18	H≤23	
			For female	single display	L≤82	W≤42	1.95	H≤23		
				dual display				H≤18	H≤23	
		Round the rollers	For male	single display	L≤90	W≤48	1.875	H≤22		W≤85
				dual display				H≤18	H≤22	
			For female	single display	L≤85	W≤45	1.89	H≤22		
				dual display				H≤18	H≤22	
	Without cameras	For male		single display	L≤80	W≤42	1.9	H≤22		W≤80
				dual display				H≤18	H≤22	
		For female		single display	L≤80	W≤42	1.9	H≤22		W≤75
				dual display				H≤18	H≤22	
	Music & game(a storage card)				L≤80	W≤45	1.78		H≤28	W≤105
Male phone	With cameras	In A surface		single display	L≤80	W≤50	2	H≤28		W≤105
				dual display				H≤25	H≤28	W≤110
		Round the rollers		single display	L≤80	W≤50	2	H≤23		W≤105
				dual display						W≤110
	Without cameras	single display			L≥80	W≤46	1.95	H≤20		W≤83
		dual display						H≤18	H≤22	W≤85
	Music & game(a storage card)				L≥80	W≤50	1.9		H≤30	W≤120

From the operative levels, product creators taste the taste of the product. In spite there is a relevant process of planning, definition, research, development, review and publicity and promotion, but the industrial design is the initiator of product style, product semantic and product character. As a designer , there will be direct action to improve the design quality, experiencing the target customers' life in a deep-going way and being an insider in characteristic, which. So, it is urgent to improve industrial designers taste.

Taste and patterns of life are concerned. If a designer will design a first class car, but he had no experience of driving luxury sedan, and customer's life and social, how he can do from a user view to design. The design products also will be very difficult to move the target groups. Product resonating with users is also the resonance of designer heart and user hearts. As a designer, raising his personal life, experience in his industry and product for which the customers life characteristic and the crowd feature, there will be the most direct to raise the quality of design.

7 Conclusion

The process of preliminary concept producing is essential for the product. The product definition decides the product's "gene". In order to capture the users' hearts and target to the users at first sight, it is must needed to give products enough emotional appeal and more latter symbol to meet higher levels of people's spiritual needs.

More and more products have enriched our lives. Most of the products are improving in usability and humanization, but at the same many products are little in emotional appeal, and can't attract a man. In this respect, as a fashion leader, Apple's products will inspire us that each product is full of the sensitive elements influenced by the Apple's culture. Because the world thousands of Apple fans promote product across "gap" as early in the product user, Apple's products can be on the market peak. With the continuous development and integration, mobile phones will evolve into a strong personal mobile terminal, the form will also change. But in fact, whether function or form, it must be based on people's demand, and this is also the focus on humanism product design.

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Once Broken, Never Fixed? The Impact of Culture and Medium on Repairing Trust in CMC

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Abstract. Communication in today's media choices of texts, tweets and posts remain influenced by who we are and our subjective context. Given globalization, distance education and diverse teams and workgroups, successful communicative interaction is facilitated by interpersonal trust, or the trust between conversational partners. When conflict erupts, as it will in relationships, in work groups and within organizations, the restoration of trust and stability is aided by one's personal analysis of internal and external factors. The objective of this study is to investigate how communication channels (IM and video) influence people from different cultures (China and the US) in trust development and trust reparation.

Keywords: Media, culture, computer-mediated communication, trust, trust repairing, trust perception.

1 Introduction

A 1989 Nobel Peace Prize winner, the Dalai Lama, has remarked; "I find that because of modern technological evolution and our global economy…the world has greatly changed: It has become much smaller. However, our perceptions have not evolved at the same pace; we continue to cling to old national demarcations and the old feelings of 'us' and 'them'[1]."

Currently, the 17-nation, European currency union member nations are learning their individual financial stability is dependent upon the cohesion of their collective [2]. In a world of such blurring and enduring boundaries, sensitivity to cultural influences persists. A fundamental research question in this area is how to transcend our nationalistic differences in CMC. Investigation in this area is called for in order to understand how such communicative misunderstandings occur when members of different cultures collaborate, and how such miscommunications may be overcome.

Trust plays an important role in distant collaboration. Often people are assigned temporarily to collaborate on a common mission such as juries, presidential commissions, global virtual teams, or ad hoc committees. On the one hand, swift trust provides the immediate cohesion such working relationships require for successful collaborations. On the other hand, swift trust is fragile and once broken, it is hard to

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repair. This becomes far more challenging when the collaboration was in computer-mediated environment, and in the cases where the collaboration involves people from different cultures. This goal of this study is to understand how culture and media channel interplay in restoring trust.

2 Related Work

In researching cross-cultural collaboration in CMC, a key issue is trust. With trust, miscommunication resulting from contrasting cultural barriers may be overcome [4]. In collaborative work when misunderstandings and conflicts occur, how trust is repaired becomes an important research question. We seek to address this issue and therefore ask how media influences the repair of trust in individuals from eastern and western cultures when negotiating with others from their own culture.

Interpersonal trust has long been studied in organizational settings. Trust is defined as the state someone is in when they are willing to accept vulnerability [5]. Trust is necessary when engaging in business or communicative activities wherein uncertainty prevails, particularly when visual cues are unavailable as in a text-only communication environment. We first review the literature on how trust perception and trust repair are measured. Related trust studies on cross-cultural computer-mediated communication are then reviewed. We conclude our review of related literature and propose the hypotheses that guide our work.

2.1 Trust Perception and Trust Repairing

Trust plays a central role in establishing and maintaining cooperative and productive associations. The willingness to believe in the well-placed intentions and goodwill of others as well as cooperative reciprocity [6] define trust. Successful communicative interaction is facilitated by interpersonal trust, or the trust between conversational partners. McAllister [7] proposed two different types of interpersonal trust. Cognitive trust is based on an intentional judgment of the competence and reliability of others. Social and cultural similarity can influence or increase the level of cognitive trust. Affective trust is based on emotional bonds and relationships. Some level of cognitive trust may be necessary for affective trust to develop because individuals' baseline expectations for reliability and competency of others must be met before they invest further in relationships (McAllister, 1995). Cognitive trust enables us to participate in interactions both personal and professional; a personal liking of the other is not necessary but belief in one's rational capability is requisite. Affective trust is based on individualized preference for another's personality, attitudes and bearing. Both affective and cognitive trust are essential to promote successful information exchanges.

Central to interpersonal trust is the perception of another's credibility. An individual deemed trustworthy is one to whom positive expectations of behavior are attributed. Trustworthiness is comprised of three components: benevolence (perceived intent), integrity (perceived values) and ability (perceived competence) [8]. When conflict erupts, as it will in organizations, groups and among individuals, restoration of good will is aided by an analysis of internal and external factors. Confirming [9]

findings that trustworthy actions restore trust, Tomlinson & Mayer suggest that when issues of benevolence and integrity result in a violation of trust, trust is difficult to repair. But when ability is perceived as the distrusted factor, it is usually irreparable.

Successful trust repair hinges on acknowledgement of the trust breach and commitment to reparation. When one's trust has been violated, trust repair is achieved only by subsequent acts of reparation [10]. The effectiveness of trust restoration can be measured by the victims' satisfaction with the restoration offered, the transgressor's recommitment to the broken rule, the reduction of each party's negative emotions, and by each party's willingness to interact in the future [11]. People begin collaborative interactions with trust [12 and others], but when trust is breached an acknowledgement and signs of changed behavior must ensue.

2.2 Culture and Computer Mediated Communication

It is only recently that cross-cultural computer-mediated collaboration research is explored, and particularly for eastern and western participants. Many use the cultural dimensions of individualism vs. collectivism [13] and low vs. high contextual [14] communication styles [15, 16]. It is worth noting that although participant pairings were made along nationalistic lines, there is no presumption of absolute homogeneity among the participants. Instead, these studies focus on aggregate measures of how individuals from similar cultural backgrounds tend to respond or behave.

Accepting that a variety of influences predispose one to preferences for media type, contact frequency or purpose of communication, the prevalence of communication channel choices now available creates a complex environment for empirical understanding. Numerous findings, some seemingly at odds with others, differ depending upon task type and participant partnering. For example, Chinese participants talked longer face-to-face than in an IM channel while their American counterparts talked less, regardless of medium [17]. In [16], Chinese talked less than American participants while using an instant messaging (IM) tool. Video conferencing and video chat offer advantages and disadvantages as well. Zhang et al [18] found that video is not always helpful but does increase trust when dealing with conflicts; [19] revealed advantages for non-native speakers using a video channel.

The effect of technology on communication occurs when interpersonal cues available in face-to-face interactions are minimized—as in the case of audio-only or text-only chat. Some cues may in fact be amplified in a video-infused condition in that environmental distractions may be fewer, focusing attention to the upper body or a single person. Richer media channels—those providing exchange of additional nonverbal cues—include real-time sight and sound may engender higher levels of cooperation [20], while task type affects participant experience in the cognitive and social demands required by task fulfillment.

Tasks utilized in research of culture and CMC include brainstorming or idea generation [17, 16], price-fixing negotiation [18], and map navigation [21]. Results from these tasks are mixed, and it is difficult to separate culturally-based responses from media and task interactions. Bos et al [22] used an investment-type, social dilemma game, Daytrader, to measure trust perception. While these studies suggests there is a media and gender effect on trust perception, the contribution of the current study is to investigate the cultural differences in CMC channels, not only in trust

development (as shown in previous studies), but also in trust repair when a trust violation has occurred.

2.3 Research Hypotheses

We are interested in how computer-mediated communication channels influence trust for people from China and the US. While the body of previous work includes many studies examining CMC and culture, the present study investigates trust and applies it to a computer-mediated, cross-cultural comparison. Diverse collaborations can benefit when communicative partners trust each other. By intentionally manipulating trust across stages, this study contributes to our understanding of how trust may be repaired after suffering a breach. Based on our understanding we expect to find that the communication channel used (IM or video) will engage participants differently.

H1: (medium effect) As the richer channel, video will be more engaging for both cultures than IM. The increase in nonverbal cues will be more efficient and lead to higher levels of trust reparation for both Chinese and US participants.

Further, it is our expectation that Chinese participants will spend more time in communication with their partner in trust building interactions than their American counterparts, and therefore will evidence increased performance times during the task.

H2: (culture effect) Chinese participants will spend more time than Americans performing the task, because their national influence for greater relationship-building activities will take longer.

Communication styles differ cross-culturally. While people from eastern cultures like China converse more implicitly depending on non-verbal cues to detect the true meaning of the conversation, people from western cultures like the U.S. tend to be more explicit. Therefore we expect that video will benefit Chinese participants in trust development and repairing by providing these non-verbal cues.

H3: (interaction effect of medium x culture) Video will help Chinese participants in trust development and reparation more than IM, even when conversing in their native language. American participants will not demonstrate a media difference.

3 Method

Participants: Sixty undergraduate students from a university in the United States participated in this study: 30 Americans (born and raised in the US), and 30 Chinese (born and raised in mainland China or Taiwan, and residing in the US for less than 2 years). All participants were in the 18-24 year age range, and conversed in their native language: either American English or Mandarin Chinese. Gender distribution was evenly balanced across culture and media type. Participants were paid $15 and earned raffle tickets as a bonus, based on points scored in the game (ranging from 1 to 7 tickets) for the prizes (iPod, $50 and $25 gift cards).

Task: Each participant played with a confederate in a social dilemma game called Daytrader [24]. It simulates a 30-day investment cycle, involving 5 rounds of practice followed by 30 official rounds of investment. Participants were given 40 points per round to invest, and they were told their goal was to make as many points as possible.

A simple formula was shared for calculating combined points per round: Payoff for the round = [(your investment + your partner's investment + market fluctuation)/2]. The market fluctuation was a random number assigned by the game that ranged between -10 to 10 points so that, participants were unable to know exactly the confederate's accurate investment amount. Instead they had to rely on the verbal commitment made with the confederate and then deduce from the payoff the confederate's cooperation with that commitment. A bonus of 200 points was awarded to the player making the most points after each set of five rounds. Throughout the game, participants were unable to verify their partner's investment amount; they were able to only see their own results as the game progressed.

Procedure: Upon arrival, participants responded to items on a background survey. Game instructions were explained. Participants were told they were playing against another student. Participants played five rounds in the presence of the experimenter to ensure they understood how to play. Thirty official rounds were played by the participant with the confederate. After each 5^{th} round, the participant and confederate were provided five minutes of IM or video chat time to discuss their performance, or anything they wished. After every 10^{th} official round, each participant completed a survey to gauge trust levels. Before they left the lab, the experimenter debriefed each participant.

Trust Stages: The official 30 rounds were divided evenly into 3 stages: building trust, breaking trust and repairing trust.

In the building trust stage, the confederate purposefully invested additional points resulting in the participant receiving greater returns on their investment. Seeking to establish collaboration and good will, the confederate overbid his investment for the gain of the participant. In the discussion protocol, confederates reiterated that the more the partnership invested, greater gains were realized. In addition, to facilitate our trust building, the random number for each round was positive between 0 and 10.

In the breaking trust stage, the confederate intentionally reduced his own investment amount, thereby earning the bonus, or at least sharing the bonus with the participant. The confederate acknowledged the poor performance and attributed it to factors not related to his benevolence and honesty, but rather pointed to explanations such as typographical errors, misunderstanding how to play the game, poor math skills or bad market conditions. Random numbers were negative between -10 to 0 so as to further complicate the lowered payoffs.

In the repairing trust stage, the confederate sought to regain trust by increasing the group investment and positioning the participant to earn the bonus. During the communication, the confederate began with an acknowledgement of ineptitude or an admission of self-interest, followed by an apology and statement of recommitment to the participant's success immediately following. Random numbers were positive between 0 to 10 to strengthen the trust reparation effort.

Media: Each participant conversed with their confederate partner via instant message (IM) or video conferencing. For the IM condition, AIM and MSN messengers were used for American and Chinese participants respectively. For the video condition, Google chat was used for both nationalities.

Trust performance measures: In our game, each participant's investment represented a measure of trust. A trusting participant would invest more to the "partnership" when they developed trusting feelings towards the confederate. If they felt the confederate was untrustworthy, their strategy would be to invest less, keeping all or most of the 40 points for themselves. Therefore, participants' investment is used as the trust performance measure. In addition, task completion time per round was recorded to measure how fast or slow trust developed, was broken and repaired in each stage.

Trust Survey: A background survey was given prior to the practice round to collect demographic and technology usage information. The trust survey was given at the end of each stage to measure trust perception (affective trust, cognitive trust, and trustworthiness). Questions were adapted from previous literature [5, 11, 10, and 23]. A Likert scale of 1-5 was used in the survey, ranking most negatively (1) to most positive (5).

4 Results

Our hypotheses were tested by analyzing the effects of culture and media across the three stages of trust building, trust breaking and trust repairing trust. *t*-tests were performed to compare the means of participant scores for investment amounts, survey responses, and performance time by culture affiliation and media type. Then, analyses of variance (ANOVA) were run to test for interaction effects.

4.1 Trust Performance: Participant Investment and Task Performance Time

In comparing investment amounts in points by stage, both cultures began investing at roughly the same rate in the trust building stage. While Chinese investment amounts were significantly lower in the breaking trust stage than in building trust stage ($t(30)=2.31$, $p<.05$) and the repairing trust stage ($t(30)$-3.11, $p<.01$), but the repairing trust stage investment was also significantly higher in the building trust stage ($t(30)=2.20$, $p<.05$). American participants' investments revealed no significance in a comparison of all three stages (Figure 1). There is a significant interaction effect of culture and stage on participants' investments ($F(2,112)=3.47$, $p<.05$).

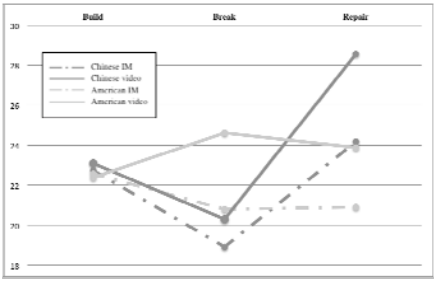

Fig. 1. Participant investment (points) by culture, media, and stage

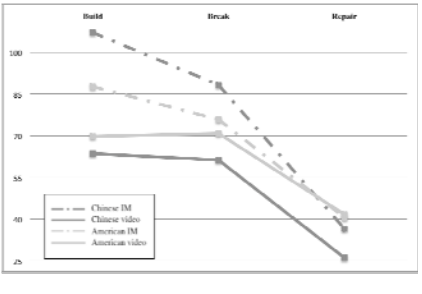

Fig. 2. Task performance time (sec) by culture, media, and stage

In terms of task performance time, both US and Chinese participants spent more time in the building stage in IM than in video. As expected, the video condition aided efficiency even more so for Chinese ($t(29)=6.36$, $p<.001$) than for Americans ($t(27)=2.19$, $p<.04$) in this first stage. At the breaking trust stage within culture, the Chinese were statistically more efficient using video than IM ($t(29)=2.78$, $p<.01$), than the Americans. In the repairing trust stage within culture, the Chinese again were statistically more efficient using video than IM ($t(29)=2.86$, $p<.01$), than the Americans (Figure 2).

There is a significant main effect of stage ($F(2,112)=26.25$, $p<.01$). Both American and Chinese participants spent less time moving from the stages of building trust ($t(59)=1.99$, $p<.05$) to breaking trust ($t(59)=4.87$, $p<.01$) to repairing trust ($t(59)=6.38$, $p<.01$).

The main effect of media ($F(1,56)=14.06$, $p<.01$) and interaction effect of media by culture ($F(1,56)=6.45$, $p<.05$) were also significant. Comparing IM channel to video, video saved participants time in the building and breaking trust stages ($t(58)=5.58$, $p<.01$; $t(58)=2.36$, $p<.05$)).

Additionally, a post-hoc test of the interaction effects of media and culture showed that video significantly saved time for Chinese participants when comparing channels ($t(29)=3.69$, $p<.01$), but not for Americans.

4.2 Trust Perception

Participants' subjective ratings of trust towards the confederate partner was captured after each stage. The main effect of trust stage was significant for both affective trust and cognitive trust (Affective Trust: $F(2,114)=9.14$, $p<.01$; Cognitive Trust: $F(2,112)=6.73$, $p<.01$). The building and repairing trust stages were significantly higher than in breaking trust (Affective Trust: $t(60)=3.53$, $p<.01$ and $t(60)=3.78$, $p<.01$; Cognitive Trust: $t(60)=3.05$, $p<.01$ & $t(59)=2.90$, $p<.01$), (Figure 3).

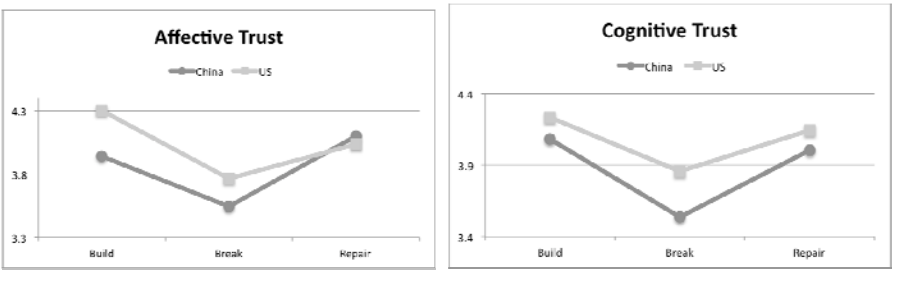

Fig. 3. Affective & Cognitive Trust by culture and stage (1=least trust, 5=most trust)

There was no difference between trust building and reparation stages, demonstrating that affective trust and cognitive trust repaired to the same level as was initially evident in building trust.

The interaction effect of stage and culture was significant for affective trust ($F(2,114)=3.44$, $p<.05$). Chinese participants reached a higher level of affective trust perception in repairing than in both the building and breaking stages ($t(31)=3.35$,

p<.01; $t(31)=1,98$, $p<.05$), while American participants did not. The main effect of media was significant for cognitive trust ($F(1,56)=2.90$, $p<.05$). In the breaking and repairing stages, perception of cognitive trust was higher in video than in IM ($t(59)=1.98$, $p<.05$; $t(58)=2.42$, $p<.05$).

4.3 Trustworthiness

The main effect of stage was significant ($F(2,112)$, $p<.01$). Building and repairing trust stages were significantly higher than that for breaking trust ($t(60)=4.49$, $p<.01$; $t(59)=2.38$, $p<.01$). Building trust was also significantly higher than repairing trust ($t(59)=2.03$, $p<.05$). The main effect of media was also marginally significant ($F(1,56)=3.80$, $p=.06$). In the repairing trust stage, participants' perception of trustworthiness was higher in video than in the IM channel ($t(58)=2.05$, $p<.05$).

5 Discussion

The objective of this study was to investigate how communication channels of IM and video influence people from different cultures in trust development and trust reparation.

In support of H1, Chinese participants perceived higher levels of cognitive trust and trustworthiness in the video channel than in IM during the stage of trust reparation; Americans did so in cognitive trust but not trustworthiness. In addition, the video channel increased task efficiency, especially in the stages of trust building and trust breaking stages (Figure 2).

H2 was also supported. Figure 2 shows that Chinese participants spent more time in the building trust stages for both channels, but somewhat less so in the video channel as compared to Americans. Even though Chinese participants in the IM condition were delayed by typing Mandarin characters on a western keyboard, in the video condition, Chinese spent less total task time than Americans. One implication we draw is that the extra time Chinese participant spend in discussions; e.g., relationship building, may yield a greater degree of efficiency in performance time.

In support of H3, our data showed trust performance measured participant investment amounts were significantly higher in the trust reparation stage, compared to building or breaking trust for Chinese participants (Figure 1). This was not true for their American counterparts. We see a similar pattern in the perception of affective trust. Chinese perceived higher levels of affective trust in the reparation stage, compared to building or breaking trust stages. For American participants, there were no stage differences on perception of affective trust. These findings suggest that the perception of affective trust is critical to repair trust violations.

From a cultural perspective, we found Chinese participants spent greater amounts of time in discussions about their investments and strategies than American participants. In task time, however, Chinese participants spent less time than their American counterparts. This implies that Chinese participants spent more time in conversation, perhaps building relationships, yielding a greater degree of efficiency in terms of performance time.

Trust performance--measured by the amounts of participant investments--significantly improved in the stage of restoring trust than in the stages of building or breaking trust for Chinese participants, while American participants' trust performance was non-significant. For American participants, there were no stage differences for affective trust; results of Chinese participants were significant for cognitive trust changes by stage. These findings suggest that the perception of affective trust is critical to repair trust violations. Our study found two components of interpersonal trust--cognitive and affective trust--are affected differently by media and culture. Video conferencing improves the perception of cognitive trust, but not affective trust. When trust was broken, Chinese participants spent more time than Americans talking about it, however, their task efficiency surpassed that of their American counterparts'.

6 Conclusion

In summary, our study shows that video does improve trust reparation, especially in the perception of cognitive trust and trustworthiness. It appears that the perception of affective trust is critical to trust reparation, as was observed in our Chinese participants. Chinese participants not only perceived higher levels of affective trust in the trust repairing stage than in trust building stage and trust breaking stage, but also demonstrated improved trust perception in the final stage as compared to the previous two stages. These results provide some insight into ways cross-cultural collaborations may move past conflicts and misunderstandings toward greater efficiency and conversational success.

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Part IV

Cultural Issues in Business and Industry

Using Embedded Technology Badges to Derive Social Networks, Patterns of Interaction and Space Utilization in a Corporate Headquarters

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Abstract. Badges developed by Hitachi High Technologies (Hitachi calls this process "Business Microscope") were used to gather interaction data, and sensors stationed in monitored locations recorded space occupancy-utilization from 25 meeting areas and 86 individual workstations in the global headquarters of a large manufacturing firm in the upper Midwest, USA. One hundred thirteen participants in 19 work groups/departments wore individual badges throughout seven work days. Social networks were derived from the interaction data (based on three-minutes cumulative interaction per day). This objective approach to deriving empirical networks and space utilization improves on many existing techniques that rely on inconsistent observation, subjective surveys, individual or group reconstructions (e.g., focus groups).

Keywords: Social networks, social network analysis, space utilization, interaction patterns.

1 Introduction

Academics, consultants and business leaders have long sought objective methods to rationalize investments in office workspace due to occupants' overestimates of the time they spend in the office and in specific locations [1], [2]. In addition, these constituencies have become interested in measuring important aspects of knowledge worker productivity [3]. In this regard, some investigators have begun to accept social network analysis as a proxy measure of at least some pertinent aspects of work group performance and organizational effectiveness [4]. However, measurement approaches that meet all the rigorous criteria for experimental control, reliability & validity required for academic research are rare in applied work; at the same time, applied research methods often rely on subjective measures that fail to predict future behavior and thus do not provide adequate business intelligence for decision makers [5].

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2 Method

In an effort to explore these issues and address some associated methodological limitations, Haworth's Ideation group partnered with Hitachi High Technologies, a Hitachi company that developed an applied measurement system called "Business Microscope" to conduct this research. This study used their approach to empirically derive social networks from patterns of interaction and space utilization within 19 work groups/departments over a 10-day period (seven business days). Participants wore individual badges (called "nodes," featuring infrared senders/receivers, accelerometers) around their necks while in the office throughout the study period (see Figure 1); these nodes were returned to a "base station" each night for downloading data and re-charging (see Figure 2). Twenty-five meeting areas and 86 individual workstations were monitored via sensors (called "beacons") placed in each (see Figure 3). These areas were selected (convenience sample) to represent all three floors in the headquarters of a large manufacturing firm in the upper Midwest, USA (see Figures 4-6). Each individual node and area sensor sampled interaction/use data every 1.5 seconds. From these data, the presence of participants (for objective space utilization) and the nature of their interactions (with a cumulative minimum of three minutes a day, along with identifying "speaker" & "listener") were derived using Hitachi's proprietary software (based on previous studies of 119 companies in Japan).

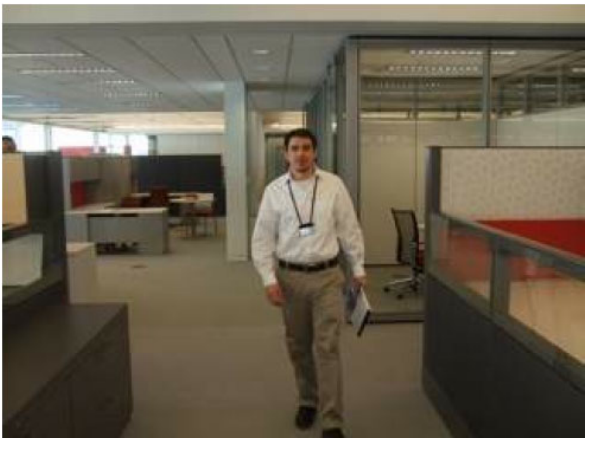

Fig. 1. Participant wearing a badge ("node")

These methods yielded empirical social networks that reflected the frequency and timing of interactions among participants during the seven business days of measurement (see Figure 7). Formal, enterprise-relevant collaboration could not be disentangled from Informal (merely social) communication, yet certain levels of social interaction may facilitate collaboration by influencing trust and other important mediating factors linking workplace strategy to pertinent business

outcomes [6], [7], [8]. In addition, these measures gave precise estimates of space utilization across the 25 meetings areas and 86 individual workstations monitored (see Figures 8-10). These data could be used to rationalize future office floor-plate or real estate strategies.

Fig. 2. Depiction of "base station" for "node" storage & data download

Fig. 3. Illustration of a sensor ("beacon") in a meeting area

Fig. 4. Areas of the floor-plan monitored/sampled on the first floor

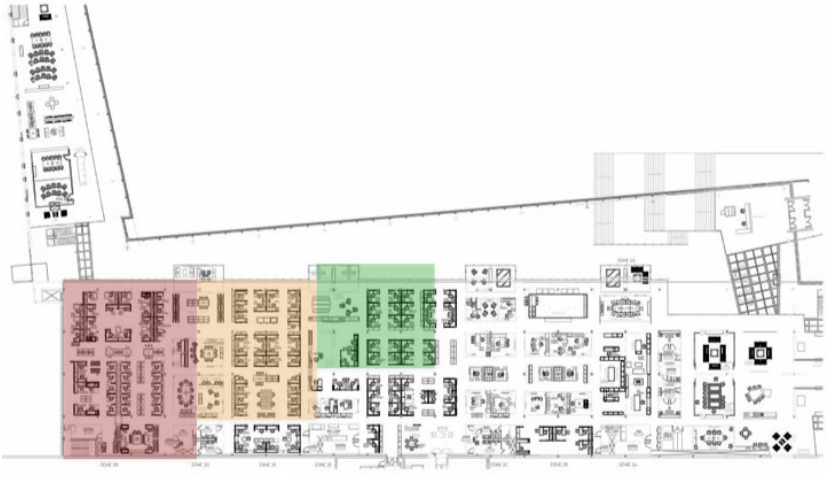

Fig. 5. Areas monitored /sampled on the second floor

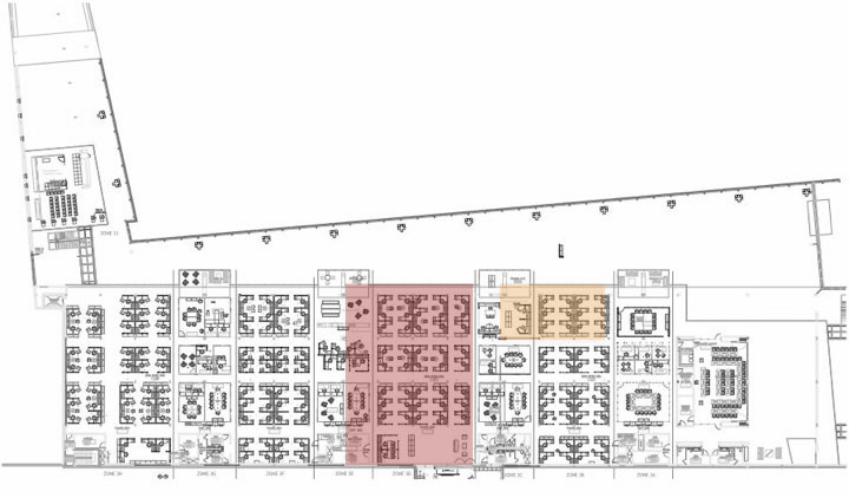

Fig. 6. Areas monitored / sampled on the third floor

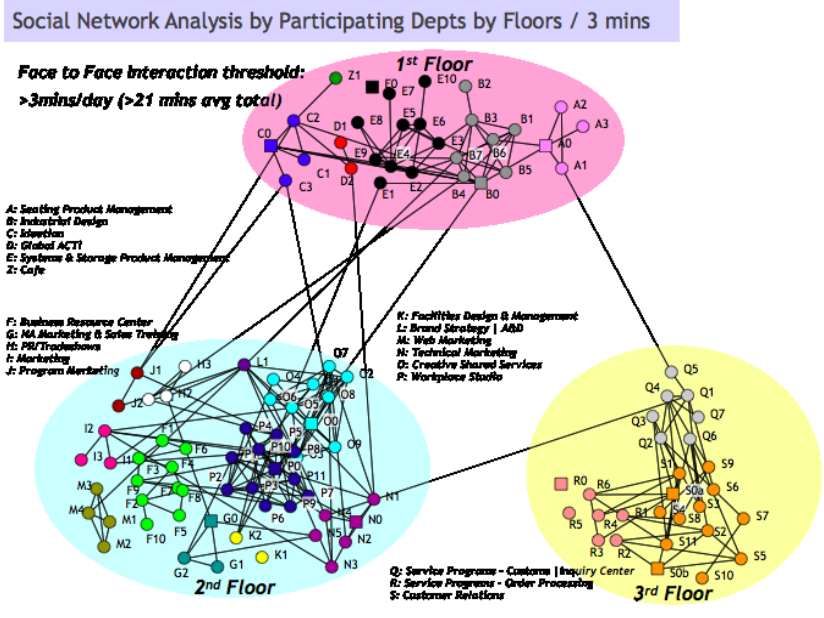

Fig. 7. Illustration of social networks within and among the three floors of the headquarters building

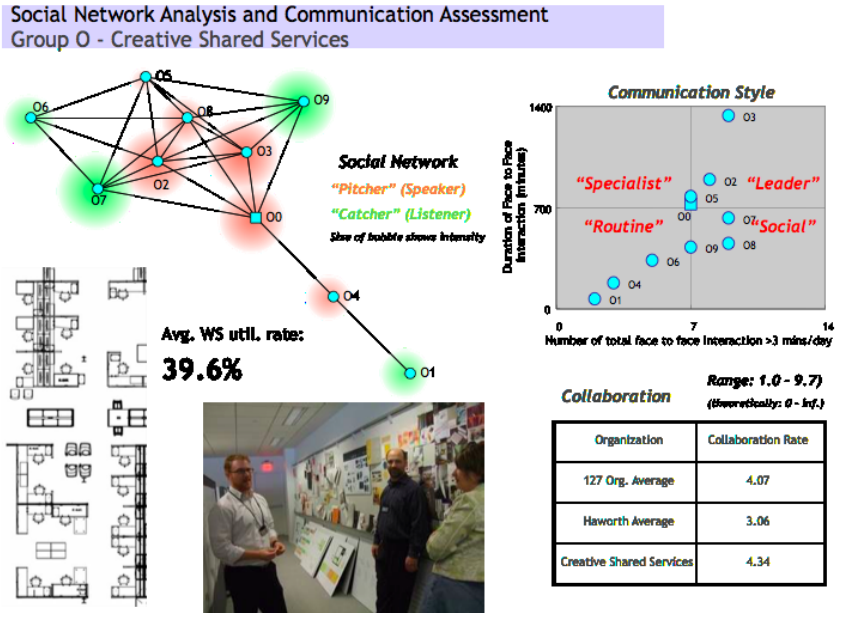

Fig. 8. Illustration of social network and space utilization within one work froup

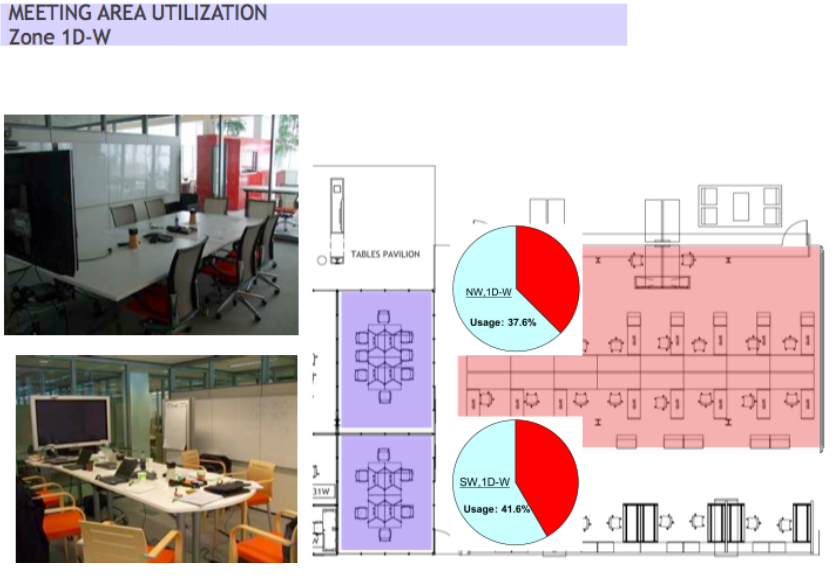

Fig. 9. Illustration of space utilization rates for two group meeting areas

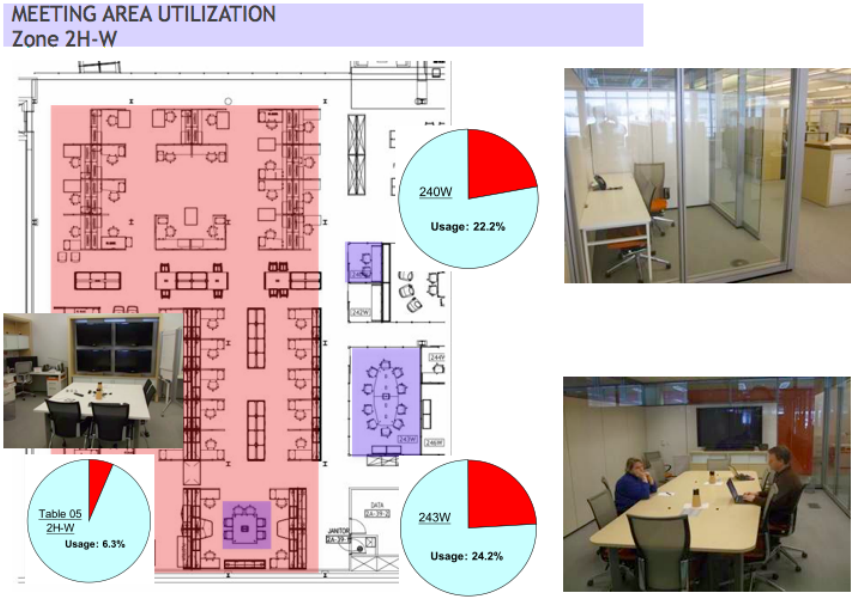

Fig. 10. Illustration of space utilization rates for shared meeting spaces

3 Conclusion

This exploratory/feasibility study demonstrated the usefulness of Hitachi High Technologies' "Business Microscope" for evaluating face-to-face social networks and documenting objective space utilization within the office environments of large organizations in the United States. Although certain features of their data analyses (e.g., determining "speakers" and "listeners" for particular interactions) may be culture-specific, following further data collection in more companies outside of Japan, the relevant algorithms could be adjusted so that their output indeed reflects these behaviors. This technology could be used to evaluate the impact of a number of independent variables relevant to workplace strategy and design. Techniques that provide decision makers with predictive business intelligence are certainly needed; Hitachi's "Business Microscope" represents real progress in this salient area of applied research.

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Can I Help You?: Towards the Improvement of Occupational Experience for Convenience Store Employees in Taiwan

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Abstract. This article explores the occupational experiences of convenience store frontline service employees in Taiwan. We find that in addition to physical labor, employees must incorporate job crafting to effectively meet customers' assumptions and expectations for immediate and efficient services, and to manage many types of in-store contingencies. We consider the infusion of job crafting into frontline service work to be critical to the smooth operation of the overall convenience store service experience. However, these skills are largely considered to be 'invisible,' and are not adequately supported by the convenience store work context. We suggest that certain types of smart devices be incorporated both seamfully and seamlessly into the convenience store environment, to work in tandem with, and to support frontline service employees.

Keywords: convenience, frontline service employees, experience-based design, task revision, seamless sensing, seamful actuating.

1 Introduction

In Taiwan, an average urban citizen only has to walk less than 500 meters to reach a convenience store, and will patronize one on average 17 times a month [1], to receive instant access to a wide variety of products and services, 24 hours a day, seven days a week. We found that the customers' assumptions of, and expectations for immediate service within convenient stores can take physical, mental and emotional tolls on the providers of these services. Initially, the nature and content of convenience store work appears to be labor intensive and monotonous. Upon closer examination of the insights garnered from our data, we found that convenience store work is far from mundane, and workers must possess a wide range of skills to manage frequent spontaneous in-store incidents. In general, employees must be equipped with certain interpersonal and emotional management skills in order to provide service to a wide range of customers. Their attitudes towards, and interactions with, customers, such as displays of courtesies, friendliness and efficient and effective service delivery have considerable effects on customer satisfaction, as found by Hochschild [2] and Rafaeli [3].

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Moreover, employees must also be prepared with a wealth of information that is both within and beyond the convenience store product and service parameters. For example, they are often requested by customers to provide street directions, transportation information, or recommendations for local attractions or eateries. In order to cope with the broad scope of on-the job duties and responsibilities, we discover that employees need to be more sufficiently supported both emotionally and by the technological facilities in-store. To this end, after providing a brief review of literature, and a description of convenience store working experiences, we will focus the discussion on suggestions for both emotional and technological enhancements.

2 Literature Review

Previously, research conducted on convenience stores emphasized business, management, marketing and retail perspectives, Terasaka [4], and Cheng et al [5]. However, other studies, such as those by Rafaeli [3] , Mohr and Bitner [6] and Katz et al. [6] have suggested that the experiences of frontline service employees are also a critical component to consider in the overall service experience. Despite the fact that front line service work may appear to be monotonous and routine, in reality, these roles often require the infusion of many elements of "invisible skill," such as job crafting. The adoption of these types of skills may be necessary when interacting with a wide range of customer types, oftentimes under extreme time pressure.

More specifically, job crafting occurs when employees adapt some aspects of their preexisting jobs to suit their individual needs. The adaptations are usually within the parameters of their preexisting work roles, and are frequently performed without direct knowledge or permission from management level staff [7], [8]. These changes can vary in scope, type, frequency and duration, and may also be visible or invisible [8]. Job crafting can give workers the opportunity to take initiative and express creativity, and may increase efficiency. Further, studies show that some employees may be motivated to engage in job crafting, for the opportunity to increase their sense of control over their work, develop a sense of connection with other social beings present in their work environment, and derive positive feelings relating to self image and job meanings [7].

Job crafting is still a relatively new avenue of research, however, most studies conducted on job crafting, in fields such as custodians, nurses, professional restaurant cooks concur that for the most part, job crafting has advantages for both individual job performance and for the overall organization [7], [8]. These positive changes derived from job crafting thus make it a potentially fruitful area of research to consider in a convenience store setting.

3 Methodology

This research was operationalized through the utilization of a triangulation of data collection methods, including field studies, in-depth interviews and experience based lab research. A purposive, non-random sample was used to reach the interviewees of interest for this study. We interviewed 16 employees from a variety of store locations

backgrounds and characteristics. To further enhance our interview data, we also conducted further interviews and focus groups in a replicated convenience store lab in our research center. We also enlisted 16 additional volunteers to test our technological enhancements in the simulated convenience store lab.

4 Employee Work Circumstances

Convenience stores are distinguishable from other retail settings for their ability to efficiently provide a wide range of constantly updated products and services. Since new products and services are added frequently, convenience workers must employ considerable efforts into retaining information about these additions. Moreover, they must recall and convey this information to customers rapidly and accurately in order to prevent customer impatience or frustration. One employee explains:

> *It's hard to let the customers understand unless you can be very clear. Sometimes even if you have reminded him, he will still tell you that he didn't know and then accuse you of not providing enough information. Then he will file a complaint against you." (Male, 30s, full time)*

In order to be able to be better informed about new products and services, many of the employees will take it upon themselves to try the new additions. For example, in addition to reading the internal company publications, they will take time to sample new food products, or to go through the steps on the information kiosk to visually familiarize themselves with the steps to complete a particular task. These "hands on learning and experiencing" tasks are examples of voluntary roles some employees will undertake, in order to provide more knowledgeable, personal and comprehensive service to their customers.

During their shifts, workers have frequent competing demands on their time; and are constantly interrupted from their task at hand to assist with another task. An assistant store manager describes the content and nature of her work shift:

> *Our work is scattered. Very scattered. We get distracted a lot. Sometimes we feel really annoyed. (Female, 20s, assistant store manager)*

For example, one frequent source of task distraction is processing and accepting customer purchases and payments. Major convenience store chains in Taiwan, such as Uni-President 7-Eleven have strict policies that lines are not to exceed over three people in length. Once a fourth person joins a line, the cashier is required to ask for immediate assistance from his/her colleague(s). Upon arrival at the cash register, usually the cashier will shout, "I can help the next waiting customer." However, it is usually unclear which waiting customer s/he is referring to, and there is usually a tumult that follows as customers vie to be the next served.

Waiting customers can cause considerable consternation for the frontline employees. According to our field observations and interviews, customers are usually unoccupied according to our their focus and line of vision is usually directed towards the cashiers. One worker describes:

> *I start to get really nervous. It's like I want my hands to go faster, but they can't. Then I look out at the line and everyone looks really impatient and that makes it even worse…I just put my head down and try to go even faster. (Female, 20s, part-time)*

One way of coping with the visual cues of impatience and annoyance from waiting customers is to simply ignore them, or to distract oneself from feeling nervous by accelerating their motions. However, we found that more experienced employees have developed their own methods of processing customers through their lines quickly. One store manager describes a situation in which he is processing bill payments for one of his regular customers. He explains:

> *If the customer is a regular whom you can trust, you will be tearing the [receipt] stub when she's counting out the money. You count the money the same time she's counting. Then you give her the receipt and it takes less than five seconds. (Male, 30s, store manager)*

In this particular situation, the frontline employee is experienced enough to anticipate the actions of the customers. When the customer presents him with a bill that she wants to pay, he is able to condense the motions required to complete the process. He also is observant and counts the money simultaneously with the customer. Since this is one of his regular customers, he has placed implicit trust in their interactions, so he knows that she will have the right amount of money to complete the transaction. These three elements of anticipation, observation and implicit trust trim down the customers' waiting time. It should be taken into consideration that these elements may only come into place if the cashier has spent enough time within the store, interacts with customers on a regular basis, and has a comprehensive understanding of the inner workings of each transaction.

We also found that more seasoned employees tend to employ certain strategies, such as directing customers into certain line formations to maintain both order and control over the lines. One full time employee explains:

> *Lots of people break the rules and try to push their way to the front. The line is especially frustrating when people don't line up in an orderly way. You have to tell them how to line up to make it easier for you. I tell them to form a straight line because it is less stressful for me, because I won't have to referee who came first and who came after. (Male 30s, full time, store owner)*

We find that not only the type of line, but also the frontline employee's ability to take initiative to direct how the customers should line up also affects his/her feelings of control over the in-store experience. In this situation, the employee is experienced enough in his role to know what type of line formation will allow him to process customers most fairly and efficiently.

These elements of anticipation, observation and initiative, among others can be considered a part of the 'invisible skill' and job crafting described by James [9], Korczynski [10], Tancred [11], Bolton and Boyd [12], and Lyons [8] involved in his job, but that is rarely recognized or appreciated by the customer, unless it is absent from the interaction. We found that all employees engage in the critical tasks of noticing, perceiving, absorbing and responding to customers. This task involves a considerable amount of both accumulated experience and consistent effort, but the employee is not given adequate training or tools to encourage or support these skills. However, our research suggests, and also supports previous research that the development of invisible skills and occasions for job crafting give convenience store employees a sense of job satisfaction and feelings of mastery over their overall work

experience. In addition to job crafting, we suggest that technological enhancements can be added to the store environment in order to provide further assist employees in carrying out their roles.

4.1 Technology Propositions

We selected and incorporated two of the previously proposed convenience store enhancements [13] to make waiting-in-line less daunting for both customers and employees. These two implementations are primarily based on the growing attention in ubiquitous computing initiated by Mark Weiser [14] so that the enhanced environment can better react to humans, make decisions, and subsequently provide attentive services.

The first enhancement is the seamless sensing for ubiquitously collecting information from both the physical environment of a convenience store and its users (customers and employees). To accomplish this, we seamlessly integrated smart sensors into a convenience store. With the seamless deployed technologies, the interactions between a customer and the enhanced convenience store environment will remain the same as usual. This is particularly important for a smart convenience store due to its variety of customers and the demand of high service availability. Currently, this concept of collecting real-time information from both customers and the store environment can be applied by using wireless sensor network (WSN) technology.

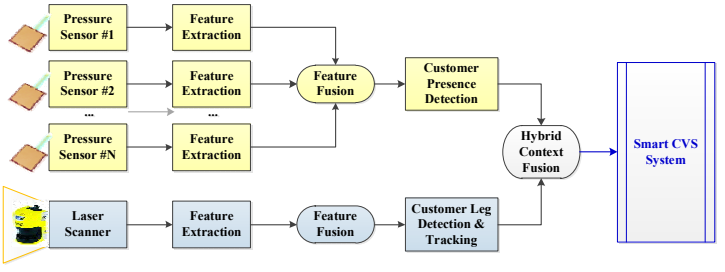

Fig.1. Block diagram of the proposed seamless customer-state detection system

More specifically, in order to detect of the number of customers waiting in line, we propose a seamless customer-state detection module that can be deployed in front of a service area (e.g. in front of the cash register). As shown in Fig. 1, the prototype of the proposed seamless module consists of pressure sensors and an optional laser scanner. All associated sensors can be used to collect features such that these features can be extracted first and later be fused to obtain more high-level and informative contexts (or even situation) to detect customers' presence, positions or their in-store activities. Although pressure sensors are useful in detecting the presence of a customer, and can be advantageous because they can be readily hidden from customers (i.e. seamlessly embedded into the environment), they become incompetent or ambiguous in correctly detecting the number of customers in some occasions or in certain locations in a convenience store. To address this shortcoming, a laser scanner will be incorporated into the module to assist in detecting and tracking the positions of

customers' legs. By counting the number of pairs of legs, the system can detect how many customers are in an area of interest (especially in front of the service counter). Since a laser scanner is more expensive than a pressure sensor, we can selectively deploy pressure sensors in the areas in front of single-user self-service machines such as the in-store information kiosks, Slurpee machines, or the automatic teller machines (ATMs) to decrease the overall costs of deployment. The system can combine these hybrid features from the pressure sensors and the laser scanner to provide a more accurate estimate of waiting customers in a convenience store. Such information can later be utilized to trigger actuators (such as a voice reminders) to call for assistance from another employee working elsewhere in the same store. Subsequently, we will further evaluate the effectiveness of this module to see if more sensors need to be employed for better accuracy improvement.

Fig. 2. The seamful screen is deployed behind the counter

The second implementation is the seamful actuating for attentively providing ambient services [13]. This is inspired by Chalmers et al. [15] and Broll et al. [16] who advocated the usefulness of both seamless and seamful designs. Rogers [17] further suggests shifting ubiquitous computing from calming people (i.e. seamlessness) to engaging people (i.e. seamfulness) and therefore enriching user experiences (this is referred to as "appropriation"). In this research, the preliminary implementation of this concept is accomplished by adding a display near the service counter. This screen will contain displays of informative and/ or entertaining media content, and will ideally serve to distract customers from the realization that they are wasting time by waiting in line.

For a preliminary evaluation of this approach, we installed a 17" display screen as a seamful device, on the ceiling, behind the service counter (as shown in Fig. 2). This screen played commercials in sequence, with the intention of attracting customers' attention. To test the effectiveness of this device, we conducted three rounds of field studies and focus groups in the convenience store lab at our research center. Alongside with three convenience store employees, we invited 16 volunteers to act as customers. However, from our observations we discovered that the majority of our participants did not pay attention to the screen, during their wait for service at the cash register. In our subsequent focus group interviews, our participants mentioned that the screen was not large enough, and was installed at an awkward angle that was too high to attract their line of vision. Moreover, they suggested that the screen would

have more effectively attracted their attention if the screen display were accompanied by sound. Thus, with these insights in mind, in the next phase of this research, we will consider elements related to the size and position of the seamful device. In addition, we will pay more attention to the display content, such as color, type of content, and ways that the content is presented.

5 Conclusions and Further Directions

Our research illustrates that convenience store work is physically, mentally and emotionally demanding. In these working situations, employees must be well equipped with certain types of skills in order to provide effective and efficient service. We suggest that both emotional and technological enhancements can be incorporated into the convenience store work role and environment. The first method includes introducing a variety of ways to recognize and subsequently encourage employees to feel a sense of mastery, empowerment and control over various aspects of their job. The second enhancement involves incorporating technological elements into the convenience store environment to work in tandem with the employees. These enhancements can potentially serve the critical purposes of reducing employees' mental burden, thus allowing them to better focus on other areas of the service experience.

Thus far, this exploratory research has made some initial observations into the convenience store work experience and environment. Next steps will involve a more rigorous analysis of the contribution of job crafting to the overall service experience, and individual workers' feelings of job satisfaction and mastery. In terms of technology, our subsequent steps will involve the evaluation of the correct detection rate of the seamless sensing module and to propose an index of a seamful device for its effectiveness in informing and engaging customers during their service experience. The intersection of emotional and technological enhancements in a convenience store setting is a relatively unexplored area of research that requires more thorough analyses from multi-disciplinary methods and perspectives.

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Study on the Perception of Car Appearance Based on Fuzzy Inference

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Abstract. This paper proposes fuzzy logic to forecast perception values of the combination of different design elements. Firstly it extracts customers' semantic information with semantic difference method; applies GRA analysis to find the key form elements for each perception, and builds the fuzzy membership between the form element and perception. Then it generates a set of fuzzy rules with the most influential form elements based on the 10 representative car samples and calculates the perception values on different combinations of the form design elements by defuzzification.

Keywords: sensory characteristics, gray correlation, fuzzy logic, fuzzy rules, fuzzy solution.

1 Introduction

With the social development and scientific & technological progress, the concepts of "humanity", "personalized" and "user-oriented design" have rooted deeply in people's mind, and also become a pursuit goal in modern product design. In order to achieve the pursuit goal of user-oriented innovation in design, it is necessary to build a bridge between the product designers and the consumers, which can understand and predict consumers' behavior and their evaluation to the product image better. Many scholars from overseas have donated themselves in the perception research of the product appearance. Hsu et al. [10] pointed out that there might be a big scale on the perception of a same product between the designer and consumer, thus the designer should consider the needs and the favors of the consumers while designing. J. Park and S.H. Han [7] from Korea applied the fuzzy rule methods to establish a relationship model between the consumers' satisfaction and the design elements in office chair design, and then made a contrast between this method and traditional ones such as linear regression and quantification theories. S. Hsiao and H-C. Tsai [12] from Taiwan established the relationship between the semantic words and the input parameter based on fuzzy neural network and genetic algorithm.

This paper takes car appearance as the research object, makes use of fuzzy logic method to forecast perception values on different combinations of the form design elements. It is organized as follows. In Section 2 the literature review is summarized. In Section 3, a model reflecting the design variables and image preference is proposed by fuzzy logic which is then illustrated with an example. In Section 4 conclusion is given.

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2 Literature Review

The globalization of competition in industry and the diversification of customers' demands as well as rapid technological developments continue to spur design-based innovations at a frenetic pace. Holbrook and Hirschman mentioned that customers' perception has played a decisive role in purchasing mature products such as car and electric goods. Perception is the nature of the information age, which leads us logically entered into a perceptual era. H-C Chang et al. [4] explored five expression modes used by consumers in conveying desire for product form, the results of which provide a foundation for the future development of enhanced investigation techniques aimed at understanding consumers' latent desires for product form. Raphaelle [9] studied the relationship between the perceptual variables and the design elements by regression analysis. S. Baek et al. [13] from Korea constructed a perceptual factor space where the perceptual vocabulary can reflect the visual information. H-B Yan et al. [3] from Japan, proposed the perceptual evaluation technology based on the multi-attribute fuzzy target-oriented decision analysis, and defined three types of fuzzy targets to represent the consumers' preferences and extended to quantify how well a product meets consumers' preferences. L-Y Zhai et al. [8] from Singapore applied rough set in evaluating human's perception of a product. H-Y Chen and Y-M. Chang [5] from Taiwan took advantage of NDSA method to extract the key design elements which influence consumer's preference most. Carmen Llinares and Alvaro F [1] from Spanish informed the differential semantic method as an analysis tool on analyzing the emotional impression in the field of Kansei Engineering.

3 Steps to Establish a Fuzzy Prediction Model and Exemplification

3.1 A Selection of Design Variables

As car is a product in large size and complex feature, this paper studies it from the most direct observation angle, namely the side exterior angle. Therefore, the key side design elements which influence consumer's perception effectively are selected after literature research and advice combination of three industrial engineers. The result is shown in table 1.

3.2 A Selection of Feeling Feature Semantics

Consumers use a range of simple adjectives when expressing their perceptions of a particular product. These adjectives provide an explicit representation of the consumers' abstract emotional response to a product's form, and can therefore furnish designers with valuable clues regarding the consumers' product image expectations and the success (or otherwise) of the generated product form in meeting its design objectives. In the current study, 29 emotional words (in Chinese) pertaining to car were collected from web sites, magazines, catalogues and so forth. These adjectives were sieved by a questionnaire survey and data analysis in accordance with the criteria outlined below such that just 15 representative emotional words remained, namely angular-streamlined, static-dynamic, hulking-ingenious, ordinary-original,

popular-personalized, economical-expensive, unsafe-safe, complex-concise, flimsy-burly, regular-honorable, exquisite-generous, straitness-spacious, clutter- harmonious, classical-fashionable, dislike-favorable..

- Criterion 1: Retain the adjectives only if they are chosen by more than 50% consumers in describing the perception of the car image in a questionnaire survey.
- Criterion 2: Retain the adjectives only if the related coefficient between the customers' favor and the perceptual adjectives more than 0.3 based on the data analysis.

Table 1. Car Side Exterior Design Variables

Car side design variables		Type 1	Type 2	Type 3
X1	Headstock type	Long and lordosis(L,X_{11})	Moderate length(ML,X_{12})	Extremely short(S,X_{13})
X2	Car tail type	Obvious kyphosis(VL,X_{21})	A little kyphosis(L,X_{22})	
X3	Radian of front window	Smooth transition (P,X_{31})	Micro-edges transition (PA,X_{32})	Edges transition(A,X_{33})
X4	Radian of rear widower	Smooth transition (P,X_{41})	Micro-edges transition (PA,X_{42})	Edges transition(A,X_{43})
X5	Roofline type	straight(L,X_{51})	A little arch camber(C,X_{52})	Vault (VC,X_{53})
X6	Body side molding type	Obvious (D,X_{61})	Not obvious (ID,X_{62})	
X7	prominence of Wheel casing	Obvious (D,X_{71})	Not obvious (ID,X_{72})	
X8	Wheel spoke type	sparse linear leaf (T,X_{81})	Dense linear leaf (VT,X_{82})	floriated (F,X_{83})

3.3 A Collection of Questionnaire and Data Analysis

The representative car pictures used in questionnaire have been got through the magazine, Internet research, site visits, and advertising vocabulary. In order to include most necessary information, we collected 47 car side pictures. Then the side pictures are classified by 20 experienced car designers. Later we construct similarity matrix between any two side pictures, and then transfer them into the "distance matrix". Through the clustering analysis based on the principle of minimum clustering center distance, we filtrate 10 side pictures whose center distances are minimum. According to the questionnaire survey, we got the mean score, scoring range and standard deviation of each picture to the representative emotional words, which is shown in table 2.

Table 2. Numerical data source for the 10 representative side car samples

Car No.	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	Angular-streamlined				ingenious	…	favorable
									mean	min	max	St-deviation	mean	…	mean
C1	1	1	2	2	2	1	1	1	3.98	1	6	1.50	4.02	…	3.65
C2	2	2	1	1	3	2	2	1	5.89	2	7	1.00	5.28	…	5.07
C3	2	1	2	2	3	1	1	2	4.74	1	7	1.70	4.43	…	3.93
C4	1	1	3	1	1	2	2	2	3.76	1	7	2.10	3.20	…	3.83
C5	1	2	2	1	2	1	2	3	3.57	1	7	1.60	4.65	…	3.57
C6	1	2	2	3	1	2	1	1	2.89	1	7	1.70	4.26	…	3.11
C7	1	1	1	3	1	1	1	1	3.30	1	7	1.60	3.65	…	3.43
C8	1	1	3	2	1	1	1	3	4.67	1	7	1.60	4.30	…	4.24
C9	1	1	3	3	2	1	2	2	3.93	1	7	1.70	3.87	…	3.89
C10	3	2	1	1	3	1	1	3	5.63	1	7	1.40	4.52	…	4.83

3.4 Establish a Fuzzy Prediction Model Reflecting the Design Variables and Feeling Feature

3.4.1 The Determination of Input Variables and Output Variables

It is important to determine the input variables, output variables and fuzzy rules in the construction of a fuzzy prediction model. This paper takes car side pictures as research objects, takes the corresponding design variables as input variables, and takes the emotional words as the output variables, so as to predict the score of each emotional word based on the establishment of fuzzy rules. During the determination of the fuzzy rule of input and output, it is not simply taking all the side design variables as input ones, but choose the key design variables which have a closely relationship with emotional words through GRA analysis.

The construction of GRA relationship can be defied by the example of side design variable namely "angular-streamlined" in table2. The following table3 shows the relational results $r(X_0, X_i) \in (0,1)$ of each design variable $(X_i, i = 1,2,\cdots,8)$ to emotional words "angular-streamlined" (X_0). If there is $r(X_0, X_i) > r(X_0, X_j)$, it means that the design variable X_i has a bigger influence on emotional words X_0 "angular-streamlined" compared with the design variable X_j ,the bigger the score of $r(X_0, X_i)$ is, the bigger the influence is. For example, the design variable X_5 "roofline type" has a correlation value of 0.76, which means that the roofline type influenced the emotional word "angular-streamlined" X_0 most. Then X_2 "car tail", X_8 "wheel spoke", X_7 "prominence of Wheel casing" and X_6 "Body side molding" also have influences in the emotional word of "angular-streamlined". According to this result, it may remind the designers to focus on these design variables when they want to improve the consumer's feeling feature of "angular-streamlined". The other design variables such as X_1 "headstock", X_3 "front window" and X_4 "Radian of rear window" which has little influence on the emotional word can be ignored.

Table 3. Correlation value between side design variables and the emotional semantic "angular-streamlined"

Car No.	Side design variable								Angular-streamlined
	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	
1	0.49	0.66	0.97	0.97	0.97	0.66	0.66	0.49	1.00
2	0.50	1.00	0.33	0.33	1.00	1.00	1.00	0.33	1.00
3	0.71	0.52	0.71	0.71	0.63	0.52	0.52	0.71	1.00
4	0.52	0.71	0.48	0.52	0.52	0.48	0.48	0.92	1.00
5	0.55	0.46	0.85	0.55	0.85	0.76	0.46	0.46	1.00
6	0.68	0.40	0.66	0.40	0.68	0.40	0.97	0.68	1.00
7	0.60	0.85	0.60	0.43	0.60	0.85	0.85	0.60	1.00
8	0.42	0.53	0.62	0.73	0.42	0.53	0.53	0.62	1.00
9	0.50	0.67	0.50	0.50	1.00	0.67	0.50	1.00	1.00
10	0.88	0.88	0.35	0.35	0.88	0.42	0.42	0.88	1.00
Correlation value	0.59	0.67	0.59	0.55	0.76	0.63	0.65	0.67	1.00

This paper selects the key design variables which has a correlation value more than 0.6 with the feeling feature semantics. And this is regarded as the fuzzy rule in the following research. The following table4 delivers the results of key design variables of each semantic word.

Table 4. Key design variables of each semantic word

Semantic word	Key side design variable					Semantic word	Key side design variable			
Angular-streamlined	X2	X5	X6	X7	X8	Exquisite-generous	X1	X2	X4	
Hulking-ingenious	X2	X5	X8			Ordinary-original	X2	X3	X5	X8
Unsafe-safe	X1	X2				Straitness-spacious	X1	X2	X3	X5
Economical-expensive	X1	X2	X3	X4	X8	Clutter-harmonious	X3	X4	X5	
Complex-concise	X2	X5	X6	X8		Classical-fashionable	X2	X3	X8	
Static-dynamic	X2	X3	X5			Popular-personalized	X2	X3	X8	
Flimsy-burly	X1	X3	X4	X7		Dislike-favorable	X2	X5	X7	X8
Vulgar-honorable	X3	X6	X7							

3.4.2 The Obfuscation of Design Variables and Feeling Feature Semantics.

There are many forms of fuzzy number, among which the triangular fuzzy number, trapezoidal fuzzy number and Gaussian fuzzy model are the most common ones. They appear as useful means of quantifying the uncertainty in decision making due to their intuitive appeal and computationally efficient representation.

This paper constructs a series of subordinate function based on the combination of triangular fuzzy number and trapezoidal fuzzy number. The triangular fuzzy subordinate function $\mu_A(x)$ is constructed by the triangular fuzzy number (a,b,c), and $a,b,c(a \le b \le c)$ is three specific numbers, which is shown in formula 1.

$$\mu_A(x) = \begin{cases} 0, & x < a, \\ \dfrac{x-a}{b-a}, & a \le x \le b, \\ \dfrac{x-c}{b-c}, & b \le x \le c, \\ 0, & x > c. \end{cases} \tag{1}$$

The triangular fuzzy number (a,b,c) can express the approximate value of the fuzzy semantics, among which b represents the most likely value, a the max value, and c the min value. The definition of each variable subordinate function is determined by the number of the design types, which is shown in table 1. Taking X1 "Headstock type" as an example, it has three types, namely Long and lordosis type(L,X_{11}), Moderate length type(ML,X_{12}), and Extremely short type(S,X_{13}), the matching degree of each picture with each type can be described in number ranging from 1 to 3. for example, the number 1.5 can be seen as a half combination of type X11 "long and lordosis" and the other half type X12"moderate length" As there may be more than number 4 in value during the subsequent valuation after X13, the trapezoidal fuzzy number (2,3,4,4)is then used to describe this kind relationship. The triangular fuzzy numbers for the side design variables are finally constructed and the results are shown in table5.

Table 5. Triangular fuzzy numbers for the side design variables

Side design variables	Design types and corresponding triangular fuzzy numbers		
Headstock typeX1	Long and lordosis(L,X_{11}) (1,1,2)	Moderate length(ML,X_{12}) (1,2,3)	Extremely short(S,X_{13}) (2,3,4,4)
Car tail type X2	Obvious kyphosis (VL,X_{21}) (1,1,2)	A little kyphosis (L,X_{22}) (1,2,3,3)	
Radian of front window X3	Smooth transition (P,X_{31}) (1,1,2)	Micro-edges transition (PA,X_{32}) (1,2,3)	Edges transition(A,X_{33}) (2,3,3)
Radian of rear widower X4	Smooth transition (P,X_{41}) (1,1,2)	Micro-edges transition (PA,X_{42}) (1,2,3)	Edges transition(A,X_{43}) (2,3,3)
Roofline type X5	straight(L,X_{51}) (1,1,2)	A little arch camber(C,X_{52}) (1,2,3)	Vault (VC,X_{53}) (2,3,4,4)
Body side molding type X6	Obvious (D,X_{61}) (1,1,2)	Not obvious (ID,X_{62}) (1,2,3,3)	
prominence of Wheel casing X7	Obvious (D,X_{71}) (1,1,2)	Not obvious (ID,X_{72}) (1,2,3,3)	
Wheel spoke type X8	sparse linear leaf (T,X_{81}) (1,1,2)	Dense linear leaf (VT,X_{82}) (1,2,3)	floriated (F,X_{83}) (2,3,3)

According to the data from table5, the input variables can be constructed by the combination of triangle subordinate function and trapezoidal subordinate function together, namely each style of the design variable owns its own subordinate function. There are a total of 8 groups of subordinate functions. Based on this, the fuzzy rules of the fuzzy prediction model can be established.

During the process of constructing the subordinate function of the output variables (namely the feeling feature semantic words), the emotional word can be described by 7 levels with a reference of the questionnaire. Taking the "angular-streamlined" for example, its value can be extremely angular, very angular, angular, medium, streamlined, very streamline, and extremely streamlined. The corresponding triangular fuzzy number are shown in table 6. Following the same way, all the subordinate functions of the other feeling semantics can be constructed.

Table 6. Triangular fuzzy numbers for the semantic variables "angular-streamlined"

Semantics and its triangular fuzzy numbers						
Extremely angular (1,1,2)	Very angular (1,2,3)	angular (2,3,4)	medium (3,4,5)	streamlined (4,5,6)	Very streamlined (5,6,7)	Extremely streamlined (6,7,7)

3.4.3 The Establishment of the Fuzzy Rules

In order to establish the fuzzy rules more objectively, this paper makes the mean of the 7-level feeling semantics scores of 10 pictures as the output value. Taking car picture C1 as an example, the mean of the score to semantic word "angular-streamlined" is 3.98 (seen in table2). The computation process of the semantic subordinate degrees of "medium" and "angular" are shown as follows.

Semantic subordinate degree of "medium" is $0.98 = \frac{(1-0)\times(3.98-3)}{(4-3)+0}$

Semantic subordinate degree of "angular" is $0.02 = \frac{(1-0)\times(4-3.98)}{(4-3)+0}$

Table 7. Fuzzy rules for determining the "angular-streamlined" value of car side design elements

rule	IF					THEN	
	X2	X5	X6	X7	X8	Angular-streamlined	Supporting degree(Dos)
1	VL	C	D	D	T	medium	0.98
2	VL	C	D	D	T	angular	0.02
3	L	VC	ID	ID	T	Very streamlined	0.89
4	L	VC	ID	ID	T	streamlined	0.11
5	VL	VC	D	D	VT	streamlined	0.74
6	VL	VC	D	D	VT	medium	0.26
7	VL	L	ID	ID	VT	medium	0.76
8	VL	L	ID	ID	VT	angular	0.24
9	L	C	D	ID	F	medium	0.57
10	L	C	D	ID	F	angular	0.43
11	L	L	ID	D	T	angular	0.89
12	L	L	ID	D	T	Very angular	0.11
13	VL	L	D	D	T	angular	0.7
14	VL	L	D	D	T	medium	0.3
15	VL	L	D	D	F	streamlined	0.67
16	VL	L	D	D	F	medium	0.33
17	VL	C	D	ID	VT	medium	0.93
18	VL	C	D	ID	VT	angular	0.07
19	L	VC	D	D	F	Very streamlined	0.63
20	L	VC	D	D	F	streamlined	0.37

The semantic subordinate degree represents its supporting degree to the corresponding fuzzy rules (Dos), the value is between 0 and 1. What's more, the supporting degree (Dos) also shows the weights of the fuzzy rules, which can be seen in the last column of the table 7.

In order to reflect all the design variables of the car form, this paper adopts the multiple fuzzy rules, which is shown as follows. IF X_1 is A_1 AND X_2 is $A_2 \cdots$ AND X_n is A_n, THEN Z^* is B. From this formula, $A_1, A_2, \cdots A_n$ and B are all fuzzy semantic items, which are determined by both the output variables $X_1, X_2, \cdots, X_n$ (the car design element which has a link with semantic word) and output semantic variables Z^* (semantic adjectives). The values are all expressed in triangular fuzzy number. According to the 10 side pictures, 20 (10*2=20) fuzzy rules are constructed. Each fuzzy rule can connect the car design elements with its corresponding semantic adjectives. Taking the "angular-streamlined" as an example, the fuzzy rule is established in table 7.

Based on the fuzzy subordinate function and the fuzzy prediction table, the fuzzy prediction model can be established with a help of fuzzy tools supplied by Matlab.

3.5 Exemplification

The fuzzy rules are all followed effectively during the process of the fuzzy prediction. The input variable determines the matching degree with its corresponding output variable. The result we get from fuzzy prediction is a fuzzy subordinate function or a fuzzy subset. While in fact, an actuator should be controlled to make sure that there should be only a certain amount of control on a certain time. An accurate value should be found to represent the fuzzy set which shows the distribution possibility of the fuzzy control from fuzzy output subordinate function. This process is called defuzzification. This paper adopts the Centriod method which is most popular nowadays to deal with the defuzzification. The computation is shown in formula 2 as follows

$$^{y}COM = \frac{\sum_{i}\left[\mu(y_i)\times y_i\right]}{\sum_{i}\mu(y_i)} \tag{2}$$

i stands for the semantic of output variable (such as "angular" or "streamlined"), y_i is the max of the semantic variable i ,(such as "angular" or "medium"), $\mu(y_i)$ is the output subordinate function value after aggregation. Based on the defuzzification method, the fuzzy prediction process can be solved using Matlab function evalfis( ).

In order to verify the fuzzy prediction model, this paper makes an additional random choice of five car side pictures with different combinations of the design variables, which is shown in fig.1. Taking the fuzzy rule on semantic "angular-streamline" for an example, the design variable type of each picture is regarded as input variable as shown from column 2 to 6 of table8, the theoretical computation score of semantic "angular-streamlined" can be regarded as output variables after the process of defuzzification which is shown on column7 of table8. Meanwhile, the questionnaire are distributed again printing the selected ten pictures, and the mean of statistical score (add 4 based on the original score) to the semantic "angular-streamlined" are collected as shown on column 8.

Fig. 1. Car-side Pictures Chosen for testing

Table 8. Input, output and statistical values of the testing Car-side Pictures

Side picture	Subordinate design variable types					Angular-streamed	
	X2	X5	X6	X7	X8	Theoretical value	Statistical value
No.1	1.5	1.5	1.5	1.5	1.5	3.836	4.163
No.2	1.2	3.3	1.8	1.4	1.7	5.352	5.034
No.3	2	1	2.5	1	1.5	2.891	3.172
No.4	2	2.5	1.5	2	2.7	4.135	4.318
No.5	2.4	1.3	2.8	1.7	1	2.902	3.084

In order to evaluate the fuzzy prediction model, this paper adopts two testing methods, namely the T-test method and standard deviation calculation method. After SPSS software computation, T-test result is 0.10, which is larger than 0.05. This result demonstrates that there is no obvious difference between each design variable, and therefore the model is reasonable. The formula of standard deviation computation is as follows

$$\mathrm{RMSE} = \sqrt{\frac{\sum_{i=1}^{n}\left(x_i - x_0\right)^2}{n}} \tag{3}$$

x_i stands for the semantic output value of the car i, and x_0 stands for the corresponding semantic statistical score. If there is no significant error in both output value and the statistical value, then the RMSE value should be 0. The standard deviation of fuzzy prediction model and score statistical value can be computed, with a result of error 0.2652, which proves a very good consistency between the output value of the fuzzy prediction model and the semantic score.

4 Conclusion

This paper establishes a fuzzy prediction model based on the fuzzy control system. First the triangular subordinate function is constructed based on the triangular obfuscation of 8 side design variables and 15 feeling feature semantic words. Then the key design variables which have a close relationship with the feeling feature semantics are found to establish the effective fuzzy rules after the GRA (grey relationship analysis). Last the defuzzification is completed by the fuzzy toolbox supplied in Matlab software. Taking the semantic words “angular-streamlined” for an example, the scores of each design variables can be collected, and once more, the scores of other feeling feature semantic words to the corresponding design variables can be acquired, too.

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Employee Experience Management of Convenience Store in Beijing

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Abstract. This article explores the occupational experiences of convenience store frontline service employees in Beijing. The results of our in-depth interview illustrate that there are some human factor issues in the experience of the employees, such as material handling, graveyard shift, ease of being injured, low salary, lack of career perspectives and unfair rules. We suggest that future researches should pay more attention to improve the experience of the employees, as their experience is directly related to their interaction with the customers as well as the service satisfaction of the customers.

Keywords: Convenience, frontline service employees, experience, in-depth interview.

1 Introduction

The convenience store originated in the United States in 1920s and the first convenience store was opened in 1946 which was named 7-Eleven. Because of its own characteristics such as in the center of downtown, providing a wide variety of products and services, 24 hours a day, convenience stores are playing a more and more important roles all over the world these years.

Convenience store of Beijingdeveloped late, but it is developing rapidly recent years. In 2004, there were only 13 convenience stores in Beijing, but now there are more than 1000 of varied convenience. Take 7-Eleven as an example, in 1994 there were only 5 7-Eleven in Beijing and today there are total 100 7-Eleven stores. Because of its convenience, the development of convenience store is of great significance to Beijing. China Chain Store & Franchise Associationinvestigated115 top management of China chain industry and found that the most promising retail is convenience store[1].

Generally speaking, the work in convenience store is thought to be easy, labor intensive and monotonous and the frontline service employees don't need special skills and high competence. However, after deep interview of the frontline service employees, we found that their work is far more complex than our hypothesis.

The frontline service employees have to master interpersonal skills which influence customer satisfaction greatly. For instance, the displays of courtesies, friendliness and efficient service delivery will make the customers satisfied while lack of

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them would make the customers annoyed and disappointed. What is more, they may meet different kinds of customers, including the disrespected and the unreasonable. In this case they must put up with these customers and adjust their moods. So it is also necessary for them to master emotional management skills.

2 Literature Review

As the idea of service has greatly changed and the retail environment has changed rapidly, Customer experience is becoming more and more important. In recent years, managers have been increasingly aware of the importance to create value for their customers in terms of experiences. Creating excellent customer experience seems to be one of the critical objectives in today's retailing environments [3]. Convenience stores, as the most promising form of the retailers, are also trying their best to improve customers' experience. For instance, researchers have developed a large number of scales to evaluate the customers' experience and satisfaction, such as SERVQUAL, RSQ and so on. However, previous researches mostly focused on customers and seldom pay attention to the experience of frontline service employees [4].As a matter of fact, as Mohr and Bitnerand Katz pointed out, the experiences of frontline service employees should be considered as a critical component in the overall service experience [5].Improving the experience of frontline service employees is as important as upgrading the customers' experiences. The convenience store experience is conceptualized into the following four dimensions: (1) physical environment, (2) products, (3) service procedures, (4) frontlineemployee. The framework provides us with new perspectives for researching how interactions between customers and employees in the convenience stores.

In general, we use the method of job crafting to capture the actions employees take to shape, mold, and redefine their jobs. Those who actively compose both what their job is physically, by changing the job's task boundaries, what their job is cognitively, by changing the way they think about the correlations among job tasks, and what their job is relationally, by changing the interactions and relationships they have with others at workare called job crafters [6]. Job crafting is a psychological, social as well as physical act, in which cues are read about physical boundaries of the job and are explained by motivated crafters. Job crafters act upon the task and relational boundaries of the job, changing their identity and the significance of the jobduring this process. By doing so, job crafters create different jobs for themselves, within the context of defined jobs[7]. So that job crafting is a creative process which captures how individuals gradually get used to their jobs from the point of view of creating and sustaining a viable definition of the work they are doing and who they are working for [8].

Job crafting changes the meaning of the work through changing job tasks and relationships because it allows employees to redefine the purpose of the job and experience the work differently [9].Job crafting may also reshape one's work identity. And as we know, the reasons for shaping a work identity are basic. Individualstry their best to establish social communities that support desirable images of themselves [10].

3 Methodology

We carried out the research through various datacollection methods, including field investigation, in-depthinterviews. In the first stage, we use field method to investigate 11 convenience stores (7-Eleven) in different districts of Beijing. In the second stage, we interviewed 10 convenience stores' frontline service employees from two store locations.

3.1 Subjects

10 subjects (4 male and 6 female, mean age: 24.9) who is working at convenience stores (7-Eleven) in Beijing. Our sample contains different positions in convenience stores: 1sale manager, 2 assistant store managers, 1 store monitor, 1 salesclerk, 3 part-time employees for day shift and 2 part-time employees for night shift. The sample was purposive, non-random which invited convenience stores' employees from two different stores who are interested in the study and are pleased to join our interview.

3.2 Process

We started our in-depth interview in Jan 7th and ended it in Jan 21st. We went to 5 convenience stores (7-Eleven) to invite employees for our interview, but only 2 stores are interested in our study and would like to join our interview. The interview for every employee lasted around one hour.

The interview outline was draw up according to job crafting which refers to their works, emotions, customer interactions, lines, space /layout and so on. As a result, we could have a comprehensive understanding of the frontline service employees' daily work.

4 Results

From the perspective of human factors, there are some possible issues in the convenience employees' experience, including physiological human factors, cognitive human factors and organizational human factors. In the following, we will discuss these issues respectively.

4.1 Physiological Human Factors

For all the retail stores, the universal problem is material handling. They have to constantly update products so that the frontline service employees must deal with material handling every day. If you know nothing about material handling, it is possible that you may hurt you joint. One worker mentions:

> *One night we added nearly 50 boxes of water, and I had to handle all these by myself. So I was handling and handling, all the time. I really felt exhausted and had a back pain after finishing it. However, you have to do it as long as you work at the convenience store. (Male, 24s, part-time)*

Despite it, convenience stores are distinguishable from other retail setting for their providing fast food and running for 24 hours a day. As a result, they are heavier workload comparing to other retail setting employees. What's worse is that night shift makes you very tired and sleepy; moreover it is a danger to your health. One employee explains:

> *To be honest, I don't like working graveyard shift. First of all, you are quite sleepy when working; especially form 23 o' clock to 01 o' clock. Further, it completely reverses your life from normal. You are sleeping when all the others are working and when they are sleeping, you are working. There is no doubt that graveyard is harmful to your health. After working graveyard for about 1 year, now I seldom eat lunch and sometimes felt headache. (Male, 24s, part-time)*

4.2 Cognitive Human Factors

Although the work in convenience store is thought to be easy, labor intensive and monotonous, in fact it is not the case. First, they have to work under stress. The stress comes when there are a lot of customers waiting in line, when they have to accomplish the sale target for special products in festivals. Furthermore, they have to pay for the loss if they make a mistake when checking out.And they are afraid of the products to be stolen. One assistant store manager describes:

> *I felt particularly anxious when a great many customers were waiting in line, maybe 40 to 50 customers in rush hour. I hurried up to check out as well as comforted the customers. If some customer is impatient and get angry with, you can't quarrel or even explain to him/her. You can't answer him back no matter whether he is right or wrong, or no matter how rude and unreasonable he is. The only thing you can do is just to ignore him or apologize to him. In a word, you can't exhale your emotions and you can't be yourself when you are at work. (Female, 24s, assistant store manager)*

Second, they have to put up with varied impatient and rude customers. Third, their works are all chores, so it is easy for them to get distracted. Fourth, they have to do the monotonous repetitive work every day and their job is inferior in social position. Last but not least, they are likely to be complained if the customer is unsatisfied with them. In this situation, it will be very hard for them to be promoted both in their position and salary.

4.3 Organizational Human Factors

Even if the employees have occupational skill training before work, it is easy for them to get injured at work. For example, you may be scalded by the soymilk machine; you may be scratched by the banknotes; you may be bruised by the storage shelves. A store monitor says:

For us, it is normal to be injured when working, perhaps 2 or 3 times a month. But all the injuries are not serious; we don't pay much attention to them. They will be ok in 1 or 2 days. (Female, 25s, store monitor)

Besides, it is a common sense that the rate of demission is very high in convenience stores. One reason for this is that the staffs' salary is too low. In Beijing, the hourly pay for part-time employees in convenience stores is only 9 or 12 yuan. Even for the full time employees, their monthly pay is about 2000 yuan, which is much lower than the average salary in Beijing. Another reason maybe is that they don't have a good vocational development. One part- time employee sees the job in the convenience store as follows:

I don't want to be a full time employee after I graduate. You have to do a lot of work here, but the salary is very low. Despite these, you don't have a better prospect. Yeah, you may be promoted form salesclerk to store monitor, then assistant store manager and manager store manager. After becoming a store manager, you may open a franchise store by yourself. But that is too difficult. Moreover, I think the managerial rule is kind of unfair. I really can't understand why we college students do the same work as the social workers, but their salary is higher than us. Anyway, I can accept the job here as a part-time job, but not my full time job, not my career. (Female, 20s, part-time)

5 Conclusions and Further Directions

The research illustrates that the work in convenience store is not only labor intensive, but also needs mental skills and emotional skills. We found that there are some potential human factors and ergonomics issues in the experience of the staffs. (1) Physiological human factors: they have to handle materials every day and it is easy for them to be injured; they have to work graveyard shift and get very exhausted and sleepy and suffer a danger to health. (2) Cognitive human factors: they have to work under stress and make quick and flexible responses to varied emergencies and reluctant customers; they must bear the complaint, rudeness, disrespect and unreasonableness of customers; they have to put up with the repletion, bore and monotonity of their job. (3) Organizational human factors: their hourly/monthly pay is much lower than the average salary in Beijing; they don't have a good occupational prospect; they are unsatisfied with the unfair wages rules.

For future research, we can explore solutions to these existent issues. Meanwhile, it is critical to analyze the interaction between the frontline service employees and customer as well as the experience of the customers in convenience stores. Further research may use questionnaire and experiment to evaluate the experience of both the employees and the customers. Then meaningful countermeasures and suggestions could be given to improve the experience in convenience and set up a systematic service design based on experience.

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Smart Store Understanding Consumer's Preference through Behavior Logs

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Abstract. This paper presents a smart store that estimates a preference of consumers concerning products from their behaviors. This paper proposes a method, which is a passive observation and an active observation, to observe two behaviors, direct behaviors and indirect behaviors. The passive observation is a method to observe direct behaviors of customers towards real products through ambient sensors. The active observation is a method to observe indirect behaviors of customers towards information of products through ambient displays. This study explains a purchase experiment using a prototype smart store that has installed the ambient shelves and displays. This study estimates the favorite clothes from their direct and indirect behavior using the smart store. The result of estimation of preference shows that accuracy rate is 87% by leave-one-out cross-validation.

Keywords: Ubiquitous Environment, Ambient Technology, Behavior Analysis, Customer Preference, Retail store.

1 Introduction

Recently, a marketing strategy is changing to one-to-one marketing era from mass marketing era. Many retail stores are collecting preferences of customers from buying histories using a system of customer relationship management (CRM), such as POS (Point of Sales) or reward card.

However, in customer preference, there is a preference not to be saved in purchase log data. As an example of the preferences, there is a window-shopping. Consumers look or touch a product when they have interest in the product. Their behaviors show their preferences but it does not appear in a buying history of the store. Therefore, in order to grasp their preference concerning products, we should assemble not only the preferences like a purchase log but also the preferences like a window-shopping.

In the field of marketing, a salesman walks beside a consumer to observe a behavior of the consumer towards a product to collect the both preference. And then the salesman investigates behaviors before consumer purchases a product [1]. Otherwise, the salesman may ask consumers a reason why they select the product, in a store. These ways force consumers to feel a psychological burden. Moreover, this cannot collect many data in short term.

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As a way to assemble data of people in a store without a psychological burden, there is a ubiquitous environment [8]. The ubiquitous environment is equipped with embedded devices, such as camera or tactile sensor. It can assemble data of human in this environment through the devices. As example of the ubiquitous environment, there is a smart house [7]. The house can assemble location data of a person through cameras and sensors that located floor or kitchen in the house. This paper proposes a smart store that estimates a preference of customers from behavior of customers using a ubiquitous environment technology. This paper also shows a result that estimated a preference from a purchasing experiment using the smart store.

2 Smart Store

The aim of our research is to develop a smart store that can estimate customers' preference from their behaviors. This section explains three things. First are behaviors that we observe to estimate a preference. Second is a way to observe behaviors. Third is a method to estimate a preference from behaviors.

2.1 Direct and Indirect Behavior

In order to develop a smart store that estimates a preference from behaviors, we should detect behaviors related to their preference. In a report of marketing [3], when consumers choose a product in a store, consumers look at the product and pick up it in order to obtain product information such as a color, form and size. They watch and read contents of POP advertisement (Point of purchase advertising) of a product when they are interested in it. This study has assumed that there are two types of behavior based on customers' preference in a store. One is a behavior towards a real product in a store. This study calls this behavior towards a real product as direct behavior. Another is a behavior towards information of a product that is shown in a display or wall. This study calls this behavior towards information as indirect behavior.

Table 1. Example of direct behaviors and indirect behaviors in a retail store

Behavior	Object of Behavior	Example of Behavior
Direct	Real Product	To look at a product To touch a product To take (pick up) a product To check a product and oneself in a mirror
Indirect	Information of product	To watch information of product shown in displays To check information using an information device To ask information of product to a person

We have shown an example of the direct behavior and the indirect behavior in Table.1. This study has assumed that customers have direct towards a product or indirect behaviors towards information of a product when they are interest in it.

2.2 Passive and Active Observation

As the way to observe the customers' direct and indirect behaviors, we propose two observation ways, Passive and Active observation.

Passive Observation. The passive observation is a method to observe behavior that people have affected to an environment. In the case of a retail store, the passive observation observes voluntary action of customers towards products based on their preference. In this study, we assume that direct behaviors are a part of voluntary action. We observe the direct behavior using a way of the passive observation. As direct behavior to observe through the passive observation, this study has selected two direct behaviors, which are to touch and to take (pick up). After the customer found the product in which he/she had interest, the customer touches the product to get outline information of the product. And then, if the product matches his/her preference, he/she takes the product to investigate detail of it. From the above reason, we assume that to touch and to take a product is related to a preference of a customer. On the other hand, to touch and to take a product only happens at a shelf, which has put a product, in a retail store. If we equip ambient sensors on shelves in various locations, we can perform the passive observation concerning direct behavior of customers towards real products using the sensor-equipped shelves.

As a device for the passive observation, this study has developed a camera-equipped shelf. The camera-equipped shelf can detect changes of products on this shelf through using the Open CV library [4] of image processing. We convert observed data through the shelf into two direct behaviors of customers as shown in Table.2. In this study, to touch a product is small movements of a product's position or small changes of the form on a shelf. To take a product is large changes of a product, such as a product disappears from a shelf. For example, if a little change of a product on a shelf has happened 10 seconds, we convert the observed data to the behavior data that a customer has touched the product 10 seconds.

Active Observation. The active observation is a method to observe behaviors that people has been affected from environment. In the case of a retail store, the active observation actively offers information to customers through ambient device, such as a speaker and an electric display, and observes reaction of the customers concerning the information. In this study, we assume that indirect behaviors are a part of reaction. We observe the indirect behaviors using a way of the active observation. As indirect behavior to observe through the active observation, this study has selected one direct behavior, which is to watch. If a customer has interest in an advertisement of a product, the customer watches the advertisement for a while. The customer does not watch or looks aside from the advertisement if it does not match the preference of customer. From the above reason, we assume that to watch information of a product is related to a preference of a customer.

As a device for the active observation, there is an ambient display. Reitberger et al. [2] also has developed an ambient display that shows customers activity for distinct regions in the store using data of camera in the store. We have developed an ambient display that has installed a function to detect a face. We have used the Open CV library to detect a face. Our ambient display does not only offer information to customers but also observes that a customer watches an advertisement of a product or

does not it through an equipped camera. For example, the ambient display, which has put on near by products, offers product information when a customer has touched or took the product. And then, the ambient display observes that the customer watches or does not watch the information for a while.

We convert observed data through the display into one direct behavior of customers as shown in Table.2. To watch an advertisement is that the face of a consumer is in front of the display. For example, if there is the face of a consumer in front of the display during 20 seconds, we convert the observed data to the behavior data that a customer watches an advertisement of a product in 20 seconds.

Table 2. The passive and active observation way of behavior of a consumer towards a product by a camera-equipped shelf or display

Observation method	Behavior	Observed behaviors through ubiquitous devices
Passive	Touch	A small movement of a product's position on a shelf A small change of the form on a shelf
	Take	A product disappears from a shelf
Active	Watch	A face of consumer is in front of an electric display

2.3 Estimation of Customer Preference

Using the active and the passive observation, we have assembled data of the time when consumers have direct and indirect behaviors. We make a model to estimate that a product is a favorite one or unfavorite one using the data of the time. We use support vector machine (SVM) using an RBF kernel to make the model. The SVM algorithm was performed using the kernlab in R [6]. Explanation variables for the SVM are the time of touching and taking products and the time of watching an advertisement of products on the display.

2.4 Smart Store

We have developed a smart store. The smart store has composed of the camera-equipped ambient shelves for the passive observation and the camera-equipped ambient displays for active observation. The advantage of our smart store is that a customer does not use a device, such as a touch-screen information appliance. There is the Metro future store [5] that assembles data of customers' preference using the shopping trolley that is equipped with a mini-computer and sensors. The Metro future store can assemble data correctly if customers use the trolley. If a customer does not want to bring the trolley, the system cannot collect data from the customer. Moreover, customer needs to learn the usage of the system. If a customer is poor at information appliance, the customer does not use the appliance.

Our smart store estimates a preference of customers from assembled data, as shown in Fig. 1. First, the smart store assembles data of two direct behaviors from devices for passive observation. The smart store also assembles data of one indirect behavior from devices for passive observation. Second, the smart store converts the observed data to the behavior data based on convert rules. Thirds, the smart store has made a model of a preference concerning products from data of two direct behaviors and one indirect behavior using SVM. The smart store estimates preference towards a product using the preference model from observed direct and indirect behaviors.

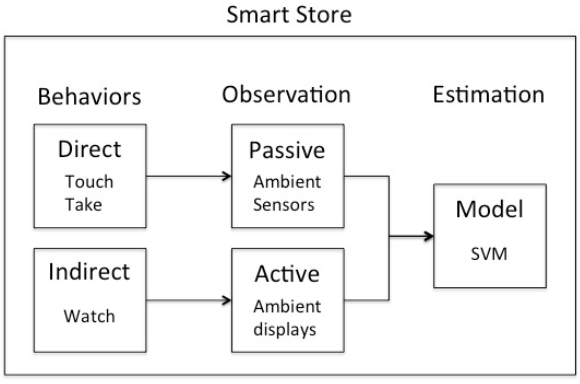

Fig. 1. Estimation process of preference in the smart store

3 Experiment

We have developed a prototype smart store in our laboratory. The prototype smart store has put six camera-equipped ambient shelves and ambient displays. One camera has observed a change, such as a movement of the product, of one product on a shelf. The one shelf has observed four clothes. The one ambient display is placed in the one shelf, as shown in Fig.2. The ambient display offered the detail information of clothes, such as shown in Fig.3, to a person when the person acts to the clothes on the shelf. For example, the ambient display, which has been put on the shelf X, has offered the detail information of the clothes A when a person has taken the clothes A from the shelf X.

We have carried out a purchase experiment of clothes by 20 examinees in the prototype smart store. The examinees have purchased favorite clothes from 8 clothes (T-shits) in the prototype smart store. One examinee has gone into the smart store alone and has selected one favorite product.

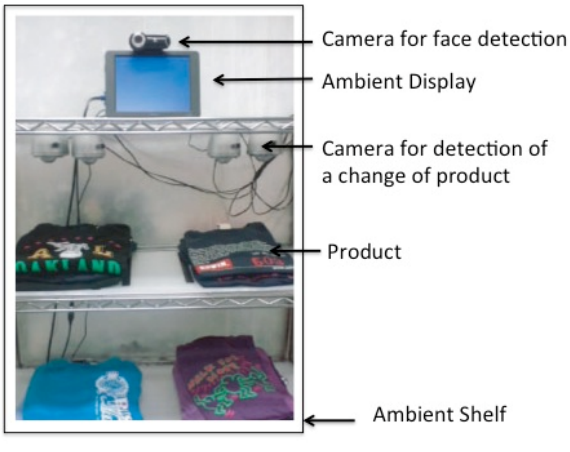

Fig. 2. The ambient shelf and the ambient display that our smart store installed

Fig. 3. This is an example of information. The information of a product offered to a person through the ambient display when the person act to the product on the shelf.

After a purchasing experiment, we have carried out an impression experiment that an examinee answers likes and dislikes of 8 clothes, which has been placed in the smart store, by a rating scale of 5 degrees. We have used rating data of the impression experiment to evaluate results that has been estimated from behaviors. We have categorized the rating data to two classes (C1 and C2) because we have assumed that the grade of over 4 indicates clear interest of examinees. The C1 is a class of favorite product and it has composed of products marked the grade over 4. The C2 is a class of unfavorite product and it has composed of products marked the grade of under 3.

We have gained 160 behavior data (8 clothes * 20 men) from both experiment of a purchasing and impression. Table 3 shows a part of data concerning time (seconds) of examinee's behaviors. For example, the No.1 of examinee has touched the product B for 2 seconds and taken it for 7 seconds. The examinee also has watched the detail information of product B for 6 seconds.

Table 3. A part of examinee's behavior towards products in the temporary retail store for this experiment

Examinee No.	Product ID.	Time (seconds) of Behavior			Class	Rate
		Touch	Take	Watch		
1	A	2	9	6	C2	3
1	B	2	7	6	C1	4
…						
1	H	0	0	0	C2	1
~						
9	G	7	0	0	C1	4
9	H	3	5	4	C1	5
~						

The examinee has marked the degree of four to the product B in the impression experiment and it is classified as the C1, which is the favorite class, in this experiment.

We have made 7 models, which is combination of two direct behaviors and one indirect behavior, to estimate a preference of clothes (T-shirts). The 7 models have been made by the SVM using an RBF kernel in kernlab of R. We have evaluated an accuracy rate of 7 models using leave-one-out cross validation. Table 3 shows the accuracy rate of each model.

We have defined the models using only direct behavior as DB. We have made three types of the DB that are the To, the Ta and the To-Ta that is combination of To and Ta. The error rate of estimation using the three types of DB (To, Ta, and To-Ta) is from about 29% (DB(To)) to about 17%(DB(To, To-Ta)), as shown in Table 3. The result indicates that a person touches a product when the product does not match preference of the person. To touch a product shows the uncertain interest of the person to the product. To take a product shows that a customer has more interest in the product. Therefore, if a product that a customer has touched, one of feature in the product may match a preference of the person. Moreover, when a customer has taken a product, the person may have had interest in a few feature of the product.

We have defined the models using only indirect behavior as IB. The IB (W) is about 16% and is better than the model of DB. A customer watches information of a product to get detail of the product. Therefore, to watch needs time that a customer reads contents. Therefore, if a customer cannot get information that has matched his/her preference, the customer stops watching soon. To watch indicates interest in a product of which an ambient display shows information.

We have defined the models using direct and indirect behavior as DIB. There are the To-W, the Ta-W and To-Ta-W in the DIB. The DIB(To-W) and DIB(Ta-W) are same error rate of the model of ID(W). However, The DIB(To-Ta-W) model has been the lowest error rate (13%) than other models. This result indicates that combination of direct and indirect behavior is effective to estimate preference of customer concerning products. We can detect clue of preference from direct behaviors and make sure the preference from indirect behavior.

Table 4. Estimation error of preference of customer concerning clothes using each model based on direct and indirect behavior

Behavior	Touch	Take	Touch & Take	Watch	Touch & Watch	Take &Watch	Touch & Watch & Take
	DB(To)	DB(Ta)	DB(To-Ta)	IB(W)	DIB(To-W)	DIB(Ta-W)	DIB(To-Ta-W)
Cross Validation Error	0.288	0.169	0.169	0.156	0.156	0.156	0.131

4 Conclusion

We have presented a smart store that estimates a preference of customers from behaviors of the customers. As a method to observe direct behavior towards a product and indirect behavior towards information of a product, we have proposed a passive observation and an active observation. The passive observation is a method to observe

voluntary actions of customers towards products based on their preference. As a device for the passive observation, this study has developed a camera-equipped ambient shelf. The active observation is a method to observe reaction of people concerning information from which an environment offered. As a device for the active observation, this study has developed a camera-equipped ambient display. We have developed a prototype smart store that has installed the ambient devices. The experiment using the smart store has indicated that the smart store can assemble direct and indirect behavior.

We have made models to estimate customer preference of product from the time data of two direct behaviors and one indirect behavior towards products. The estimation result has shown that a model, which is put together with direct and indirect behavior, is the accuracy rate (87%). The rate is higher than a model of only direct behavior and only indirect behavior. The result has indicated that the combination model of direct and indirect behavior could estimate preference of customer concerning products.

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Toward the New Sullivan Principles in the Information Age: Conflicts and Challenges of Multinational Information Technology Companies in Asian Countries

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Abstract. A free and open communication environment is essential for a democratic society. Information and Communication Technologies (ICTs) serve as a basic structure for creating democratic communication environments. We have to try to understand ethical issues which ICTs can cause and the importance of multinational companies' social responsibility. This paper presents case studies in conflict between governments and multinational information technology (IT) companies over internet regulations in Asia, specifically in China and South Korea. By analyzing recent conflicts, we develop an improved understanding of the embedded values of information technology and its possible effects on society. This analysis also allows us to anticipate possible future problems and understand future information environments. Furthermore, I suggest basic ethical concepts, identifying six principles which multinational information technology companies should consider when they implement their technology in other countries.

1 Introduction: Internet Regulation and the Importance of Private Companies

Cyberspace has become not a free space anymore [1]. The online world is a place which is controlled by each country's government regulations using such means as filtering, censorship, and surveillance. Regulations continue to evolve, just as technologies do. Ronals Deibert and Rafal Rohozinski analyze and categorize three types of government regulation: first generation control, second generation control, and third generation control. First generation internet control techniques involve denying access to specific internet resources by directly "blocking access to servers, domains, keywords, and IP address" [2]. Second generation techniques involve the consolidation of legal and technical control over the online environment, allowing the country's government to take quick action in future problematic situations. Third generation techniques involve distributing pro-government information or information that discredits or demoralizes political opponents in order to lead public opinion in cyberspace. Governments, also, try to keep and use any data that will make trouble for political opponents [2].

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IT companies play an important and specific role in this situation. IT companies have a better understanding than government or individuals about the technological structures and mechanisms of the information world. The companies need to have close relationships with both governments and individuals. They have to fulfill government requests, while serving their customers, who are both users and citizens. In many cases, regulative actions make the companies implement technology that can violate human rights, invade privacy, and limit freedom of speech. Sometimes, regulative actions conflict with a company's own values regarding the uses of technology. When this occurs, the companies have to make difficult choices among respecting the law by complying with government requests, protecting their own values and profits, or serving the rights and interests of their users. Another problem is that the situation and context of regulatory actions varies depending on the individual government. Since many major IT technology companies are multinational companies, this variety of contexts may represent an extraordinary challenge.

Each country's situation, internet-related regulations, and conflicts are different, but they can be comparatively considered in an international context. Asian countries, part of a huge economic boom, have become venues for these problems because of their highly varied government structures and regulations and because technology companies want access to their markets. Most major information technology companies would like to succeed in Asia. However, the complex differences between the social and cultural contexts in the region make it difficult, and place companies in some controversial situations.

Compared to western countries, Asian countries are culturally, socially, and politically diverse and different from the western countries in which most multinational companies originate. Also in many Asian countries, governments have traditionally intervened in private companies and industry, and have historically repressive traditions of media control [3][4]. Therefore, studying cases in the region offers us examples helpful in developing an understanding of current problems and conflicts and in anticipating the future of the internet environment.

2 Case 1. China vs Google

China has one of the highest levels of information control technology in the world [5]; the Chinese government intends to control all information that comes in and out of the country. The government has required all IT companies in the country to enforce a high level of censorship and surveillance and to provide dedicated IT experts and tools for these purposes. Multinational IT companies have also been ordered to follow these government requests and are asked to engage in self-censorship and to provide individuals' records without appropriate legal procedures, even though this is quite different from what they do in their home countries.

Google, the company that has the world's largest search engine, highly censored all information provided to its users in mainland China. For example, it did not allow access to some politically controversial information, such as information about the Tiananmen Square protests. However, the company decided not to follow the Chinese government's strong self-censorship requests, insisting that they limit free speech on the web [6].

In March of 2010, Google announced it would no longer censor information as the Chinese government had required, redirecting all online requests and traffic arriving at google.cn to its Hong Kong branch, google.com.hk., which provides uncensored search results.[1] The Chinese government showed concern about Google's decision, by warning the company it would not be able to get its Internet Content Provider (ICP) license renewed, an annual requirement. In response, Google stopped redirecting its traffic in early July. Instead, it made a landing page that allowed users to choose between Google China and Google Hong Kong. Finally, the Chinese government renewed the company's ICP license, though strong contentions between the government and the company continue. Also, some services of Google China temporarily remain blocked in mainland China, perhaps by the Chinese government – Google reports this outage is not due to a technical problem [7].

Keith B. Richburg says this conflict between Google and China is one between free speech online and strict censorship and control [8]. The issues which Google raised regarding its conflict with the Chinese government were mainly two: censorship and freedom of speech. As the company said in their official blog, "self-censorship is a non-negotiable legal requirement" in China [6]; monitoring published online material is an IT company's responsibility. Both ISPs and ICPs have to block, censor, and report whatever the government designates to be "illegal," generally socially sensitive issues or threats to national security [2]. Illegal content includes not only commonly regarded socially unacceptable contents, such as pornography and gambling, but also politically controversial information and Western media [9]. The extent of government-defined illegality is not only broad but also vague. For example, descriptions of banned content include such terms as "Western decadent culture" and "information with political implications" [10].

China is a highly censored country. Serious ethical problems in China, of which IT companies must be aware, include the possibility that technology will be used for violating human rights, including the freedoms of speech and access essential for democratic society. The self-censorship mandated for IT companies involves implementing access/administrative/personal control over individual and institutional computer systems, installing censorship software at each information point and at gateways to international networks, and retaining data [10][4]. The main external reason given by the government for internet regulation in China is social security, but in many cases censorship and filtering are likely used for political reasons to block anti-government information and unaccepted viewpoints such as those regarding illegal political activity. Censorship has been applied to web sites run by Tibetian exiles and the Taiwanese government [2] [10].

Information technology can be used to threaten individuals' safety as well as limit free communication. One of the reasons Google decided not to follow the Chinese government's regulation requests was that the company found that human rights activists' Gmail accounts had been hacked. The company's official blog announced that, "Gmail accounts of dozens of human rights activists connected with China were being routinely accessed by third parties" [6]. China has also been suspected of monitoring and data-mining its political opposition, journalists, and human rights activists' private information, such as personal email accounts and personal web

[1] http://googleblog.blogspot.com/2010/03/new-approach-to-china-update.html

activity records. The information can be used for law enforcement, and used as evidence in individual arrests. It is clear that many political dissidents active in cyberspace in China have been arrested and harassed. Currently, it appears that at least 72 individuals are in prison in connection with information crimes [5]. These arrests and imprisonments occur without proper legal grounds or formal process in many cases.

3 Case 2. South Korea vs YouTube

South Korea is a democratic country [11]. The country provides higher levels of freedom of information and speech by comparison to China. Perhaps, as a result, the country's approach to internet regulation is based on a legal process, rather than simple rule by authority. As one of the most highly-connected countries in the world, South Korea was quick to develop social and governmental awareness about internet regulation. They were first to adopt new regulation methods, such as real name requirements, an approach on a national level [12]. However, there has been controversy around government efforts to have more control over the information world in recent years.

In April of 2009, after an amendment to the Information Act took effect, YouTube Korea decided to stop their uploading services in South Korea in essence refusing to follow the new version of the act. The amendment to the information act included the extension of real name registration requirements. Under these requirements, a website which has online content publishing features and more than 100,000 daily visitors has to confirm users' real names and resident registration numbers. Previously, the real name registration requirements were only applied to websites with 300,000 daily visitors or more [12].

Real name registration requirements have been actively discussed in South Korea. Assenters to the rule say that the rule is effective in reducing cyberviolence, including online bullying, abusive comments, and the spread of illegal content, as it makes users feel more responsible for their published contents and comments [13]. Opponents insist that the rule can violate such human rights as privacy and freedom of expression in cyberspace.

Anonymous internet communication has had positive effects on the creative development of internet culture in South Korea. It has encouraged more participation in online activity, critical opinions on culture and society, and equal and participatory relationships between citizens [14]. Specifically, anonymous communication on the internet has expanded political discourse. Although South Korea is a democratic republic, the level of media freedom is not high [15]. Social and political discussions in the country were long been repressed under dictatorial and military regimes until the 1990s, and political discourse among ordinary citizens was suppressed before the introduction of the internet. Because anonymous communication on the internet has played an important role in expanding political discourse and promoting citizen participation, it can be regarded as having more positive than negative effects on society.

Real name registration requirements could have negative effects. They raise personal information security and privacy issues, in that individuals' personal

information would be shared by many private and public sectors, and most internet activities would be recorded and traceable. Real name registration requirements have the potential to limit individuals' free speech and could be used as a tool to strengthen government control and surveillance of ordinary people [16]. Besides this rule, the amendment of the Information Act contains many changes to reinforce government surveillance and repress individual freedoms. One of the most important changes imposes restrictions on defamatory information in cyberspace requiring portals to delete or suspend online articles if anyone complains an article is "fraudulent" or "slanderous" [2]. Though the Korean government claims that the amendment is only intended to keep the internet clean and orderly, this increased regulation is suspected to be a response to concerns about the internet's growing effect on political discourse and its power to mobilize people, as demonstrated in the massive civic protest in 2008 [17].

The conflict between YouTube and the Korean government has raised several issues regarding internet regulation in the country. First, it has reinvigorated the debate about the appropriateness of internet regulation. Even though the regulation was enacted by a legal process, an inherent ethical problem is embedded in even the most valuable information technology, because it can possibly be used to control and monitor individual lives, a point which Korean society may not have sufficiently considered. Second, the conflict has raised issues regarding the effectiveness of internet regulation, and the difficulty in predicting whether regulations have the desired consequences. Although YouTube announced it has closed upload services in South Korea, internet users in Korea can still use these services, including the upload service, freely if they switch their preference settings to another country.

This decision by YouTube has helped to raise social concerns, creating conditions in which internet users are frightened of that their communications might be monitored, limiting free speech rather than decreasing cyberviolence. Research shows that after the implementation of the law, the number of postings and users who write and reply significantly decreased, but the number of slanderous comments and swear words was not significantly reduced [18].

YouTube's reaction against the South Korean government is only possible because the company is multinational, hosted larger market outside of the country. Therefore, it is less restricted by local government. The YouTube case is meaningful, not only because it raises important questions about internet regulation and human rights in Korean society, but also because the company was the first to refuse to follow the law and can serve as an example to other IT companies. Note, though, that the option to refuse to comply may not be available or could be very difficult for domestic companies.

4 New Sullivan Principles for the Information Age

When an IT company starts to do business and implement its technology in other country, localization of its product is important. In most cases, the issue is how to design and implement appropriate technology in each local situation. However, IT companies also have to set up their policies and make business decisions based on each country's context including local laws, cultural and religious background, and social norms [19]. Localization may require companies to violate democratic principles.

ICTs are not just a tech product but also an important infrastructure. A flourishing information society and culture will come about when certain preconditions are met:

> (1) a functioning public sphere (print, electronic, digital, broadband) open to broad participation and deliberative engagement among major social groups; (2) a percentage of the public communications system capacity reserved for non-commercial exploitation in order to strengthen the foundations of civil society and associational development; (3) guarantees of citizens' information rights through freedom of information laws, government transparency, and public service obligations for information providers to serve the public-opinion formation process; and (4) access to knowledge, information and an educational system that cultivates independent judgment instead of rote learning [3].

IT companies have to consider social responsibility when selling their technology. Technology is not neutral [20]. IT technology, specifically, has embedded value as a means of control and surveillance in society. People who deal in IT technology should be cautious that their technology is not used to repress society.

Multinational IT companies, especially, have to aware of the ethical issues of their technology when they implement it in another country. Since their technology is often hosted outside of the country they are seeking entry to, these companies are less influenced by local laws. It is easier for a multinational company to raise an objection to a local law than for a local company. They can better consider ethical values and compare the local situation to that in their home countries or in other countries in where they do business. Their reaction for or against government can serve as an example and possibly influence local companies. Furthermore, in the long term, their actions can cause future policy changes in local governments, perhaps leading to the alleviation of regulations and controls [9].

The Sullivan Principles were a code of conduct that was developed by the African-American preacher Rev. Leon Sullivan, in 1977 for doing businesses in South Africa under apartheid. It was a set of ethical guidelines for multinational corporations to use in making decisions in an ethical way to protect the human rights of black workers in South Africa. It promoted corporate social responsibility and suggested values that corporations should think about when they operated their businesses in South Africa. The principles contained articles urging corporate awareness to local people in vulnerable situations, respect for universal human rights, the equal treatment of people both from their native countries and in the local country, and the improvement of social and living conditions of local people [21].

Many IT companies are not aware that ICTs are crucial to foster democratic environments in modern society. Also, some IT companies sell their technologies to governments even though they know those technologies are used to violate human rights and threaten human safety, and even though they have a social responsibility for the societies in which they run businesses [22].

Internet regulation is typically both positive and negative in its effects. It is needed to keep cyberspace secure, specifically to protect children and prevent cybercrime. However, as we've seen in the previous section, it can have harmful effects that can

threaten individuals' freedom and rights. Ethical IT companies have to consider the potential for negative effects associated with the introduction of their technologies.

In the previous section, I explained possible ethical problems regarding ICTs and regulation by analyzing two cases, the conflict between Google and the Chinese government, and between YouTube and the South Korean government. Based on that analysis and using the original Sullivan Principles as a framework, I have developed six, specific ethical principles for multinational IT companies to think about when they implement their technology in other countries, to protect basic human rights and to foster democracy on the internet.

Principle #1: Multinational IT companies have to be aware that *users in local countries must be treated and respected the same as users in those companies' native countries.* This requires a guarantee of the same level of basic human rights for local users who use the companies' technologies and services.

Principle #2: When multinational IT companies receive legal regulation requests, they must consider whether *the regulation request is based on appropriate legal grounds and takes place in the context of a transparent legal procedure*.

Principle #3: *Multinational IT companies should avoid politically motivated internet regulations*, specifically those regulations imposed to enforce or exclude certain political ideologies, suppress political mobilization, or repress political dissidents or human rights activists.

Principle #4: Multinational IT companies must *provide free speech and free access to information for local users*. This doesn't mean they must provide unlimited freedom; companies have to respect local laws. But if they find that local laws significantly curtail freedoms and create highly restricted environments, then the companies should take appropriate ethical positions on the issues or laws.

Principle #5: Multinational IT companies have to *protect their users' personal security, private information, and identities*. Though companies might record and retain users' private information for technical reasons or customer services, they should not allow an individual's private information to be used either commercially or politically without that individual's consent.

Principle #6: Multinational IT companies must make an effort to *improve the overall information environments of local countries to foster a more democratic cyberspace*. A free and active communication environment is essential to the emergence of a democratic society. Multinational IT companies bear a social responsibility for their technologies' uses, and are partners in designing the overall social communication environment.

5 Conclusion

The recent increase in internet regulation creates conflicts between governments, IT companies, and citizens. In this paper, I focused on conflicts between governments

and multinational IT companies. Since ICTs are relatively new, we do not have enough precedents for its regulation, and it is difficult to foresee the possible effects or problems associated with present and future regulation. Therefore, I analyzed two different cases: China vs. Google and South Korea vs. YouTube. Recent government internet regulations in those countries involve censorship, filtering, and surveillance which multinational IT companies are required to enforce potentially threaten basic human rights and individuals safety.

IT companies have to make difficult decisions, choosing between governments and users. I suggested basic principles to help multinational IT companies make ethical decisions based on these case studies and the framework of the Sullivan Principles. My new Sullivan Principles for the Information Age are designed to promote multinational companies' social responsibility, encourage more democratic societies and help the companies find an ethical balance between government requests and the protection of user rights and safeties, especially for companies that do business in other countries.

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Designing for Social Commerce Experience as Cultural Consumption

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Abstract. Social commerce websites are facing a challenge of how to use social media effectively in reaching their users in this globalization age. In this paper I look at two successful cases of social commerce websites, TaoBao of China and Etsy of the U.S. and argue that the design of a social commerce website should implement effective local SNS features to connect with and engage its users, mediate their identities, and empower them in this rising participatory culture.

Keywords: social commerce, social shopping, culturally localized user experience, cultural consumption, genre, affordance.

1 Social Commerce and Social Shopping

With the global popularity of Social Networking Service (SNS) websites such as Facebook and Twitter, e-commerce websites have rapidly embraced the concepts of "social commerce" and "social shopping" to reach their targeted customers and accomplish business goals. Forrester Research estimates that social media marketing will reach 3.1 billion by 2014 [1].

Both "social commerce" and "social shopping" suggest integrating SNS features into the core functions of e-commerce websites—using Internet-based social media to "allow people to actively participate in the marketing and selling of products and services in online marketplaces and communities" [8]; however, researchers have not agreed on their definitions. While a small group of researchers distinguish social commerce (as collaborative networks of online sellers) from social shopping (as collaborative networks of online shoppers) [8], most people use them in an interchangeable way, which is followed in this paper. Generally social commerce websites rely on the wisdom of crowds in the form of user-generated content such as lists of friends, lists of favorite products, product reviews and recommendations, groups and communities, voting, and discussion to engage new and old users—including sellers or shoppers—into a collaborative e-commerce experience, and therefore online communities of consumption are formed.

The emerging trend of social commerce has brought the following benefits to online shopping websites. First, the various social activities users are engaged in those social commerce websites make those websites more "sticky." SNS features such as games, chats, and rewards systems prolong users' visiting time and encourage them to come more often. As a result, the stickiness usually leads to the increase of sales.

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Second, social shopping features help online shopping websites more effectively reach a type of online shoppers that were hardly to serve well before, recreational shoppers who do not have particular shopping goals. Window-shoppers are a common scene in the bricks-and-mortar shopping centers, but traditional online marketplaces lack an effective way of attracting and retaining them as most people do online shopping for its efficiency and convenience. Indeed a majority of online shoppers are utilitarian shoppers. The social shopping atmosphere glowed from the e-commerce websites now gives recreational shoppers more reasons to visit shopping websites for fun and for other hedonic motives [2].

However, as Forrest analyzes, social media marketing gets much tougher as social media is adopted by more companies [7]. E-commerce websites are facing a challenge of how to "cut through the noise, reach an audience and make an impression," particularly in this globalization age. In this paper I look at two successful cases of social commerce websites, TaoBao of China and Etsy of the U.S. and argue the design of a social commerce website should implement effective local SNS features to connect with and engage its users, mediate their identities, and empower them in this rising participatory culture.

2 Designing a Dialogic Genre of Social Commerce for Cultural Consumption

Here I use the lens of cultural consumption [3, 6, 9] and a dialogic genre view [10, 11] to examine the use practices of social media on the social commerce websites and to explore ways of designing for better local user experience.

I argue that the huge amount of user-generated content found from social commerce websites shows that online sellers and shoppers are not passively consuming the technology, but energetically engaged in cultural consumption, a productive activity in which consumers apply creative strategies to attach meanings to the objects they consume and make sense of their everyday practices [11]. Through cultural consumption, users turn a usable technology into a meaningful one—a technology they are related to. As a result, they consummate their experiences with the technology into Culturally Localized User Experience, an experience in which users creatively use and consume a technology in their local contexts to fit into their ways of life and to mediate and construct their identities, an experience that integrates the "situatedness" and the "constructiveness" of technology use in local contexts.

A dialogic view of genre considers a genre as both a behavioral construct and a structural construct [11]. As a behavioral construct, the generic features of a genre represent social responses to recurrent situations [4]. As a structural construct, a genre enacts an emergent structure of technology use [5], as a stabilized assemblage of articulations, for the time being, in an ongoing process of structuration [11].

The integration of two aspects is important in technology design as this dialogic view of genre offers us a better vision to examine technology affordance and distinguish instrumental affordance from social affordances. Here instrumental affordance refers to affordances emerging from use interactions in the material context, while social affordances are the affordances on the activity level that emerge from use interactions in the sociocultural and historical context. For example, the

instrumental affordances of a social commerce website include accessing product reviews, finding interesting products through friend's recommendations, rating recent purchase, and so on. Its social affordances could include sharing clothing style information, having fun, and etc.

In the case of social commerce websites, if designers only focus on design features and instrumental affordances such as the ability of rating products and generating a favorite list, the created social commerce website will not bring a lot of extra values to the online marketplace. More sophisticated designers will look at what social affordance a website could nurture, aiming to consummate user's experience into cultural consumption, an active form of consumption practice when social meanings are generated, identities are created, and agency is reinforced.

3 The Cases of Taobao and Etsy

Taobao and Etsy are two successful social commerce websites in its local contexts. Taobao.com, a Chinese C2C (consumer-to-consumer) giant with online shopping and auction services, was ranked as the 4th most visited website in China and the 15th globally as of March 2011, higher than Amazon.com and eBay.com, according to Alexa.com. Etsy.com is a New York-based online marketplace for handmade goods around the world and boasts sales in excess of $300 million in 2010 [13].

The competitive edges of Taobao and Etsy in the arena of social commerce can be attributed to the following factors: Both websites are targeted to both sellers and shoppers at the same time, providing a full spectrum of social commerce experience; both put a lot of efforts in helping small sellers succeed in their online marketplaces; both focus on developing user communities with various SNS features. More important, both successfully nurture a distinctive online culture of consumption that blends well with their SNS features, and it is these cultural consumption practices surrounding online shopping activities that make them succeed.

In the case of Taobao, while eBay (China) or Amazon (China) are just a place for doing business or shopping to Chinese users, TaoBao provides a world of Jianghu, a peculiar culture based on the popular Chinese Wuxia (Martial artists) novels and movies. Jianghu, which can be translated literally as "rivers and lakes," refers to a fictional universe, world, and milieu where the adventurers, rebels, wanderers, unemployed laborers, gangsters, and outcasts of society gather. In that world, everyone has a dream of becoming a hero in the end, even the most-powerful one who governs the world of Jianghu, with superb martial arts skills honed from years of earnest practice and undertaking demanding trials, all the while earning love. The SNS platform TaoJianghu combines shopping and social networking with fun games, which matches the imagination of many ordinary Chinese people who dream of quickly becoming rich through adventure and luck. Indeed TaoBao means "searching for treasures" in Chinese.

In comparison, Etsy follows the tradition of the American DIY (Do-It-Yourself) movement that started from home improvement projects in the 1950s and advocates an attitude of "live the handmade life." This slogan touches many people, who aspire to live a greener life by supporting locally produced grocery and goods. It is also part

of the "culturally sustainable product development" worldwide [12], which explains the popularity of Etsy outside of the U.S.

Resonating with their unique social commerce cultures, both websites utilize and localize the SNS features in different ways. On the website of TaoJiangHu, a subsite of Taobao, gaming experience is a highlight for this scene of social commerce. Various third-party applications of games are embedded in Web pages with complicated rewarding systems to entice social shoppers to come more often and stay longer. Online communities are directly labeled as bangpai (gang) to create the atmosphere of Jianghu. While bolstering shopping business is the ultimate goal, Taobao puts more energy in engaging users into its immersive shopping experience subtly and prioritizes on developing long-term relationship over other business goals. In contrast with relationship-oriented SNS design on Taobao, the SNS features on Etsy are more task-oriented, i.e., to get a user involved into assorted crafting activities for living a handmade life. For example, the features of Virtual Labs and Livestream are used to hosting crafting workshops as people would see from Etsy's bricks-and-mortar competitors such as Michael's or Hobby Lobby.

As online shoppers participate in "the work of cultural consumption" [3, 6, 9] on a social commerce website like Taobao or Etsy, they conduct identity performance and display who and what they are, accomplishing their dreams of Jianghu or living a handmade life. At the same time, they are empowered to become more active participants in these communities of consumption because both websites support an easy transition from a shopper to a seller: With a link away, a veteran shopper could open his/her online store easily.

4 Conclusion

Studying the cultural consumption out of social shopping practices on social commerce websites opens up new avenues for culturally sensitive design in this glocalization age. It shows the successful design of a social shopping website should implement effective local SNS features to connect with and engage its users, mediate their identities, and empower them in this rising participatory culture.

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Designing Web Marketing that Works for Users: Finding Best Practices through Evaluation and Conversation

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Abstract. Many think of marketing as a separate discipline from user experience design; however, marketing is an integral part of users' experiences in using many web sites. This paper describes methodology and findings of a study aimed at understanding how to effectively use marketing promotions to raise financial advisors' awareness of relevant products and resources on a fund family web site, while at the same time supporting the broader experiences around their intended uses of the site. High-level guidelines for using marketing promotions on a web site are described, as well as tactical best practices to guide design of such promotions.

Keywords: Marketing, web promotion, user experience, best practices, root cause analysis.

1 The Challenge: Creating Effective User Experiences through Balancing Web Marketing and Users' Needs

Web marketing is an important web design area in which a user-centered design approach can be used to create more positive user engagement and support marketing objectives more effectively. Web marketing is often driven by marketing managers and creative agencies who rely largely on intuition, with little or no user research performed to inform the process. In many cases, this has led to ineffective web marketing; banner blindness, a phenomenon according to which users ignore web marketing banners on webpages, is a clear example of how this approach can fail.

In this paper, we will illustrate how to apply a user-centered design approach to improve web marketing, and highlight a number of strategic guidelines and tactical design best practices derived from our extensive experience as user researchers and UX consultants and in particular a user research study that we conducted for a major financial services company. We have mainly two intentions: 1) to help marketing managers, creative designers, and executive decision makers in marketing organizations create more effective web marketing materials by leveraging these best practices; 2) to share ideas with fellow user researchers about how to better conduct web marketing client research.

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1.1 Background Information

The research effort and learnings described in this paper were sparked by a fund family's desire to better understand the most effective way to reach and benefit its customers using web promotions. The organization's marketing group was working with a creative services agency, and had realized that they had difficulty providing clear guidelines to the agency to direct the development of promotions. In addition, the web site design team wanted to better understand how these promotions would affect end users' overall experiences with the site.

The research project focused on understanding best practices for marketing promotions on a fund family web site. A fund family is a provider of a set of funds, such as mutual funds or exchange traded funds. Familiar examples include Vanguard, Fidelity, Putnam, iShares, and StateStreet. Web sites provided by these fund families have a number of different objectives, such as: providing information to aid in the fund selection process, providing information and tools that may be of value to users of the site (to encourage return visits and enhance the brand), and promoting new fund products offered by the fund family.

For this study, the fund family focused on their primary user base of financial advisors. Although individual investors may use the fund family site as well, the site is primarily aimed at meeting the needs of advisors who come to the site to research and select fund products. Through work that had been done exploring Personas of different financial advisors [1] and prior research activities, the team had a general understanding of the primary (explicit) goals advisors have when coming to the site – typically tactical tasks such as researching and selecting fund products. They also had an understanding of advisors' latent needs that can be met by the site, which are more often strategic in nature – such as becoming smarter about their investing, and providing information to their clients.

1.2 Marketing as It Relates to Users' Needs

Marketing has sometimes been seen as being driven by a business benefit rather than a user benefit. This perspective can lead to design objectives along the lines of "achieve the greatest business benefit with the least 'harm' to the end user." A counterpoint to this perspective is the idea that the goal of marketing is to raise awareness, and that what the user is being informed of may actually be useful information – so that providing this useful information through effective marketing may actually be beneficial for both the business and the end user.

To create this type of mutually beneficial marketing promotion, it is important to understand what end users' goals and needs are when they encounter promotions, and whenever possible to align promotions with those goals and needs. Here, the distinction between explicit and latent needs becomes important. It's more common for users to come to a site with an explicit goal that is independent of what is marketed there, but they may still have latent needs that a marketing promotion may address. In such cases, the challenge is to satisfy these latent needs while still supporting the primary explicit goal or need that brought the user to the site.

2 The Methodology: Blending Evaluation and Conversation

This study was a blend of generative and evaluative design research, rather than a traditional usability study. Instead of evaluating the usability of the specific designs and web sites shown, the goal was to generate guidelines to aid in future design activities by evaluating effectiveness of and reactions to a variety of approaches to web marketing.

2.1 Methodology Overview

For the study, ten financial advisors evenly representing the target user segments were recruited. Each 90-minute session began with a discussion to understand advisors' goals and needs for using a fund family web site, followed by a review of eight to ten live sites and a few targeted mock-ups. In this review, each advisor was asked to evaluate the examples shown using a semantic differential rating system, and engage in an in-depth conversation regarding their reactions.

The study was highly qualitative in nature, with insights primarily extrapolated from the in-depth conversations with advisors. Root-cause-analysis-style probing – understanding the "whys" behind advisors' reactions to what they saw – played an important role in these conversations and the subsequent analysis. Unlike a usability study, this was not task-based, although discussion was grounded in users' goals in coming to the web site.

The study had a number of limitations. The small sample size and multiplicity of examples meant that users did not have "fresh" experiences with most of the promotions. The conversational focus on the promotions added to the artificiality of the experience. However, the deep discussion of advisors' reactions and recognizable patterns when synthesizing across participants gave the team confidence in moving forward with the best practices identified.

2.2 Web Promotion Examples Used for Discussion

The bulk of the study focused on evaluation of eight to ten live sites, some of which are shown below. Mockups of several design directions were tested as well.

In determining which examples to use to aid discussion, the team followed these guidelines:

- *Use real-wdorld / fully interactive examples when possible.* Although a few mock-ups were used to evaluate specific ideas, the most robust feedback came from the evaluation of live sites with fully interactive promotional elements on them. Advisors engaged more actively with the live sites; with the mock-ups, they were somewhat hindered by the reduced interactivity, and were critical of the lack of refinement of some of the concepts. It's worth noting that marketing promotions impact people on a very subjective level, so that the kind of suspension of disbelief that can be looked for in "wireframe" evaluations was less effective for this type of evaluation.
- *Come up with examples incorporating a variety of elements.* Because the team was interested in exploring all alternatives without preconceptions, we found examples that incorporated a variety of promotional elements and techniques – color, size, amount of text, amount of animation, etc. Examples are shown plotted against two key axes below (where static-dynamic includes both interactivity and animation).

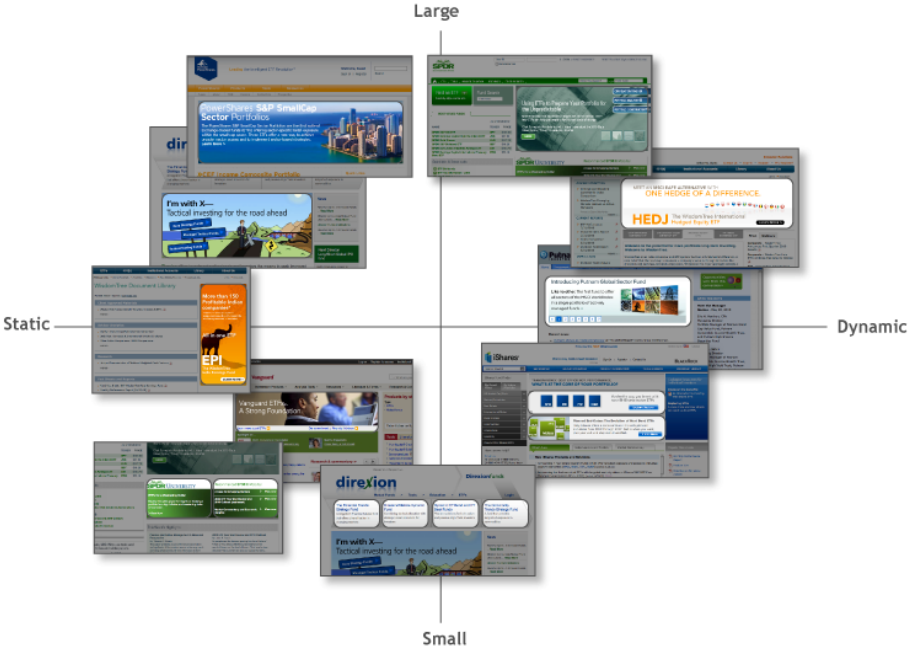

Fig. 1. Matrix of examples based on size vs. interactivity/animation

2.3 Moderation Practices

In moderating the sessions, the research team employed the following practices:

- *Gather initial information to understand users' explicit goals and latent needs.* A preliminary discussion captured specific information regarding how advisors use fund products, how they work with their clients, and what they explicitly come to fund family sites to do. The background information helped the team see potential latent needs, and information about why they go to fund family sites identified advisors' explicit goals. This was used both to interpret their reactions to the marketing promotions presented as well as to help ground the discussion in intended use at the beginning of the session, and at various points throughout.
- *Vary the presentation of alternatives.* In this type of study, only the first few examples being reviewed will get a realistic evaluation, since users will become inured to the effect of promotional elements after looking at many different ones. By ensuring that each type of promotion was seen first and at different points in the ordering, we were able to control for this to some extent.
- *Employ root cause analysis to uncover deeper reactions and latent needs.* A critical aspect of this research was that we were showing the promotions as a means to understanding the "why" behind advisors' reactions to different alternatives. Advisors' initial reactions were useful, but more important information was revealed using root cause analysis similar to the "five why" method originally employed by Toyota for problem-solving [2], and subsequently

used by others including Reichheld to better understand customer motivations and needs [3]. This method was used to probe beneath initial responses to get at the underlying information needed to determine best practices – e.g., hearing that an advisor doesn't like animation is useful, but learning that it's an issue because they can't keep up with reading the text or feel distracted from what they came to the site to do is more valuable information.

- *Use rating tools to aid discussion.* Ratings tools such as Likert scales or semantic differential scales [4] can be a useful method for directing conversation. It can be difficult to meaningfully compare ratings numbers, and in fact for this study that was not our intention – instead, we used the ratings as a way to ensure that we clearly understood whether advisors' reactions were positive or negative, and how strong those reactions were. The ratings also helped us probe on why one promotion worked better than another. We used semantic differential scales based on key criteria such as actionability (likelihood to click on it), usefulness, interest level, understandability, noticeability and disruptiveness. A 5-point scale was used to keep a simple assessment with enough granularity to highlight differences.
- *Avoid using words that suggest "marketing" or "promotion" during review.* Throughout the study, the term "information presentation" was used in lieu of "marketing" or "promotion." Using a neutral term of this sort avoided bias and also helped the team understand how participants naturally interpreted the promotional elements – as generic information, promotions or advertising. After all examples had been reviewed, we did conclude with a frank discussion to elicit advisors' thoughts on marketing.

2.4 Generalizability of Insights

We believe that the insights in this paper may extend to other situations in which web site marketing promotions are used as part of campaigns to promote products, a brand, or specific content; however, informed by research conducted by one of the authors in relation to online advertising and merchandising in the eCommerce space [5], we see paid ads or promotional merchandising as significantly different in nature, and would not expect our learnings to apply to these. Based on our experience with other industries (one of us has prior experience at eBay, and the other two have consulted on projects across a variety of industries), we also believe that the principles and best practice generated from this study may be generalized beyond the financial services industry.

3 Findings, High-Level Guidelines and Design Best Practices

3.1 General Findings

The primary goal advisors stated for coming to any fund family web site was tactical: to get information, usually about specific funds. Much of the workflow we observed was focused on this activity – advisors avoided looking at other things on the page, especially prior to completing their intended task. Advisors evaluated the overall effectiveness of a site and the home page on how well it helped them accomplish their primary goal.

Advisors also stated that they did sometimes find useful information they hadn't been looking for. This information helped them with strategic goals such as becoming smarter about their investing, and providing value and information to their clients. When information was highly useful, advisors appreciated it and began to incorporate it into their explicit goals for visiting the site.

Things that were perceived as "marketing" elicited different kinds of responses from advisors, some quite emotional in nature. Some advisors reacted very negatively, assuming that if something was "marketing" it was aimed at benefitting the company rather than the advisor. Some simply ignored it as being irrelevant to their goal in coming to the web site. Still others, as business people themselves, considered it an expected way to attract attention.

Advisors had the most positive reactions to marketing that they thought would benefit them (as opposed to benefiting the company that provided it), leading them to revisit the promotional area and positively impacting the brand overall.

3.2 High-Level Guidelines

Based on these general findings and informed by our previous research experience [5], we identified the following high-level guidelines. Ultimately, these guidelines all support the primary goal the team identified for web marketing that will best serve both users and the organization: to raise awareness of valuable information that helps advisors achieve their goals, in a way that instills trust and reinforces the brand. They are used to ensure organizational alignment when beginning development of a marketing campaign, and to communicate broad intent to those involved in design.

Do Not Divert Customers from their Primary Goals. A key finding along the lines of "avoid harm" is that web site promotions should not divert customers from their primary task of getting fund information. Advisors had negative reactions to this type of promotion, and reported less interest in visiting these sites. Examples of such diversion include animations that are highly distracting, and eliminating or minimizing important functionality from the home page in order to enhance visibility of promotions.

Add Value by Helping Users Achieve Latent Needs. From the perspective of adding real value, web promotions are most beneficial for customers and ultimately the company brand when they help users achieve latent needs aligned with their strategic goals of becoming smarter about investing and providing value to their clients. This is a perfect opportunity for marketing techniques, as it is necessary to raise awareness of ways these latent needs can be met on the site.

Avoid Looking Like an "Ad." When marketing promotions come across as advertisements, advisors lose interest and ignore them. We saw this happen when promotions were used to promote information that benefits the company or that is of no interest to advisors, and also when they looked like an advertisement, with meaningless "benefits" language, stock graphics and "gimmicky" presentation.

Add Visual Appeal and Reinforce the Brand. Because marketing promotions may have high visibility within the site, they should be used to add visual appeal to the site, and to reinforce the brand attributes.

3.3 Design Best Practices

Eight web marketing design best practices were uncovered. Unlike the high-level guidelines above, these are tactical and actionable. The goal was to be specific enough that they could be used independently to guide design efforts and assess effectiveness.

It is important to note that the success of web marketing depends on having an optimized combination of many design best practices, not just one or two. In this sense, these are similar to the patterns in Christopher Alexander's *A Pattern Language* [6] – together, they holistically create an experience that can have tremendous appeal, but combined with less effective practices, they can lose their impact. For example, we saw many examples where clear headlines and supporting text were combined with content that was simply focused on setting up, leading to a lack of attention or comments that these promotions were intrusive. The one promotion that stood out as a true winner, receiving positive feedback from all the advisors in the study, employed almost all of the best practices.

Below are the best practices identified from this research study.

Provide Only Useful Content. When content is of interest to advisors or gives the impression of benefiting them, they are more likely to attend to it and see it as being valuable information.

When advisors weren't interested in a topic, they were more likely to dismiss it as "marketing" or "advertising." When advisors perceived that content was benefitting them, they were more likely to see it as informative or useful; if they perceived it was aimed at benefitting the fund company, they saw it as marketing or advertising and more often discounted it.

Importantly, it isn't just the specific promotional item that is impacted by usefulness – seeing a single useless piece of information can "taint" a promotional display area so that advisors would ignore it in the future as well.

Use All Elements to Reinforce a Coherent Message. Promotions with a strong, clear message that is reinforced by all of the elements and imagery (photos or graphics) within the promotional area get more mileage out of each element and create a more impactful, satisfying communication.

Study participants tried to find connections between elements on screen and across screens to create a coherent message. In some cases, they "read into" what was displayed in order to do this – even if those connections were not actually intended (e.g., story-telling around photographs and graphical elements, as well as linking of headlines adjacent to messages even when there was no linking intended). Lack of relevance or disconnection was one of advisors' largest negative comments in evaluating graphical elements and content within message areas.

Use Large, Clear Headlines and Succinct, Useful Text. Headlines that are easy to scan and supporting text that provides useful information without "fluff" catch users' attention and encourage action. The headline should be written using clear

straightforward language that is direct and to the point. Supporting text is most effective when it provides useful, non-repetitious information.

Advisors paid more attention to headlines they could process quickly. If headlines were difficult to understand or were not noticeable, some advisors simply ignored them. Advisors stated that their method of processing information on the page was to scan the headlines for key words that they found interesting.

When supporting text simply restated the headline, advisors were likely to consider it "fluff" and not read it. As a side note, when supporting text had a marketing focus to it, some advisors found it intriguing, while others were turned off.

When buttons are provided, a general term such as "Learn More" is not as effective as a link that more specifically describes the action the user will be taking, such as "Get Fund Info" or "Explore Sectors."

Make Visuals Professional, Attractive and Contrasting. Visuals that draw attention in a way that is not "ad-like" are more likely to be noticed, and reactions to them are generally more positive.

A well-known issue that can impact web marketing is the phenomenon of "banner blindness," in which users ignore elements that come across as ads due to appearance or placement [7]. Advisors commented that images create more of a marketing feeling; although this is not always a negative, they must be used very carefully to avoid being perceived as an ad. Stock images should especially be used with care as they are often used in ads.

Visual contrast helped draw attention, specifically via contrasting colors and distinct visual elements (e.g., a colorful photo stands out better than an illustration in the same color that is used throughout the website). Large images drew attention, but some advisors were sensitive to the space they took and they may be perceived as more marketing or advertising oriented. Smaller images in a colorful field may be more effective. Advisors' reactions to specific types of visuals varied, but in general advisors preferred visual elements that were relevant to the message being conveyed, professional, high quality, "sophisticated" (not "gimmicky"), and colorful.

Due to their high visibility, visuals should be used to reinforce the professionalism and brand identity of the site.

Apply Movement with Caution. Animation and movement can effectively draw attention, but if not implemented carefully can alienate users.

Animation drew a range of reactions from advisors – some loving it, some hating it, and some neutral. Animation and movement did tend to draw advisors' attention initially, although whether they read what was in the promotional area had much to do with their reaction to the animation. Although a few advisors liked dramatic animation, most ignored it as being marketing or advertising, or found it distracting and upsetting.

Timing and selection of animated elements is especially important, as advisors found it frustrating if the timing did not line up with their processing speed. Animating background elements rather than the primary text can help allow maximum processing time for the core messages being presented, while still providing movement to draw attention.

When an animated "slideshow" of messages is presented, labeled tabs provide the most obvious way to get to specific items and also help highlight content that the advisor may not have seen in the slideshow (i.e., these tabs function as mini headlines). Tabs or controls without labels were less noticeable as clickable, and did not expose the content associated with them. Even with labeled tabs, a few advisors did not realize they could click on these tabs to control the display of a message. Having tabs control the message area on hover instead of on click would more effectively support discoverability.

Avoid Cluttered Promotional Elements. Simple presentation of messages with adequate white space makes it easier for users to see the information being presented.

In general, advisors responded well to simple presentations with single messages or a layered message area with simple controls. When multiple messages shared a space, simple treatments (such as links or identical treatments without graphics) were easier for them to process than more visually complex ones. Layered messages worked best when the tabs for them were clearly presented.

Keep Home Page Design Clean. Reactions to web promotions are highly impacted by the design of the home page surrounding them. A clean home page design with strong, simple themes increases visibility of promos as well as advisors' receptiveness to them.

Many in the study combined their comments on the promotional information on the home page with the design of the home page overall. In general, advisors said they liked home pages that were not busy, and that had simple, clean composition. They complained when information was too dense, or there were too many different types of elements or colors on the page. Advisors commented favorably on sites that had consistent color themes and simple layouts.

Promotions tended to be less noticed on pages that had many other competing elements. Furthermore, to gain attention for promotional items on such pages, more intrusive visual design and animations may be required.

Leverage Secondary Pages. Locating promotions on content pages is viable if done well. One potential advantage of locating a promotion on a content page is that those pages tend to be less busy than home pages, so there is less to distract from the promotion.

Only one content page promotion was evaluated, but we found it very effective to generating user engagement and supporting the campaign message relative to all other promos evaluated.

5 Impacts

The learnings generated significant impacts on the fund family marketing and web teams through our efforts of involving in the research process and communicating the findings on multiple occasions. Below are the key outcomes:

- *Web promotion successes.* The design of a major campaign for this fund family has adopted many best practices that we mentioned and based on web metrics, this

campaign has generated far greater user engagement than previous campaigns that featured design practices inconsistent with our suggestions.

- *Improved design process.* The best practices have helped to create "shared vision" [8] regarding web promotions within the organization. In particular, a process has been established according to which web marketing promotion designs need to be reviewed against the design best practices outlined in the paper. We use this process to encourage marketing managers and creative agencies to have conversations around how to incorporate these best practices into their designs.
- *Continuing learning.* One way of leveraging qualitative user research is to generate design ideas based on the learnings and then validate the effectiveness of these ideas through quantitative testing. Based on our suggestions, the business is beginning to conduct A/B tests to field test web marketing design alternatives that are informed by learnings from this research.

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The Entwined Economic and Cultural Issues in the Production of Barbie in Taiwan, Taishan

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Abstract. Barbie Doll is regarded as one of the most important design labels representing the twentieth century. Up until today, it is estimated that around 100 million Barbie dolls have been sold in 150 countries around the world. In 1967, the manufacturer of Barbie, Mattel Inc., set up a joint venture establishment, the Meining factory in Taishan Township, Taipei County. However, Mattel shut down the Meining factory in 1987 due to rising labor costs, the development of the local economy suddenly lost its basis. In 1998, the township council imported the concept and practices of community building and employed the industry of doll culture as a program to enhance the local economy. This way, not only has Taishan Township brought about new business opportunities, many of the women participating in community development can hopefully improve their self-empowerment.

This paper reviewed the development history of industries in Taishan Township from the perspective of globalization theories, aimed to analyze the difficulties of local industrial upgrades from the perspective of economic geography, and examine the effects of industrial promotion strategies in community building. Lastly, this paper aimed to explore opportunities for the empowerment of women in the community. It hoped to clarify the issues of industrial upgrading, community building, and women's empowerment regarding local industry development history, and reestablish the relationship between economic development and cultural experience.

Keywords: Barbie doll, community building, global commodity chains, cultural and creative industries, women's empowerment.

1 Hometown of Barbie — Taishan Township in Taiwan

In 1956, Ruth Handler, the founder of toy manufacturer Mattel Creations, discovered a doll called Bild Lilli while taking a vacation in Switzerland. This doll was based on a

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comic character from a notorious newspaper, Bild Zeitung, in Germany. Lilli the doll was originally positioned as low-class entertainment for adult males (Fig. 1). However, Ruth did not know this. She was looking for a three-dimensional doll that had the figure of an adult woman, in order to replace paper dolls. She had noticed that her daughter Barbara had been interested in paper dolls representing high school girls, university students, or career women, rather than infants [12].

Ruth suggested that an adult-figured doll could be a breakthrough in a toy market dominated by baby dolls [9]. Ruth asked her engineer Jack Ryan to redesign the image of the doll she brought back. In 1957, Mattel commissioned Kokusai Boeki Kaisha in Japan to seek manufacturers. On March 9, 1959, Barbie Doll was launched at the American International Toy Fair in New York. This was how Barbie Doll was born.

The first Barbie Doll that Mattel introduced to the market was blonde with a ponytail, dressed in a zebra-striped swimsuit (Fig. 2). After that, Ryan adopted 'planned obsolescence' to accelerate the adoption of Barbie Doll. With constant innovations and redesigns, the images of Barbie have been evolving. During the first year, Mattel sold 350,000 Barbie dolls, which was an impressive achievement. Up to date, approximately 100 million Barbie dolls had been sold in 150 countries worldwide [15]. Barbie doll is considered as one of the most important designs of the 20th century [9].

Fig. 1. Like a beautiful object, Lilli promises to please you [12]

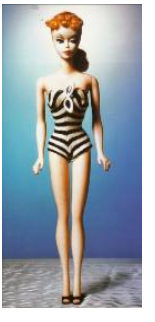

Fig. 2. First generation Barbie launched in 1959[9]

At first, Mattel manufactured Barbie dolls in the US and the UK. However, production was moved to developing countries because the wages in the US and the UK were too high. In 1967, Mattel established a joint venture with China General Plastics Corporation, who enjoyed government incentives in bonded warehousing. The new factory, Meining plant (originally one of China General Plastics Corporation) was located in Taishan Township, Taipei Country. This began the prosperity of Taishan Township in textile, production, and OEM businesses.

Taishan Township is located at the western tip of Taipei County. The township has a total area of 19.1928 square kilometers and a population of approximately 63,000 people. It is divided into 15 villages, with more than half of the residents being immigrants from other places. Taishan Township is a typical industrial town outside Taipei City. In 1978, the opening of highways and construction of the Wugu Interchange had a great impact to the town, where the economic activities had originally focused on agriculture. Transportation became easer and faster, and factories started to appear, including petrochemicals (Meining), textiles (Far East), and other sectors (e.g. Sanyo, Taifu Food). Nanya Plastics also expanded their capacity. The original farmlands were soon replaced with factories [14, 11].

In addition to Meining plant in Taiwan, Mattel also established factories in Korea, Japan, the Philippines, and Hong Kong. However, Taiwan was the first OEM factory set up by Mattel in South East Asia, as well as the largest one in the world at that time.

There were only 30 employees at the beginning. The facilities expanded quickly, and soon the second factory (in Touchen), the third factory (in Bali), and the fourth factory (in Pingchen) were established. Soon there were over 3,000 employees. According to some veterans, the number of formal employees and contractors of all four factories exceeded 8,000 people in 1983 [14].

At the beginning, Meining plant produced stuffed toys, and the main task was sewing. In 1969, with improved skills, the plant started to produce Barbie dolls and other toys for Mattel. The production consisted of head-making, spraying, hair planting, molding (hands, legs and accessories), clothes cutting, sewing, and assembly. The production lines were run in three shifts around the clock (Fig.3). Some tasks were outsourced, such as sewing, spraying, hair planting and combing, and plastic injection. Some employees of the Meining factory also set up small workshops with others, outside their regular jobs. There were over 30 contractors for plastic injection in Taishan. The production of accessories, such as bow ties, rings and socks, became an income source for community housewives who could work from home. In total, Meining plant produced an average of over 20,000 Barbie dolls each day, accounting for 50% of the world supply [3].

Meining plant drove the development of the local economy and provided a living for residents in Taishan Township. At that time, about one third of the local population was employed by the factory. The neighboring grocery stores and eateries formed a small business circle. The life histories of many Taishan villagers are intertwined with the Meining factory. Many women, nicknamed 'Miss Meining' (Fig. 4), left their hometowns and worked for a foreign company. They experienced the modernization of Taiwanese society as it moved from agriculture to industrialization. Meanwhile, the outsourced tasks of the Meining plant presented an opportunity for housewives to earn an income. For many local residents, migration, employment, romance, marriage, house purchases, and starting their own businesses were all related to the Meining plant.

Fig. 3. Female workers engaged in OEM operations at the Meining plant. (Picture taken by Chao-Ming Wu).

Fig. 4. The 'Miss Meining' women working at the Meining plant. (Picture taken by Chao-Ming Wu).

However, Mattel decided to switch the focus of production to South East Asia where labor was cheaper. In 1986, employees were made redundant; by 1987, production in Taiwan closed down completely. Many families suddenly lost their incomes, and the bustling streets of Taishan Township suddenly became quiet. Many former employees continued in the plastic injection business by starting up their own companies. Some of

them continued to produce hair for dolls. In 1988, former employees who had worked together for decades established the Meining Association to organize regular meetings [14]. Nowadays, Meining plant has faded into history.

2 Development of the Industry of Doll Culture in Taishan

The OEM factory established by Mattel, Meining Corp., had a profound impact on Taishan Township. The introduction of Barbie doll allowed the town people to experience modernization and enhance their own sense of identity. It even transcended time and place, and became internalized as part of the memory and culture in Taishan [14]. Ten years after the closure of the Meining plant, Taishan Township found a new opportunity in its past. When the central government promoted 'community building', also known as "community empowering" in Taiwan, in the 1990s, Taishan Township decided to focus on the development of the industry of doll culture, attempting to recreate a hometown for the Barbie Doll. In 1998, the new town mayor, Guo-shu Li, began the policy of community building by highlighting cultural characteristics in order to enhance the quality of life and the environment for local residents.

Starting on August 16, 2003, the Taishan Township Office began introducing talented people in fashion and craftsmanship, and organized workshops to educate local residents. Such efforts included a Doll Costume Design Camp and the Doll Creativity Workshop – Training of Seed Teachers, to train talented residents to make doll costumes [11]. On April 24, 2004, Tai Shan Doll Museum opened. This project was initiated by Guo-shu Li and supported by the Council for Cultural Affairs. The museum displays a variety of documents and artifacts, as well as doll costumes of all kinds. Examples are different models of the Barbie Doll manufactured by the Meining plant, machine tools operated by workers, pictures of factory dinners and costume designed and sewed by seed teachers. The collection allows tourists to learn more about Taishan Township. It has also laid down a solid foundation for the development of local industries. The Community Building Association and local residents established the Community Industry Co-operative on December 21, 2005, as the main body for promoting the industry of doll culture. Efforts were made to develop talent in the making of doll costumes, and to develop merchandize associated with Barbie Doll through working with shops and different industries. On January 21, 2006, the Taishan Township Community Cooperative of Taipei County was established to assume the liability of the Community Industry Co-operative. At this juncture, a concept to promote community building by reviving local industries has turned into a sustainable business model operated by a local cooperative.

However, with the completion of various initiatives in 2006, the resources from the government began to dry up. Tsui-E Ku, chairperson of the Learning Community Committee, organized the Learning Community Building Association of Taipei County by teaming up with professionals, experts, scholars, and educators, to pursue lifelong learning and community development. Nevertheless, with the step-down of Guo-shu Li and local political infighting, the promotion of the industry of doll culture came to an abrupt end, and the activities of the museum almost stopped.

With the support of Guo-shu, a former member of Taipei County Parliament, Meining Workshop was established in 2007, and an application for the patent of the

brand name "Meining" was filed as well [11]. The workshop continued to display doll costume designs and organize events. Community housewives with skills were recruited to give Barbie dolls a local look (Fig. 5). In 2008, the Multi-Employment Promotion Program initiated by the Executive Yuan to curb rising unemployment rates provided a timely budget to the workshop. During the same year, the workshop organized the Doll Festival (Fig. 6), allowing community residents to continue their efforts in making Taishan the hometown for Barbie dolls.

Fig. 5. The new face of Barbie dolls, designed and tailored by community housewives

Fig. 6. Community housewives preparing for Doll Festival in the Meining Workshop

3 Issues Arising from Producing Barbie Dolls

The community of Taishan Township integrated external and local resources in order to walk out of the misery resultant from the departure of global capital. Meining Workshop created its own local industry with the concerted effort of the community. All these are issues worthy of examination from the theoretical perspectives of economic geography and gender studies.

Firstly, how did Taishan Township establish competitive advantages and became the production hub of Barbie dolls in the structure of globalized production? How it could maintain the development of the local economy after the departure of Mattel is a practical and imperative question. Secondly, the OEM production of Barbie dolls is a labor-intensive and low-value-added industry. Could Meining Workshop introduce creative designs and break through from the technology and locked-in knowledge of traditional industries?

Finally, the Barbie Doll is often referred to as a stereotype due to its overly perfect body and sweet looks. More often than not, Barbie Doll is the subject of criticism in gender studies. Can the women in Taishan Township dedicated to the industry of doll culture break through the limitations imposed to women and voice out their opinions in the public domain, free from the boundary of private domains? Can they realize women's empowerment in this process?

Based on the above, this paper set out to examine the following issues surrounding the industrial development in Taishan Township.

1) The keys to innovations and industry upgrades from the perspective of economic geography in the development of industries in Taiwan and the international division of labor under globalization;

2)The cultural and creative industries as a competitive advantage from the perspective of community building;
3)The potential for women's empowerment from the perspective of gender studies in the context of community development.

This paper reviewed literature and relevant studies, and examined the theoretic implications of the industry of doll culture in Taishan Township.

4 Theoretic Implications

4.1 Opportunities for Local Industries under Globalization

After the Second World War, globalization began driving the global economy. The US and Western Europe controlled industrial production [2]. Capitalism drove economic development and structured them into the New Economy in the 1990s. The characteristics of the New Economy are information, networks, and globalization [10]. The dominance of the US and Europe in the global economy pulled the marginal countries into the production chain they controlled. This production pattern is generally called a Global Commodity Chains (GCC) in sociology and economic geography [7].

Based on the nature of industries, Gereffi divided commodity chains into producer-driven commodity chains- product R&D driven by international brands, and buyer-driven commodity chains- the whole production chains controlled by large distributors and wholesalers [7]. Gereffi indicated that buyer-driven commodity chains are mainly for labor-intensive and low-value-added industries and consumer products, such as ready-made garments and toys. Taishan Township was such an example. Generally speaking, the industrial development of Taiwan after the Second World War was the establishment of buyer-driven commodity chains in the new structure of the international division of labor.

However, Dicken et al. indicated that it is necessary to develop sensible analysis structures and conceptual classifications in order to understand international economies. The analysis structure of GCC cannot tackle the power and interactions of individual entities in detail [6]. Therefore, Coe et al. developed the analysis structure of global production networks (GPN), to more effectively analyze the intricacies of the interactions between members of global industries [5].

The concept of networks helps to understand the strategic alliances of individual production units and local goods/resources within a single region. These complicated interactions are critical to the analysis of local developments [5]. The development of local economies hinges on three essential elements, global production networks, local assets (including hardware and software), and local institutions (including governments and private sectors). This analysis structure can deal with the possibilities of local industry upgrades in greater granularity [5].

The OEM manufacturing of Barbie dolls in Taishan Township was in such an inflection point as it identified the next opportunity after the exit of foreign capital. Meanwhile, an analysis of the doll and creative industry of Taishan Township cannot ignore the impact of globalization on local industries. It should also deal with local production networks, hardware, and software, and the intricacy of interactions between

public and private sectors. The establishment of Meining Workshop is an example of product innovations and local industry developments. It is the fruit of efforts from the government and community building in pulling together people, assets and resources.

4.2 Revival of Local Industries — Cultural & Creative Industry

In 1991, the Taiwan provincial government invited Professor Miyazaki Kiyoshi, from Chiba University, to instruct the methods used to revive communities with traditional arts and craftsmanship. The model of combining the development of traditional arts and tourism was incorporated into the community building, which was a policy developed by the Council for Cultural Affairs in 1994.

Sharon Zukin made a further analysis on how cultural resources can enhance urban development [16]. With the disappearance of manufacturing industries and the emergence of fiscal austerity, cultures have become an industry. Cultural consumption and cultural industries, offering a variety of tokens and spaces, have become the source of a symbolic economy in cities. Companies were replaced by artists, and the economic activities of companies shifted to the manufacturing and selling of creative products, such as entertainment. The emergence of the symbolic economy enhanced the development of cities and towns, and created a large number of laborers. It also changed the thoughts of consumers and employees.

Allen J. Scott proposed similar ideas based on his observation of culture industries [13]. In a society of advanced capitalism, changes of production models and niche markets evolve rapidly. As a result, a post-Fordism culture economy has emerged. It includes the aestheticization and semioticization of commodities. Manufacturers have to pursue and market product differentiation to highlight cultural characteristics, in order to survive the fierce competition. In the culture industries, the elements of fashion, trends, and types force producers to seek product differentiation and flexible specialization. Cultural economies are inconsistent in certain aspects. Different departments represent the variances in technology, transactions, employment, and products. Also, the outputs of cultural industries are highly sensitive to product specifications and the cultural contents of local areas. In other words, they are subject to the influence of emotions and local images. Companies should use this characteristic as a competitive advantage.

According to the above analysis, it is necessary for cultural industries to take into consideration the current status of modern society in order to utilize local advantages, and appropriate technologies and local job markets, with the purpose of expressing cultural characteristics and variances. For example, Taishan Township reconstructed the collective memories of community residents by designing and making doll costumes. They established the community production entity to fight against the experience of being marginalized. This process is more than just a choice of product marketing strategies. Rather, it is the push and pull of the local space (where people live) and the fluid space (where capital accumulates) in the reality. It is an economic choice for the community industries, as well as a cultural choice made by individuals after the disembedding of the dialects between globalization and localization [8].

4.3 Fluid Gender Implications in Global Commodity Chains — Barbie Doll and Women's Empowerment in Taishan Township

The Barbie Doll carries strong gender implications. Barbie dolls symbolize a paradoxical female role. Her perfect body and independence are a learning model for girls. The US gives high ratings to Barbie's happiness and self-achievement [1]. But, the focus on good looks can be taken for the objectification of women. Barbie's sweet image is considered a great female example. It restricts the possibility of females challenging the patriarchal system. Besides, its production process is also an embodiment of the typical gender division of labor. In the Meining plant, the production procedures consisted of several tasks. Male workers operated machines to shape out the bodies and limbs, whereas female workers were responsible for cutting, sewing, hair planning, accessories, assemblies, and box-loading, which were tasks not requiring the operation of machines [14]. It was a gender division of labor, dictating that females were responsible for assemblies (Fig. 7) and males were engaged in technical tasks. This gender division of labor underrated the significance and importance of assembly tasks handled by females.

Fig. 7. In the Meining plant (picture taken by Chao-Ming Wu), female workers were mainly responsible for assembly tasks, such as cutting, sewing and hair planting, and box loading, which did not require the operation of machines

Also, some Barbie Dolls were made by housewives working outside the plant. This mode of production was out of particular government policy. In 1974, the Taiwan Provincial Governor proposed the Implementation Guidelines for Home Workshops. In 1978, the Council for Economic Planning and Development published the Guidelines for Home Workshops in Communities. Such policies created many job opportunities in Taiwan, it also revealed that females contribute a certain percentage of household incomes [4]. Nevertheless, all these policies showed the gender division of labor, for example, breadwinner vs. homemaker. When industrial developments become part of the community building, this may turn around.

Meining Workshop was established by a group of housewives interested in sewing and costume making. Efforts were made to make Taishan Township the hometown of Barbie Doll with the set-up of a co-op by community building, partly supported by government subsidies. Under the guidance from industry and academics, the workshop focuses on the design of doll costumes and the revival of the local economy. Housewives participate in community development with a gentle touch. Community building emphasizes self-empowerment. It requires internal strength, rather than an external push. In this case study, self-empowerment means the women reflect upon their traditional roles by getting involved with community development and realize their self-empowerment in daily life and public domains.

As females at the Meining plant were subject to the gender conditioning in the Taiwanese society in the past, it is important nowadays to explore how the establishment of the industry of doll culture in Taishan Township as a creativity industry influenced women's empowerment. This is a key issue worthy of further study.

5 Conclusions and Follow-Up Studies

As a developing country rising from the ashes of the Second World War, Taiwan became engulfed into the globalization and international division of labor in the 1950s, and became an OEM powerhouse for companies in the US and Japan. However, the drastic political and economic changes after the 1980s took international capital out of Taiwan. Many scholars have examined the impact of globalization on local economies, but there are limited case studies on Taiwan. Meanwhile, there are few studies addressing the effects of the exodus of foreign capital on local economies; hence, this paper hoped to explore the intricate interactions of global capital and local industries from the perspective of a single community. This approach was in contrast with the grand theory that takes macro views. This paper hoped to enrich the theoretic structures with extensive empirical studies.

The competition for production and sales has been increasingly intensifying in the era of globalization. There have been many studies, both in Taiwan and overseas, examining community building and the creative industry; however, these papers have rarely investigated communities under the context of globalization. As a result, they are likely to neglect the potential effects of global economies on the communities in question. Hence, this paper hoped to address these issues from the perspective of the global economy in order to assist local communities in the understanding of the challenges and bring local creative industries in line with the trends in the global economies. Although local communities in Taiwan can no longer achieve economic development with cheap and abundant labor, they can seek their own niches in the global market with the utilization of cultural capital, product design and marketing, and initiatives in the creative industries.

Finally, there is extensive literature discussing the Barbie Doll, but most of the studies have analyzed the implications and meanings of Barbie as a consumption symbol in a western cultural context. The economic and cultural impacts of the manufacturing of this popular toy on developing countries were usually overlooked. Barbie dolls are often the subject of criticism from feminists in developed western countries. An interesting paradox is that many women in the developing countries achieved their economic autonomy and gender equality by participating in the production of Barbie dolls. It reversed their original disadvantage status in the society. Taiwan was once a global manufacturing hub; and the production of Barbie dolls had significant historical meanings to Taiwanese society at that time. Above all, to the people in Taishan Township, it is a part of their collective memory.

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Experience Design on m-Commerce in China — Digital Marketing Oriented Social Innovation Design

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Abstract. Mobile service has been a new economic growth point and provided development opportunities by the popularization of the mobile device. In this paper, we take marketing as a point to discuss the social innovation design in m-Commerce.

Keywords: service design, e-Commerce, m-Commerce.

1 Challenge and Opportunity

Internet is rapidly changing the world where we live, and a number of innovative services are developed, which bring more benefits and convenience to users. Among those applications, the development of e-Commerce meets the desire that users are able to purchase goods without leaving their home and open convenient way for the remote trans-regional commodity trading, so they have become the powerful weapons for competing in the market. With the simultaneous development of mobile Internet, e-Commerce also began to penetrate into the mobile platform, which is called Mobile Commerce(m-Commerce).

Because the mobile device can be portable, there is closer relationship between mobile services and the daily activities of people. In China, more and more people rely on mobile phone to contact each other. On January 19, 2010, data of " report on 2009-2010 China's mobile Internet market conditions and the behavior of Internet users " latest released by Ai media marketing consultation showed that, as of December 2009, the total number of Chinese mobile phone users had been more than 2 million. At the same time, a number of emerging mobile services are increasingly popular, such as mobile micro-Bo, Mobile SNS and mobile games. Some web services which are popular for desktop applications have begun to develop versions for mobile platforms. Meanwhile, China's business development in 3G will greatly improve the mobile network environment, and enhance the ability to the spread of multimedia contents, which attracts not only more and more users, but also provide the new stage for the diversified and personalized mobile services design.

In this area, challenges and opportunities exist side by side. As more and more people join in the mobile network, more and more functions are developed, and then smart mobile devices will become the ideal end of the marketing services. Services based on the mobile platform are also showing a great potential to become the focus of the most compelling competition of next-generation mobile devices.

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It is believed that although there are similarities between e-Commerce and m-Commerce because of the same origin, however, there is a big difference in practice. If just do some streamlining to services which are successful for the desktop applications, then migrate to mobile platforms, there will be this or that problems. In some senses, Mobile services are Unique and require not only to maintain the connection with the existing desktop applications and services, but also create and develop new interactive service models for the "mobile" and "changing" space. In this paper, we take marketing as a point to discuss the social innovation design in m-Commerce.

China's m-Commerce is still in its infancy, and studies focused more on business models and technological methods, but research on innovative approaches and related theory from the aspect of users' experience were relatively less.

Once the technical bottleneck is opened, experience design will become a key factor in m-Commerce. Mobile services innovative design which is experience-oriented, promotes concept of human-centered design, methods and forms of information interaction between persons, products and services and it optimize information environment to improve information services and provide innovative design solutions for users' good experience by studying the specific persons and their activities.

2 Basic Understandings on Designing for Digital Marketing in China

Because of the customers cannot "feel" the product directly, the marketing becomes very important and play an important role in m-Commerce. In digital marketing mode, the course is more interactive, and users are not passive acceptance of information, but directly involved in and have impact on the spread of marketing information. So there is a very popular idea named "permission marketing"[1] , that is, the communicate is under the condition of permission and choice of users, the new challenge is how to provide timely, appropriate, clear, effective and sustained dialogue without annoying or in the pleasant manner when people need. We believes that the digital marketing services platform should be committed to establish the good interaction with the consumers, to improve the quality of services, and it will also directly affect the users' satisfaction on the evaluation of marketing services from the aspects of the information exchange structures, innovative models, ease of use and interface design, etc.. Users' experiences in the process of interaction with marking platform have a significant effect on the brand identity and the establishment of continuous service relationship.

The core of services design in m-Commerce is how to shape good relations and interactive experience which arousing the sense of value identity among users. Compared with the desktop, mobile service design requires more attention on user's psychology and behaviors in the "mobile" and "changing" space. The "mobile" and "changing" space creates exceptional conditions for the mobile services, and also brings new opportunities for developments. It is believed in this paper that the

[1] Ad appeared in Elle (September 1994).

following two ways should be found as the innovative ways for the mobile digital marketing services:

First, time- space-based innovation service;
At present, GPS has been used widely, which makes time- space-based information interaction possible, and information management and dialogue can be connected with specific time and place to achieve fixed-point delivery, so that different people in different time can get personal information that is matched with the specific environment. There is seamless connection between reality and virtual world: for example, when getting the menu and bills in a restaurant, people can get the promotions from others in the same time. It indeed is a way of digital marketing, which is a time-space based innovation service.

Second, the integrated solutions;
Cross-platform or multi-platform is an important feature of design of mobile services, and the mobile devices will connect equipments, space and people through a variety of ways. Net of things allows mobile devices to establish contact with surrounding service equipments, for example, mobile phone can dialogue with the self-charging devices in the parking lot to achieve timing and automatic payment features. The mobile service in the future is no longer limited to a single platform, and multi-platform integration solution will be the main direction of development.

Mobile service design innovation should take full advantage of these feathers and explore them to create many new types of digital marketing which establish a close interaction between the users and the marketing services to rich people's life experience.

3 Case Study : Smart Taste Commentator

3.1 Introduction

In China, with the improvement of income of urban residents and the lives, the number of people eating out is gradually increasing. An online survey in 2006 showed that among all the 6148 respondents, 29.6% of the respondents were very like eating out, 40.7% of the respondents were a bit like eating out; another online survey in 2010 also appeared the similar to the results of the survey in 2006, and students with 20-40 years of age and office workers are the majority of the respondents.[2]

China's "food culture" has a long history, and there are eight major cuisines and a wide variety of food. Food is widely believed to be a way to enjoy life, and with the quickening pace of life, the family of young Chinese white-collar workers does not want to spend time cooking at home, and often choose to eat out, especially those who like to go out shopping, dating and entertainment. Usually, they will concern about place, food taste, price, environment and services. So programs and website that introduce a number of well-known restaurants, dishes and prices are very popular, and sometimes these services will send discount coupons. These contents of recommended foods are mostly from consumers rather than businesses, which are more persuasive and attract a lot of young man who love "eat".

[2] http://www.searchina.net.cn/report/art/report229.htm

In 2009, we worked with Nokia (China) Research Center and UI sector of the Finland headquarters of Nokia to conduct two workshops to design mobile services, and combined with some of the results of individual studies, ideas, methods and design principles, In those workshops, mobile services innovative design will be discussed from the aspects of users' experience and interaction design to provide valuable experience and references for China Mobile services design. One of the design team believe mobile services that offers "gourmet" should be a design opportunity, and the young white-collar workers may be the service's target audience, because they like making friends, entertainment, the pursuit of enjoyment, and with higher income. The key is that they like to try a variety of fresh food, and the focus of research is under which contexts people need such services, and which manner can be adopted to help the people in need through this service, we also try to find how to build the interaction model that agrees with daily activities, and how to make the process of "gourmet" hunting bring people the rich experiences.

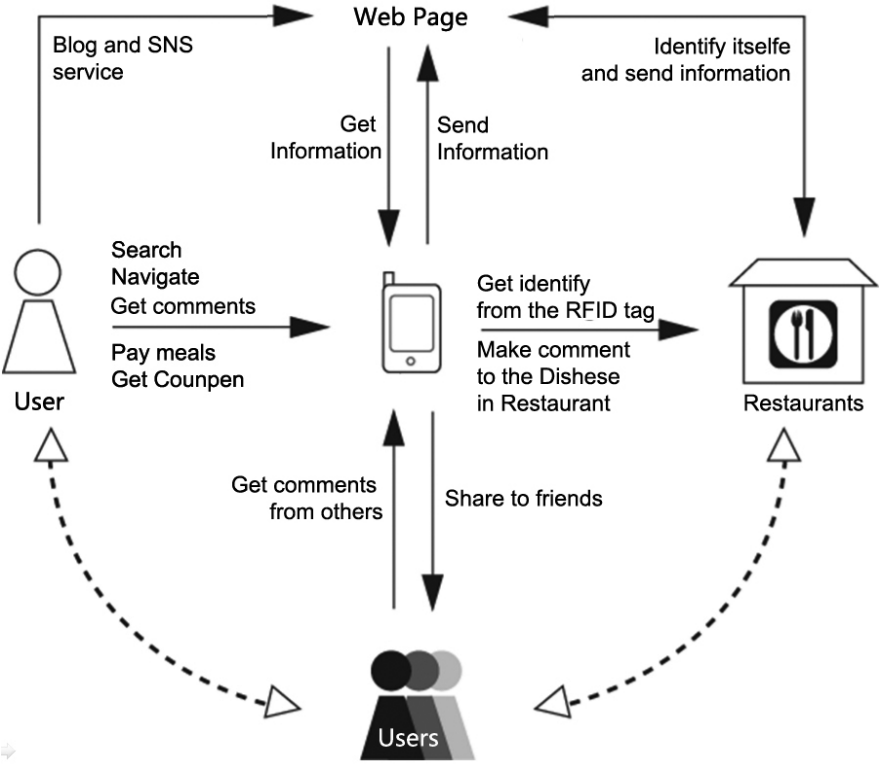
3.2 Design Concept

The concept named "Smart taste Commentator" whose user group will be young white collar, especially those who like to eat out. It is an idea brought forward in a project which is cooperated by Nokia and Information art and design department, Tsinghua University. It aims to build a public Food & Dining comments\service platform, and is enlightened by the service of a website called "dazongdianping" in China. It provides a platform for recommending, finding, sharing and critiquing of restaurant and food area by mobile service. The following is a description of the design ideas.

Goals:

- Share: Share information easily and quickly (share information not only by the SNS website\ share the definite information from the definite group\gain some benefits when share information)
- Integrated : Integrated easily among the mobile phone、the RFID tag and personal computers
- Communication friendly: One can easily read other's comments of the food before eating and also can add comments after eating
- Portable: The service based on mobile phone, It can be used everywhere
- Entertainment : Read and view other's words to have fun.
- Security : Each mobile phone has its own account, pay for the meal is safety
- Brand preference: Communicating by RFID, mobile and web.

Interaction Model:
The demo showed how to communicate by mobile service. As Fig. 1 has shown, users can get information of near restaurant through GPRS, and they can scan RFID of the menu by mobile phone to find the food which has good comments when arrived. After meal, they can input their comments by mobile phone or share with friends by internet to get credits, certain credits can exchange coupons, users can also pay bills by mobile phone directly. Fig. 2 has shown the information architecture of the service. This architecture was designed after context analysis and task analysis, and has been revised many times after tests.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Share to friends
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Fig. 1.

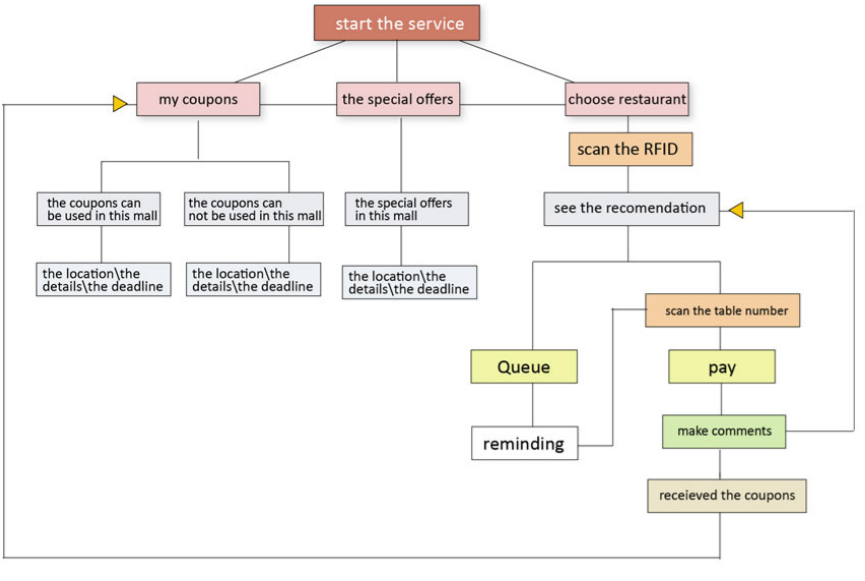
start the service
my coupons
the special offers
choose restaurant
scan the RFID
the coupons can be used in this mall
the coupons can not be used in this mall
the special offers in this mall
see the recomendation
the location\the details\the deadline
the location\the details\the deadline
the location\the details\the deadline
scan the table number
Queue
pay
reminding
make comments
receieved the coupons

Fig. 2.

Interface Design:
In the first period of interface design, the frame of interface was made to give test, in the frame, the layout and basic contents were set, when testing, students followed and recorded user to find how they interact with the service, the survey and interview was executed at the same time. They revised the design after analyzed the feedback and make some revisions, and then the final interface design, as Fig. 3 shown.

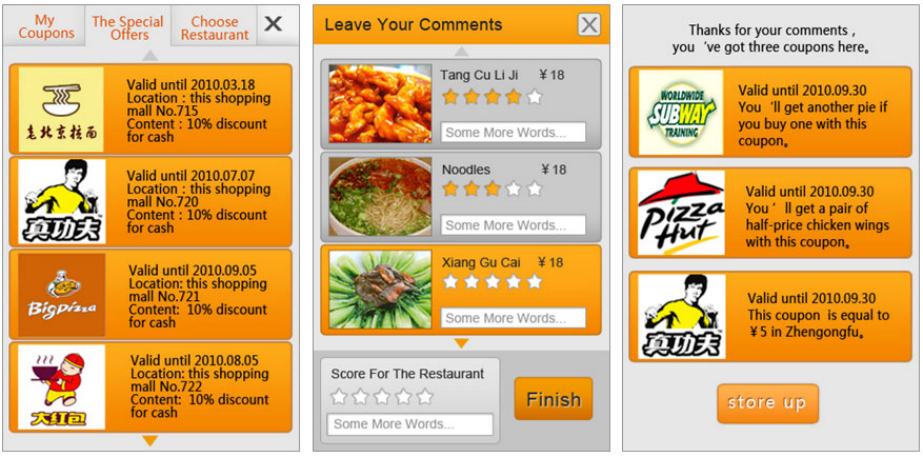

Fig. 3.

3.3 Design Method

Why do people choose A but give up B? The reason is that A brings better experience than B. For the value of the experience, Cagan once brilliantly pointed out that if the product want to be successful, it must have the functional characteristics and forms of "useful, easy to use and want to have " that should be identified quickly by consumers. What consumers are looking for is the product that can reflect their own values and quality and enrich their lives [3]. Broadly speaking, mobile services are also products, but this "product" is soft. The marketing services need to create a meaningful and pleasant living experience for users, and on this basis, to create some possible marketing opportunities, and establish brand value and identity of the value of marketing services.

Based on the above philosophy, we believe that innovative of services design should be built on the basis of deep understanding of target groups' life, and the designers need to first put themselves for the sake of users, and then the innovative design. Design research is the premise of innovative design. The aim is to discover design opportunities, determine the design goals, and propose specific requirements of innovative design, and propose design criteria to guide the creative design process.

[3] Jonathan Cagan, Craig M. Vogel, "Creating breakthrough products: innovation from product planning to program approval", Published by Pearson Education, Inc, publishing as Financial Times Prentice Hall.

As mobile services are emerging application areas, not much successful experience can be referred to. In order to discover new opportunities, we surveyed and analyze marketing services that are more popular in China now, extracted a wealth of information, and condensed guiding basic design elements and also extracted some key words that can bring unexpected surprises and freshness to people, such as in the form of simplicity, entertainment, pleasure, interesting and new contacts, natural interface, convenient, smart, polite, open, sharing, mobile, integrated, personalized, custom, communication, auto-complete, change, and other forms. These elements are extracted out from investigation of the hundreds of popular cases in China, and these key words became the basis for generating new concepts. Fig.4 shows the evaluation and analysis on China storm music player interface.

Fig. 4.

At the stage of the detailed design, the activity-oriented approach is adopted, and role-based scenario analysis is carried out, the activities law of role is reviewed and summarized, and the service design and the context where the role is are contrasted and fitted, we mentioned what will be the meaningful things for the target users through our research, then we discussed the concepts and conclude our design goal. Innovative design solutions were proposed based on the goal, user testing is conducted in real-life situation and interface design detail was revised many times, in order to make the design ease to use.

Activity-centered approach was proposed by the Norman, it can help designers better understand and grasp the psychology and behavior of uses in mobile and changing space, and it provide the research ideas to understand system relationship between people and things, human and material, time and space, behavior and meaning. To better understand the target group's activities, we took the field observation, interviews, personal experience and so on, kept records of observations and thoughts, these data were organized by scenario and use stories.

In above cases, the designers have analyzed the design trends through the survey of web service, they got clear objective and choose to start from the comments of restaurant, considering the feature of mobile service, integrated RFID, mobile and web service, brought forward valuable creative solution. This solution is not a simple copy of Web Marketing Models, but a kind of B2C, if according to the classification of e-Business. There is a point, consumers can give and share the comments, in other words, the “ads” is controlled by consumers. For the consumers, “real” information will be attained; For the merchant, good service will be spread, meanwhile, potential consumers can be attracted through the located based service. It is a double win. However, in the project, the interface design still needs new design, and more entertainment should be considered.

4 Conclusion

China digital marketing services platform can be divided into the following items, first, the network retail which takes place between the consumers, that is C2C (Consumer to Consumer); such as Taobao, eBay, market network, mainly for individual transactions, and it allows Internet transactions of unused items; second, direct selling, namely, B2C (Business to Consumer), suppliers directly provide marketing services to consumers, such as Dangdang, Dell computer sales website, which are direct marketing services established that use the network platform for individuals or groups. Due to the removal of the intermediate links of sale, direct marketing services have certain favorable price; third, relatively new way of group buying, that is C2B (Consumer to Business), a group of consumers are assembled to buy the products to achieve volume sales of the product at discounted prices. Group buying is usually initiated by the consumer, but also sponsored by the merchants. For example, buy 58 group buying networks, which substantially lowers prices to attract consumers through the increasing volume; fourth, trade services between enterprises, that is B2B (Business to Business), such as Alibaba, which is the large trading platform for enterprises[4].

The first three modes are mainly discussed in this paper. The first three service models are directly to consumers, and there are certain similarities for them, and each model has its own advantages. In fact, some services platform is a combination of multiple modes. For instance, Taobao also provides group buying services (C2B), Dangdang also pushed C2C business recently, which allows customers to sell unused books online. After the investigation and analysis of the above different methods of network marketing, combined with the characteristics of mobile services, we review and summarize the basic advantages that the best mobile marketing services should have,

1. Personalized content services

If C2C or C2B the network services attract visitors due to its extensive product information and related contents, the mobile platform need more personalized and more targeted contents because of the restrictions of the small screen, which allows users for active choice or customization in accordance with the user's preferences. The rich contents should be cleverly hidden in the simple interface, and location-based services can be introduced (Location Based Service) and the corresponding content can be pushed based on the users.

2. The reasonable, improved and efficient service process

Good marketing services should provide the complete process for consumers including access to services information, consultation and purchase. The information exchange structure agrees with activities habits of people in daily life with simple and quick steps and high efficient services.

3. Democratization

Even for the brands that have a strong influence in traditional markets, they may also be consigned to limbo in online world. There is even more democratization in the

[4] http://baike.baidu.com/view/298840.html

online world. Although there is still the market for the leading brands, people seems to believe the public comments, and the democratic service environment is more favored by the people.

4. Ease of use

Ease of use is the basic element for good experience, which is reflected by reasonable information structure and the interface design with clear layout and accurate information. Donald. A Norman summarized the four usability principles of good design in his book "The Design of Everyday Things"[5], namely: visibility, the correct concept model, the correct match and feedback; after years of tests, these four principles have broad applicability. For interface design, the violation of these design principles may lead to no utilization of the interface.

5. Offers and promotions

Offers and promotions are often the most powerful trump card for e-Commerce, which also is contributed to one of the elements that prompts people to purchase. Proper use of incentives and promotions can attract customers, and build good relationships. For example, now accumulate points which have emerged, etc., are conducive to maintaining customer relationships.

6. Safety

Because of the presence of network viruses and hackers, there is a certain security risks based internet payment. The network security is critical for the interests of the two parties of the transaction, and a variety of measures can be taken to increase the security of mobile devices termites payments, such as password, fingerprint identification and handwritten signatures.

7. Entertainment

Entertainment is a part of life, it can improve people's emotion and release one's pressure especially in the modern society. Entertainment based on reality world can bring lots of different new experience which will be popular among mobile device. It can work well in mobile time and mobile space, people can have some fun to killing time during walking, driving, riding by bike and riding by bus, etc. In the above case, we can add some entertainment element such as "finding hidden treasures game", user can find some accident pleasantly surprised present which could be a discount card or a tickets for changing a real gift, when they go out, the gift appeared according to their location in a special time in real world, it can be a good guide to digital-marketing and also a health way in life.

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Cross-Cultural Study on Shop-Floor Control System

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Abstract. This study investigates the impact of cultural difference between China and Germany on the system design and implementation of Shop-Floor Control (SFC) system. The study aims to explore the following research questions: (a) how cultural differences influence users' requirements on SFC functions; (b) what kind of user interface design should be adapted for users from different cultures; and (c) how to implement SFC system in the shop-floor management in different cultures. 10 Chinese users and 5 German users from 4 Sino-German joint ventures were interviewed in the study. Based on the interview results, 24 cultural related key findings were concluded. We discussed the implications and provided 5 design and implementation recommendations for SFC system.

Keywords: Cross-cultural study, Shop-Floor Control System, User study.

1 Introduction

Under the pressure of reducing production cost, improving quality, and responding to variable market demands, industry worldwide is rapidly adopting advanced production method like Lean Production from Toyota. Advanced production requires more than rational improvement of the production process, it also requires coordinating the production activities on the shop-floor, and tracking the system status to streamline the production.

Shop-floor control (SFC) system is one of crucial parts in contemporary advanced production. The responsibilities of SFC primarily involve job scheduling, progress monitoring, status reporting, and corrective actions [1]. The appropriate design and implementation of SFC system will benefit companies with increasing productivity, smoothing production execution and transparentizing order tracking and tracing. The success of SFC system requires comprehensive manufacturing integration of both information and people.

Previous studies indicated that users' attitudes of information system and communication technology vary across cultures. For example, Ho et al. [2] found that Group Decision Support System (GDSS) was not as well accepted in Asian country as in the United States because of different attitudes toward the appropriateness of conflict expression. In addition, the results of Leidner et al. [3] and Choe [4] confirmed the notion that users from different cultures have different requirements on information system, and therefore, information system design should be adapted for users from different cultures.

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Understanding cultural differences impact on information system is indispensible, especially for the designing and implementing in different countries. However, there is no study examining the impact of cultural differences on SFC system until now. The distinguish characteristic of SFC from other information system is that most of SFC users are blue-collar employees such as shop-floor workers or supervisors. They keep their original culture more stable than white-collar employees. Thus, the cultural effects are more significant for SFC than other high level information system, for instance Enterprise Resource Planning (ERP) system. It can be predicted that the good design and implementation with the consideration of culture will definitely increase the effectiveness and efficiency of SFC system.

In this study, we aim to investigate the impact of cultural difference on the functional requirements, user interface design, and implementation of SFC system in China and Germany. The findings of this study will provide insights for international companies on designing and implementation effective SFC system in China. Based on the interview results, recommendations on design and implementation of SFC system will be provided to researchers and practitioners.

In the remainder of this paper, we first reviewed literatures on culture and its impact on information system. Then, we presented the methodology of this study. In-depth interview was conducted to collect users' attitudes and requirements on SFC system. After that, we discussed and concluded the interview results. We ended by providing recommendations for SFC system design and implementation.

2 Background Literature

2.1 Culture and Cultural Dimensions

Culture is a complex and multi-dimensional concept. Hofstede [5] defines culture as "the collective programming of the mind which distinguishes the members of one group from people from another". Culture reflects itself not only to the visible aspects of a group, but also to a wider range of intangible aspects including thoughts, values, and behaviors.

In order to create a basis for cross cultural information system design, we must clearly identify key factors that differentiate cultures from one another. Thus, we need a robust conceptual framework to measure cultural differences. The widely considered cultural dimension from Hofstede [5,6] was adopted in this study. Hofstede proposed five cultural dimensions: Individualism-Collectivism, Power Distance, Masculinity, Uncertainty Avoidance, and Long-Term Orientation. In this study, we want to explore the cultural difference between China and Germany. According to the measurements, China and Germany has large cultural differences in the dimension of Individualism-Collectivism, Power Distance, Uncertainty Avoidance, and Long-Term Orientation. Thus, only these four cultural dimensions will be investigated in this study. Figure 1 shows the value of China and Germany for the four cultural dimensions described above. Compared with Germany, China's culture is reflected at high power distance, collectivistic, low uncertainty avoidance, and long-term orientation. An explanation of these dimensions follows.

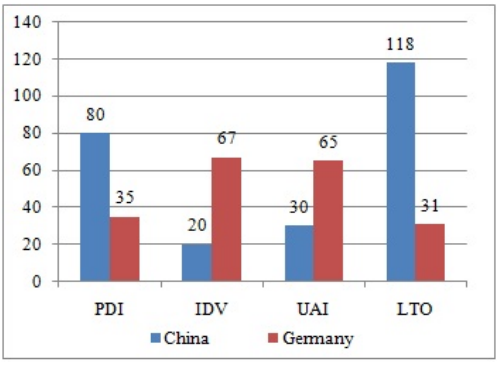

Fig. 1. Cultural dimensions of China and Germany [7]

- Power Distance (PDI)

Power distance is defined as "the extent to which the less powerful members of institutions and organizations accept that power is distributed unequally". High Power Distance society, like China, indicates that inequalities of power and wealth are expected and desired. Low Power Distance society, like Germany, in contrast indicates the society de-emphasizes the differences between citizen's power and wealth. In these societies equality and opportunity for everyone is stressed and employees expect to be included in decisions.

- Individualism – Collectivism (IDV)

Hofstede describes Individualism as "a situation in which people are supposed to look after themselves and their immediate family only", whereas its opposite pole, Collectivism, is defined as "a situation in which people belong to in-groups or collectivities which are supposed to look after them in exchange for loyalty". This dimension describes the degree the society supports individual or collective achievement and interpersonal relationships. Individualistic cultures, like Germany, indicate that individuality and individual rights are prior values of society. Individuals in these societies tend to form a larger number of looser relationships. People in Collectivistic cultures, like Chinese, tend to think in terms of groups or other collectives they are integrated in and feel responsible for.

- Uncertainty Avoidance (UAI)

Uncertainty Avoidance is defined as "the extent to which people feel threatened by ambiguous situations, and have created beliefs and institutions that try to avoid these". Members of high Uncertainty Avoidance cultures, like Germans, tend to feel threatened by uncertain and unfamiliar situations. Precision, punctuality and a repression of deviating thoughts are characteristics for people of high Uncertainty Avoidance cultures. In contrast, people in low Uncertainty Avoidance cultures, like Chinese, are more tolerant towards variety of opinions. Their societies are less rule-oriented, more readily accept changes, and takes more and greater risks.

- Long-Term Orientation versus Short-Term Orientation (LTO)

This dimension explains "the extent to which a society exhibits a pragmatic future oriented perspective rather than a conventional historic or short-term point of view". In countries with a long-term orientation, people are patient and easily accept changes. Cultures scoring low on this dimension are conventional and traditional, and concern for stability. Most Asian countries can be characterized by Long-Term Orientation while most of the western countries are more Short-Term Oriented.

2.2 Cognitive Differences across Cultures

Cultural differences are embodied in people's mind. It is not only reflected in the values and attitudes as described by Hofstede's cultural dimensions, but also reflected in different cognitive styles.

Cross-cultural studies suggested that individuals who live in different societies fostered by different cultures may have different thinking styles that shape their cognitive processes in different ways [8,9]. According to Nisbett, westerners tend to be analytical-logical in reasoning style, while easterners tend to be holistic-dialectical. Westerners focus on objects, attributes and categories, while Easterners focus on the field surroundings and relationship between objects.

Chiu [10] found that Chinese prefer to categorize information on the basis of interdependence and relationship, whereas Americans prefer to analyze the components and to infer common features when organizing information. In addition, Chinese tend to focus on thematic attributes and thematic interface structure was advantageous to Chinese users, whereas Americans tend to focus on functional attributes [11,12].

2.3 Culture and Information System Design

Understanding of culture is important to the study of information technology and information system design. Culture can influence the successful implementation and use of information technology in the company.

Harrison and McKinnon [13] reviewed the cross-cultural research published during 1990s for management control systems design. Their review identified four major weaknesses for previous research. More recently, Leidner and Kayworth [14] reviewed the critical role of culture in information systems research. They developed a theory of IT, values, and conflict. They further developed propositions concerning three types of cultural conflict and the results of these conflicts.

Leidner, Carlsson, and Elam [3] performed a cross-cultural study on the Executive Information System (EIS). They surveyed EIS users in Sweden and United States. Their findings suggested that U.S. executives use EIS primarily for monitoring and achieving benefits of problem identification speed and decision making speed, whereas Swedish executives use EIS primarily for analysis and evaluation and to achieve benefits of a more thorough, analytic decision process.

Choe [4] empirically examined cultural differences in the amount of information provided by management accounting information systems (MAIS). They collected data from samples of Australian and Korean firms. Their results found that Korean firms provided much more flexibility performance information, whereas Australian

firms provided more quality performance and traditional cost control information. They concluded that with a high level of advanced manufacturing technology, information should be provided adapted for different cultures.

3 Methodology

Based on the literatures reviews, cultural differences on values, attitudes, and cognitive style exist among users from different countries. However, these differences were theoretical based and until now there has no study empirically examining the effect of cultural differences on SFC system design and implementation.

In this study, we aim to study the cultural difference between China and Germany on using the SFC system. Three research questions were raised: (a) how cultural differences influence users' functional requirements on SFC system; (b) what kind of user interface designs should be adapted for users from different cultures; and (c) how to implement SFC system to the shop-floor management in different cultures.

In-depth interviews were conducted to collect user's attitudes, opinions and their requirements on SFC system. The objective of the interview was to discover the cultural factors which affect the design and implementation of SFC system, and to provide recommendations for cross-cultural SFC system.

Ten Chinese and five Germans working at four Sino-German joint-ventures were interviewed. In order to obtain a broad view for the use and implementation of SFC system, shop-floor workers, managers, and CEO/CFOs were recruited in the interview. Table 1 shows the job position for all interviewees. Table 2 shows the education background of all interviewees. The interviews were conducted at the office or at the shop-floor, and it lasted about one hour.

The interview was semi-structured. Three categories of questions were asked during the interview. The first part was functional requirements of SFC system. This part asked about interviewee's requirements on SFC system's functions. Sample questions were "what function do you expect for SFC system", "what operation reports are required for managers and how will you use these reports", "do you have any difficulty in using SFC system", etc. The second part was user interface of SFC system. This part asked about interviewee's requirements on how to present information on the interface. Sample questions were "which way to present information do you like, by number or by chart", "do you like the current categorization of information", etc. The third part was SFC system implementation. This part asked about interviewee's opinion on how to implement SFC system in the factory. Sample questions were "do you have any problem when the system is used in shop floor", "how users are trained to use the system", etc.

Table 1. Job position of inerviewees

Position	Chinese	German
CEO/CFO	2	2
Manager	2	2
Shop-floor worker	6	1

Table 2. Education background of interviewees

Education	Chinese	German
Master or above	1	3
Bachelor	7	1
Polytechnic school	2	1

4 Results

The transcripts from interviews were broken down by three categories: functional requirements, user interface design, and implementation of SFC system. Interviewees' attitudes, opinions and requirements were extracted. We summarized cultural-related key findings in Table 3, Table 4, and Table 5 below. Nationality CN represents Chinese users, while DE represents German users. For each finding, the cultural reason behind was listed, which include Hofstede's cultural dimensions LTO, UAI, PDI, IDV, and cognitive style (COG).

Table 3 lists 11 key findings on SFC system functional requirements. It can be found that Chinese and German users have different requirements on system flexibility, data generation, authority, and performance measurement provided in the system.

Table 3. List of key findings on SFC system functional requirement

No.	List of key findings	Nationality	Culture
1	SFC system should be **flexible for future extension** and function modification according to changing unpredictable requirement change.	CN	LTO
2	SFC system should be able to manage **most of current** shop-floor issues.	DE	LTO
3	Information or reports from IT system could be inaccurate, users can **manually modification afterwards**.	CN	UAI
4	Data from IT system should be **accurate**, the generated reports are trustful.	DE	UAI
5	The SFC system should be able to **integrate with other system** like ERP, the standard SFC solution is the best choice.	DE	UAI
6	The business process is better **not limited** by the system.	CN	UAI
7	The real business process should **obey the pre-defined** one in the SFC system.	DE	UAI
8	Managers should have **more authority** to access the system than workers.	CN	PDI
9	The access authority of system should **be alien with** the responsibility of owner.	DE	PDI
10	The performance Key Performance Index (KPI) report generated by system should classified by **work center group**.	CN	IDV
11	**Individual** workers' performance should be measured in SFC system.	DE	IDV

Table 4 lists 4 key findings on user's requirements for SFC system user interface design. The requirement differences can be well explained by different cognitive styles of Chinese and German users. The Chinese cognitive style is more holistic; whereas the German's cognitive style is more analytic. German users focus on what an object "does", thus, they prefer to organize information by functionality. For Chinese users, they focus on relations and therefore they prefer to organize information by thematic groups.

Table 5 lists 9 key findings on SFC system implementation. It can be found that Chinese and Germans have quite different way of implementing the system. The implementation differences can be explained by different level of power distance and different cognitive style between Chinese and Germans.

Table 4. List of key findings on SFC system user interface design

No.	List of key findings	Nationality	Culture
12	User interface should be **fascinating**.	CN	COG
13	User interface for workers should be as **simple** as possible.	DE	COG
14	System navigation should be classified by **department or by user groups**.	CN	COG
15	System navigation should be classified by **functionality**.	DE	COG

Table 5. List of key findings on SFC system implementation

No.	List of key findings	Nationality	Culture
16	**Learning by doing** is the best approach to understand the system for users. Most users never read user manual.	CN	COG
17	**User Manua**l and other documents are very necessary for implementation.	DE	COG
18	Successful implementation of SFC requires driving force **from top level** most.	CN	PDI
19	**End users**' understanding is the most important factor for successful implementation.	DE	COG
20	Users may submit fake data to **avoid being blamed** by manager.	CN	PDI
21	Users are not willing to **ask for help** from manager when problem occurs.	CN	PDI
22	Users seldom report system bug **to manager**, for it not really affects their task.	CN	PDI
23	Before SFC system, the manager also maintains shop-floor information by **visualization tool** like KANBAN or Excel data, most of which are redundant copy.	CN	COG
24	Before SFC system, **self-developed IT tool** is used to fulfill the requirement of shop-floor management.	DE	COG

5 Discussion

Based on the 24 key findings from the interview, 5 recommendations regarding SFC system design and implementation are provided as following.

1. ***SFC system needs flexibility but does not need to upgrade frequently.*** Chinese tend to have an unstructured approach in the work and they have higher expectation on system flexibility, whereas Germans are more structured and tend to have difficulties with changes to the rules and procedures. Considering the cultural difference, SFC system developer could use the develop technology like Service-Oriented Architecture to keep the extension flexibility, and built-in configurable workflow application can define and modify business process in the system. However, the upgrade frequency should be controlled to avoid uncertainty of change.
2. ***SFC system measure performance of group or individual.*** As Chinese workers are more collectivism, the KPI measurement on group will be more appropriate for them to form effective team. Meanwhile, the high power distance hinders Chinese worker from submitting individual-related problems to manager in the system. For individualistic culture, like Germany, the performance measurement would detail to individual workers.
3. ***User interface of SFC system should be adaptable.*** Chinese tend to focus on thematic attributes whereas Germans tend to focus on functional attributes. Thus, system menu and navigation design should be categorized by department or user groups for Chinese users and by functionality for German users. The simple and clear user interface design is the basis, but for Chinese users, they need fascinating user interface because top managers or visitors would like to see it in the plant and praise how advanced it is.
4. ***SFC system implementation driven by top manager*** is the most important factor for successfully run SFC in China. However, high power distance in China hinders normal worker actively reporting bugs or problem to the manager. Regular review meeting with users provides an opportunity to communicate with them and collect their feedback.
5. ***Choose appropriate training method for different cultural users.*** User manual and design documents are necessary for German users to understand system. For German users, the training will involve the introduction of areas such as database design, simple networking configuration and training in the use of an application development tool. On the contrary, step-by-step training and manipulation video record are the best training material for Chinese users. They believe that "learning by doing" is the most effective way to understand the system and to practice with daily tasks.

6 Conclusion

The purpose of this study is to investigate the impact of cultural difference between China and Germany on the design and implementation of Shop-Floor Control system. We conducted an in-depth interview with 10 Chinese and 5 Germans from 4 Sino-German joint ventures. From the interview, 24 key finding were categorized by 3 research questions, and were tagged with cultural difference respectively. The results of this study demonstrated that cultural difference does play a critical role in the SFC system design and implementation. Based on the findings, we discussed the implications and provided 5 recommendations for SFC system design and implementation. In the future, more quantitative and wide investigations shall be conducted to further explore the impact of cultural difference on SFC system.

Acknowledgement. We would like to thank all the participants for taking part in the interview and openly discussing their opinions.

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Design Convenience Stores for Chinese Teenagers

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Abstract. This study aimed to design convenience stores to attract Chinese teenagers. The convenience store's location, product, and image were studied. An observation and an interview were conducted to collect teenagers' requirements. After that, a conceptual design was created and high-fidelity prototype was developed. Twenty middle school students were recruited to evaluate the design concept. The results indicated that convenience stores oriented to teenagers should be located near a school, on the way to the bus stop, as close to the school as possible. Tasty meals, snacks, and self-service food and drink should be used as competing factors. Meanwhile, a positive and modern image is the deciding factor to attract teenagers. Implications for designing convenience stores for Chinese teenagers were discussed.

Keywords: Convenience store, Teenagers, User study, Experience-based design.

1 Introduction

Convenience store is an important part of our everyday life. It is a place where we can easily get daily necessities we want. In places with high population density such as Tokyo, London, New York or Hong Kong, convenience stores are sprouting from every corner, serving the needs of everyone by selling products ranging from candy, ice cream, sandwiches, magazines, newspapers and even lottery tickets.

In recent years, China has remained the fastest growing convenience store market in the world. Take the capital city Beijing for example. Beijing with a population of 17 million and growing is an ideal location for convenience store business to grow.

Teenagers in China are the trendsetters and are more influenced by the peers. They will buy the product when most of their peers have, even if they really don't need it. 51.3% of the Chinese teenagers admitted that they are easily be influenced by others [1]. Another distinctive characteristic of Chinese teenagers is that they hunt for novelty and desire to be unique. On the one hand, they have great interests in fashions and try to go with the times; but on the other hand, they still like to be unique. The distinctive characteristics of herd mentality and keeping track of fashions make the

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Chinese teenagers potential customers for the convenience store market in China. However, current Chinese convenience stores are not designed to meet their expectations. There is a great opportunity for Chinese convenience stores to enhance the percentage of teenage customers and to increase their sales volume.

In order to expend the teenagers' market of convenience stores in China, this study focuses on discovering a way to make convenience stores more attractive to Chinese teenagers, and to make convenience stores a trendy and convenient place for them to go. The objective of this study is to analysis requirements of Chinese teenagers and to design a convenience store to meet the requirements of young customers in the age of 12 to 18 years old. Experienced-based design approach was used to capture and understand teenagers' experiences and stories. The proposed design concept enhanced the end-to-end teenager's experience process when visiting convenience stores.

In the remainder of this paper, we first reviewed related literatures. Then we described the methodology used in this study. After that, the conceptual design and the evaluation results were presented. We ended the paper by discussing the results and implications for designing convenience stores for teenagers.

2 Background Literatures

Convenience store is a small store or shop that generally sells food, sweets, ice-cream, soft drinks, newspapers and magazines. Convenience stores often locate alongside the busy roads, in densely-populated urban neighborhoods, near gas stations, or near railway station. Some convenience stores open for 24 hours.

When considering the design of a convenience store, location might be one of the most important decisions. Location selection plays a very important role. It is particularly crucial for the convenience store with its dependence on high customer flows and low value transactions [2]. Many studies have examined different methods to design convenience store locations. For example, Kuo, Chi and Kao [3] developed a decision support system for locating a new convenience store. Their proposed system consists of four components: (a) hierarchical structure development for fuzzy analytic hierarchy process; (b) weights determination, (c) data collection, and (d) decision making. The results showed that the proposed system is able to provide more accurate result than the regression model.

Store image also serves an important role for the success of a convenience store. In retail store design, color is used to attract or to draw customer's attention. It is also used to project an image or to create a desired atmosphere for a store. Color can produce certain autonomic biological reactions, create certain emotional responses, and obtain attentions. Bellizzi, Crowley, and Hasty [4] evaluated the effects of color in store design. They found out that color can physically attract shoppers toward a retail display and have certain perceptual qualities that affect store and merchandise image.

Previous studies on the design of convenience stores mainly focused on the general design. Very few studies have been done to collect teenagers' requirements and design convenience stores for them. Teenagers have their special needs for the goods supplied in convenience stores. They are highly interested in PC-Games, fashions and comics. Stars, movies, comics, and games are hot topics in teenagers' web forums. Thus, in this study, we aimed to design a convenience store for Chinese teenagers.

3 Methodology

The overall goal for this study was to design convenience stores to attract Chinese teenagers. In this study, we focused on the design of location, products, and image aspects of the convenience stores. In more detailed, we aimed to study the following three questions.

1. What is the optimal location for an exemplary convenience store to attract teenagers?
2. What products are most important for Chinese teenagers and fit into the convenience store concept?
3. How to improve the image of convenience store to attract the teenagers?

In order to answer these questions, user-centered design approach was used. We first conducted an observation to learn about teenagers' activities after school. After that, we interviewed four teenagers to specify their requirements. Based on the findings from user study, a conceptual design was created and twenty teenagers were recruited to evaluate the design.

3.1 Observation

The aim of the observation was to learn more about teenagers' activities after school. Direct observation was conducted at one middle school in Beijing. The observation was performed in the afternoon right after the classes were over, when about one hundred students left the campus to go home.

It was observed that 46.8% of the students took bus to go home, 28.0% rode bike, 14.0% walked home, and 11.2% were picked up. After school, many students headed to kiosks. High demands of buying food or drinks after school were observed, but there were only kiosks near school, which can not satisfy their requirements. Thus, how to reach them after school is an important aspect when designing convenience stores to attract Chinese young customers.

3.2 Interview

In addition to observation, a structured interview with both open and close ended questions was conducted. The purpose of the interview was to specify teenagers' requirements on products and image aspect of convenience stores. Two boys and two girls aged from 14 to 16 studying at one school in Beijing were interviewed. During the interview, we encouraged teenagers to tell their experiences and stories when they visit convenience stores.

For the products aspect, the interview showed that food and snacks were most attractive for teenagers to go to convenience stores. They mostly go to convenience stores after school to buy food, mainly for the taste of it, instead of hunger. The food bought there was mainly eaten on the way back home. Girls were interested in a large variety of food and were interested in healthy food such as fruits. They liked the general idea of "do-it-yourself" very much regarding the food or drink preparation. They also concerned the hygienic standards a lot. In contrast, although the boys being asked about the self-service concept accepted the idea, they were not that

enthusiastically as the girls. School supplies being offered in convenience stores were regarded as too expansive by the boys; however for the girls, they were interested in school supplies fitting to their needs of pretty objects. Girls additionally demanded for little things such as toys and gifts or festival-related special offers very much.

For the image aspect, the general preference of western style in the appearance of the store was very clear, and the preferred style was often described as "modern". Boys as well as girls opted for a clear and bright decoration. They suggested colors as "bright" and "simple". They preferred low volume and easy background music. The idea of the adaption of the decoration to seasonal festivals was very well liked especially by the girls. When talking about the shop assistant, the most important point was the efficiency. Friendly and helpful were major requirements for their ideal shop assistant as well, whereas age and gender played a minor role.

In conclusion, we can see that the main focus concerning the products should be laid on the food aspect as this attracts Chinese teenagers most. A self-service concept for food and drink would meet teenagers' demands best. Very important is the aspect of hygiene which should be made clear by a clean and tidy store especially in the food area. Chinese style fast food with good taste can be provided to attract the teenagers. School supplies can also be provided at stores. When arranging seating area, it is better to be located at the window front, and be separated from the crowded areas, e.g. the checkout and the food preparation area. For the environment in convenience stores, a bright and modern color should be selected, and gentle background music at low volume can be played. Before upcoming festivals, the decoration and product offer can be slightly adapted. Shop assistants need to wear some kind of uniform, work at high efficiency, and be friendly and helpful. The health aspect is very important to teenagers. Thus, the store should be able to combine efficiency with the air of a young, modern and health-conscious store. It can be found in the products as well as in the image of the store.

4 Conceptual Design and Evaluation

Based on the results of the user study, a conceptual design was created and evaluated. The conceptual design focused on the design of location, products, and the image aspects of convenience stores for Chinese teenagers.

4.1 Location

Ideally, the convenience stores should locate as close as possible to the school. However, there are usually many factors restrict the location of convenience stores to be near school. Thus, we want to exam how location influences teenagers' preference.

We consider the possible location of convenience stores along the road from school to bus station and further away. Besides, the situation of crossings was also considered. Figure 1 shows the possible locations of six convenience stores along the road from school to bus stop and further away. Convenience store A is close to school, convenience store B is 50 meter away from the school, and so forth, convenience store F is 250 meter away from school. Bus station is shown by symbol H in the figure as an example. Figure 1(a) illustrates the situation of no crossings, and figure 1(b) illustrates the situation of having crossings along the road.

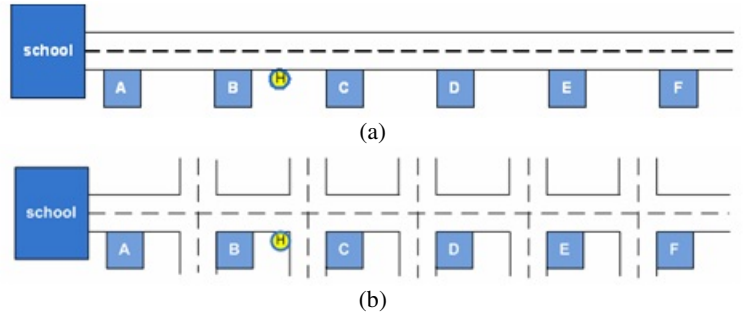

Fig. 1. Examine the influence of location on visiting convenience stores

Twenty students from one middle school in Beijing were asked for their preference on visiting the convenience stores if the store locates at the possible twelve locations with and without crossing conditions. The result is shown in Figure 2. Positive scores mean that teenagers would like to visit the convenience store, while the negative scores mean that they would not go. The higher the score, the more likely they visit the convenience stores.

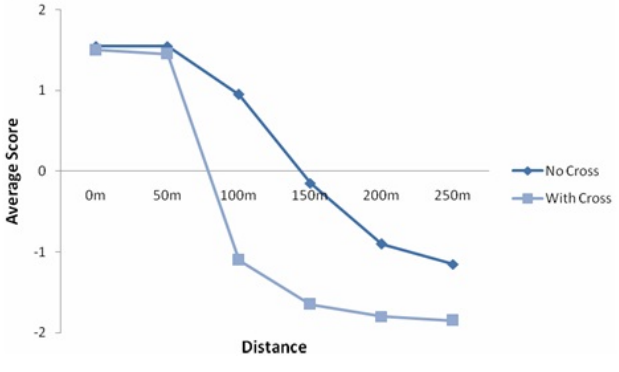

Fig. 2. Results of distance and crossings on visiting convenience stores

No obvious preference was shown as long as the convenience store is on the way from the school to the bus stop. But teenagers showed reluctance to take more walk to go to convenience stores especially if there are crossings they have to cover. Preferences decreases exponentially with distance increasing from school to possible convenience stores, and especially for having crossing's condition.

4.2 Products and Images

The next step was to design the products and image for the convenience store. Products can be divided into four major product groups: food, drink and fruit;

magazines and comics; school supplies; and additional products and services. The following design concepts were developed for different product groups.

- Food, drink, and fruit
  - Guideline: "Tasty and healthy!"
  - Mostly Chinese food
  - Self-service food
  - Self-service drink
  - Fruit cocktails
  - Soft drinks
  - Single fruits
  - Cups of sliced fruit
- Magazines and comics
  - Broad, offer gender-specific comic and magazine
  - Increasing sales volume allows lower prices and competition with bookstores
- School supplies
  - Basic equipment and consumables
- Additional products and services (e.g., cinema-related services, seasonal products, knickknacks, etc.)
  - Movie trailer
  - Cinema ticket booking service
  - Seasonal and festival related goods
  - Cute and funny things and presents

At last, the convenience store design was completed with the definition of the image aspect. The store color is green, since it corresponds with youth. The shop motto is "cinema", because the participants mentioned in the interview that this is their popular activity for spare time. Therefore, film posters will be put on the wall and movie tickets can be sold in convenience stores. The followings are the key design concepts for image aspect.

- Different shades of green color
- Seating possibilities
- Indirect lighting
- Background music
- Young and fashionable shopkeepers

In order to evaluate the design, a high-fidelity prototype was developed. Figure 3 shows the 3D overview of the store. Figure 4 shows the detailed design for the store, for example, the food, the magazines and comics, and the seating area in the store.

Twenty students from one middle school in Beijing were recruited to evaluate the design concept. The results showed that the design had a positive attraction to young customers. Appealing and tasty food was the most attractive product for Chinese teenagers. Self-service ideas were also very attractive to teenagers, but this has to be kept simple and hygienic. Besides, teenagers rated high scores for background music

Fig. 3. 3D overview of the convenience store

Fig. 4. Detailed design of the convenience store

and color of the store, but they cared less about the lighting. Cinema ticket services were also accepted and welcomed by teenagers.

5 Conclusion

This study tried to design convenience stores for Chinese teenagers. The location, products, and image aspects of convenience stores were studied. Experience-based design approach was used to understand teenagers' experiences when visiting convenience stores. Customer experience based solutions were transformed to design concepts and were evaluated by high-fidelity prototypes.

The results indicated that a convenience store oriented to teenagers should be located near a school, on the way to the bus stop, as close to the school as possible. In addition, many improvements on the products and image aspects of convenience stores to attract young customers were also provided. The main motivation for Chinese teenagers to visit a convenience store is the food being provided. Tasty meals and snacks will therefore attract customers and should be used as a competing factor. The self-service model for food and drink is highly recommended. For store's image, a positive and modern image can be the deciding factor to compete in the market.

In conclusion, location, products and image are important aspects when designing convenience stores for teenagers. The results of this study showed that our design concept was very well accepted by Chinese teenagers. But there are still some other factors, for example the price factor hinders the popularity of convenience stores to Chinese teenagers. To be able to compete in this young market segment, new ground has to be broken to lower the price level in teenager oriented convenience stores.

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Part V

Culture, Communication and Society

Cultural Effects on Arabic Electronic TV

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Abstract. Understanding users ' needs and cultures are considered two of the most important aspects of user interface design to ensure the highest level of usability. This paper presents some cultural characteristics for Arabic electronic television news web sites, through the adoption of heuristic evaluation technique. The results from the heuristic evaluation identified some major Arabic web site characteristics which are influenced by the culture. In contrast, the findings from the extensive survey have indicated the tasks needed by Arabic users, which were organized based on frequency of usage.

Keywords: Usability survey, e-TV web usability, Heuristic evaluation, interactivity cultural effects.

1 Introduction

The rapid Internet evolution enchanted many web providers to offer diversity of web services. These services are aimed to satisfy wide range of users in addition to facilitate their communication and work in areas such as: social, educational, health, commercial and entertainment. An online Electronic Media (e-media) has been proliferated in the last decade. One of the most popular types of the e-media is the Electronic Television (e-TV), which has been substantially changed and improved in the recent years.

The need to build efficient, navigational and usable interactive e-TV web sites has increased in result to the increasing numbers of e-TV users. This raised the concerns of many researchers to focus on investigating different aspects that can affect the website design and usability. Thus they produce a wide variety of useful guidelines which are based on Western culture. The globalized nature of the web encouraged wide range of web producers and vendors from different cutlers to be involved in producing a localized version of their e-TV sites.

However, the existing guidelines would not be reasonable to use in developing high quality, interactive, and usable e-TV web sites because these guidelines do not suite other cultures. Among many other cultures, Arabic culture needs to be explored due to the lack of existence of Arabic localized usability guidelines and principles.

In this paper the researchers focus on discovering the compatibility of the existing usability guidelines related to Arabic e-TV web sites as the first part of the study. Secondly, the researchers perform an extensive survey to determine the missing

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functions needed by the Arabic users. They start their investigation by using content analysis for two of the most popular Arabic news channels web sites which are Al-Arabia and Aljazeera. The content analysis is based on the adoption of Nielsen's Heuristics [1] in addition to Shneiderman's golden rules for user interface [2].

2 Related Work

There are many efforts which have been spent to study the e-TV. These studies have focused specifically on interactivity in the e-TV, which is considered as the common element in Human Computer Interaction (HCI) [3].

Interactivity involves several elements such as usability, accessibility, reliability and navigation ability. Usability is considered as key and most important element among others, since it has to deal with different interface aspects and their appearance. Nielsen pointed that usability comes first [4], because it might hinder or promote the acceptability of the web site. Thus, many studies have relied on using heuristics evaluation to assess the usability of web sites.

Thompson and kemp [5] used heuristic evaluation technique to assess web sites with strong user presence such as: Wikipedia, YouTube, and Flicker. The resultant usability strength and weaknesses, of the mentioned web sites, compared with the result of the use's usability testing evaluation to measure the validity and compatibility with the user's opinion.

Additionally, heuristic usability evaluation have been used by Martins, et al [6] to evaluate the design in EducaTV, which is an architecture for the association of value-added interactive content to educational TV programs. The evaluation applied for the TV screens concluded with enforcing simplicity to the interface design of the application. Also, Didier Augusto and Diogo de Carvalho used heuristic usability evaluation and cognitive walkthrough techniques to detect problems and improvement opportunities in designing interactive digital TV application based on multiple text modes [7].

3 Methodology

It is really important to establish effective interaction in order to build communicable interface. It is obvious that language is the most important and most effective tool for communication; it is also considered to be one of the key elements of any culture. However, the researchers could not find any existing usability guidelines to be used in developing interactive Arabic e-TV web sites.

Thus, the researchers focused on the usability as an essential element of the interaction as mentioned before. They started with exposing the content of the most common Arabic news channels e-TV (Alarabiya TV and Al Jazeera TV) through analyzing their content using Nielsen heuristics [1] and Shneiderman 's interface golden rules [2]. Secondly, they figured out the missing features in the e-TV sites and needed by the Arabic users, by performing an extensive survey, the details of both methods will be discussed in the next sections respectively.

3.1 Content Analysis

Initially, this study was started by forming a team of five, who started to analyze the content of the Alarabiya and Al Jazeera web sites. The analysis of both sites was attained by firstly focusing on the content of both Alarabiya and Al Jazeera home pages through the adoption of the heuristics and golden rules of the user interface presented in Table 1.

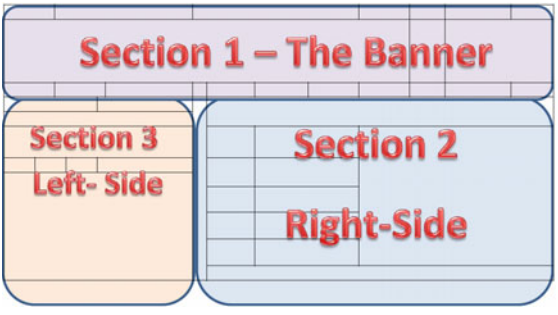


Fig. 1. Content Analysis e-TV Sections

All the coders were selected to be native Arabic speakers to fully understand the contents of the tested web sites, also to be aware of Arabic culture. The coders were trained to focus on and apply the interface rules appearing mentioned in Table 1. The evaluation involved dividing the e-TV web site pages into three different sections. Starting with the banner located in the upper section, followed by the right and left sections respectively; Figure1 illustrates the screen's division. Cultural effects influence the division of the sections related to web site's homepage because of the Arabic language writing direction. Thus, Arabic users scan screens according to their language direction.

3.2 Usability Survey

The second part of this paper is focused on finding the users' needs and desires when using e-TV. To achieve this the researchers used both interviews and observations features that need to be added to the current e-TV Arabic web sites.

4 Content Analysis Results

Based on dividing e-TV web site pages into three sections illustrated in Figure 1, the coders started to divide each section into subsections. Then they analyzed each part separately, to discover the applicability of the adopted user interface rules mentioned in Table 1, in the same time they focused on exploring the cultural influence in the design.

Table 1. Adopted User Interface Rules

	Rule	Description
1	*Strive for Consistency and standards*	Standardize the sequence of actions with similar circumstances; consistent should involve menus, terminology, alert messages, colors, icons, and button placement.
2	*Flexibility and efficiency of use*	Design to accommodate both novice and expert users.
3	*Offer informative feedback*	Support the user with appropriate feedback for all the performed actions, and keep the users be updated with the latest system status.
4	*Design dialog to yield closure*	Organize all actions sequences into groups and give the users informative feedback at the end to indicate satisfaction or failure, and to prepare for next group of actions.
5	*Error prevention and handling*	Prevent problems from occurring is better than an effective error message, and detect the error and offer simple, comprehensible and guidance mechanisms for handling the error.
6	*Permit easy reversal of actions*	Offer flexibility in updating and revising an action or a group of actions.
7	*User control and freedom*	Offer flexibility in browsing, navigating, and leaving the unwanted state without going through extra dialogues.
8	*Consumption of short-term memory load*	Minimize the consumption of users' memory by retrieving all possible data and actions instead of recalling them.
9	*Aesthetic and minimalist design*	Minimize the clutter of the supported information by displaying the essential information necessary to the users.
10	*Match between system and the real world*	Construct the process and the appearance of the system in a natural and logical order.
11	*Help and documentation*	Add an easy access, searchable and supportive materials to orient the users to the right direction to achieve their goals.
12	*Help users recognize, diagnose, and recover from errors*	Offer clear, precise and comprehensive error messages to indicate the problem and offer the solution.

4.1 Banner Section

The Banner is located in the upper part section of the web page, which is composed of three most common components, the logo, horizontal ads banner, and the main menu section. While some of the e-TV web sites include more components than the others such as the web sites languages, the date, live broadcast sign, transferring web site language, and web site registration and membership. These different components are illustrated in Figure 2 and 3 for both Alarabiya TV and Aljazeera TV respectively [12], [13].

Fig. 2. Alarabiya TV Web Site

Fig. 3. Al Jazeera Web Site Banner

The analysis of the most common banner component, according to different subsections mentioned earlier, involve the following:

Logo: this is positioned in the upper right corner and it occupied around a quarter of the upper banner space. The logo is really important to provide an identity to the accessed web site and its location on the web sites influenced by the Arabic language writing/ reading direction (right to left). However, the logo subsection is totally limited to be in the homepage of Aljazeera, while it is available on all the pages of Alarabiya web site. The logo availability supports rule number 1 from Table 1.

Horizontal ads: this mainly occupied three quarters of the banner and contained animated ads.

Main menu: which combines main menu in both Aljazeera and Alarabiya web sites, however it has additional components in Aljazeera web site, like live broadcasting button, language, and web site registration and membership. Main menu subsection presented as a horizontal ribbon and located in the bottom of the banner section. Live broadcasting button transfer the users to live station [8] instant online TV news.

Additionally, Alarabiya TV web site has top ribbon which appears on the highest line on the web site and it contains two button components. The first is located on the right hand side of the ribbon and it allows the users to display the news with other spoken languages supported by Alarabiya. The second button is the date which appeared in the most left side of this ribbon and sorted as the name of the day, the

date of the day, month, and year respectively instead of the order used in American or other western societies where the date appears as month, day, and year. The cultural influence is very evident here.

4.2 Right-Side Section

It is obvious that this section occupies two third of the e-TV web site, which composes of four subsections. These subsections are similarly divided in both Alarabiya and Aljazeera web sites, with differences in the content of each part illustrated in Figure 4(a, b). Figure 1 represents the subsections which are:

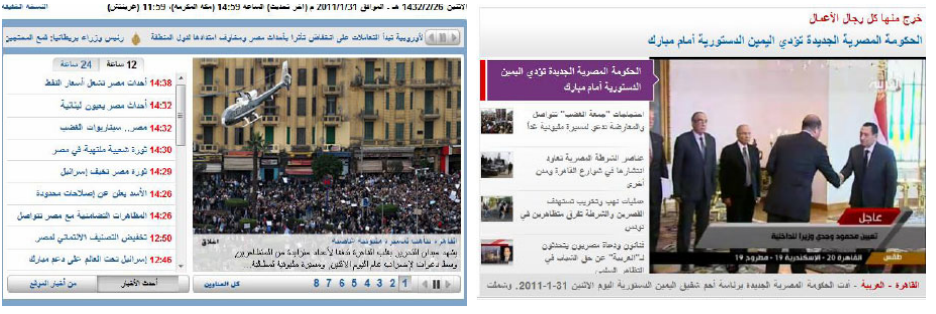
- *News Pictures' Exhibition:* it occupies a larger part of the right-side section, which contains semi screen for displaying news pictures and videos. In the bottom of this part in Aljazeera web site there is a headline news ribbon which is associated with the displayed picture and can be closed whenever the user decides to remove it.
- *List section:* it is on the left of the news pictures' exhibition subsection. The presentation of this subsection in Aljazeera web site composes either the latest (12/ 24) hours news or a selected news from the site. Users can switch between the two modes in displaying the news in addition to the availability to slide through the list. On the other hand, this area represents the top 5 headline news associated to the displayed news pictures in Alarabiya web site, and it is dynamically changeable unless the user specifically points or mouse over to exact headline from the list.
- *Top horizontal ribbon:* it contains either moving news strip in Aljazeera or dynamically changeable headlines in Alarabiya, which is compatible with the displayed news pictures and headlines in the list section. Despite of the movement in the news strip which might distract the users. Users can control the news strip movement, so they can pause, rewind or forward the news in the strip.
- *Bottom horizontal ribbon:* there is a difference between the two sites. Aljazeera web site consists of three components, which are all related to the displayed news pictures, the latest news, and all web site news. The user can control, by pausing, rewinding or forwarding, the displayed news pictures appear in the news pictures exhibition subsection. On the other hand, Alarabiya web site has a dynamically changeable headline according to the news picture, top horizontal ribbon, and the left headlines.

4.3 Left-Side Section

Left- side occupies one third of the area after trimming the banner section and it is located in the left section of the web page, which is consequently horizontally divided into four subsections. Table 2 illustrates those subsections that contain the top level, second top, special news, and scattered news list. The difference of the content in the top two levels such as:

- *Top level:* it contains web site search and advance search in Aljazeera, while it consists of live broadcast in Alarabiya web site. live broadcasting opens a new window with a large video screen and still holding Alarabiya logo, which reflects the consistency over all the web pages included in the web site.

- *Second top:* it provides the Aljazeera satellite frequencies; however it is a web site searching area in Alarabiya.
- *Special news:* this links and transfers the users to specific news in both Aljazeera and Alarabiya web sites.
- *Scattered news list:* it is a list of weekly news in Aljazeera, where it is a list of news sorted based on the readers/viewers selections in Alarabiya web site.



(a) (b)

Fig. 4. (a) Aljazeera Right-Side Section (b) Alarabiya Right-Side Section

Table 2. Lift-Side Subsections

Subsection	Aljazeera	Alarabiya
Top level	بحث تفصيلي بحث	فيديو العربية البث المباشر
Second top	نايل سات 10949 عمودي هوت بيرد 12111 عمودي عربسات 12034 أفقي	ابحث
Special news	صفحة خاصة فلسطين .. سجلات التفاوض	تونس.. بعد العاصفة
Scattered news list	أحداث الأسبوع بالصور احتجاجات يوم الغضب بمصر مصادمات السويس	اختيارات القراء يوم أسبوع شهر أكثر قراءة أكثر تعليقا أكثر إرسالا

5 Usability Survey Results

Exploring the desires of wide range of Arab users, who are addicted to browse Arabic e-TV news channels such as Alarabiya and Aljazeera, formed key research priority

for this paper. The feedback gathered from the respondents can be used as guidelines to create experimental artifact e-TV web sites influenced by Arabic culture.

Table 3 shows the most common feedback collected from the participants that are classified into three levels. The task levels reflect the status of tasks usage [2], and there are:

- *Frequent usage tasks:* which require easy access since they were asked for by the participants.
- *Less frequent tasks*: which have a lower degree of demand by participants.
- *Infrequent tasks:* which are rarely used and selected by the participants.

The revolution of the social media usage in Saudi Arabia is increasing day by day, according to [14] the number of Facebook and Twitter users is estimated at three million users in 2010. The researchers of the current study is assuming that the number of social media users in Saudi Arabia is expected to increase rapidly in the coming few years because Saudi society is classified as a collectivist society where people have strong bonds with their nuclear and extended families, in addition to the fact that Saudis look at these media as tools to express their opinion freely, these media are also used by many Saudis to contact people all over the world.

6 Discussion

The results reported from the content analysis presented in section 4 indicate that there is an overall presentation style which can distinguish the Arabic e-TV news web sites. The presentations are partly compatible with the adopted user interface rules mentioned in Table 1.

The compatibility is presented in supporting the users with all the needed information and the interactivity restricted in using buttons, embedded links, and menus selections. These interactivity styles support rules such as: help users recognize, diagnose, and recover from errors, error prevention and handling, offer informative feedback, permit easy reversal of actions, match between system and the real world, user control and freedom, and consumption of short-term memory load.

However, the contrast between the adopted user interface rules mentioned in Table 1 and the focused Arabic e-TV web sites is presented in:

- The Arabic and Middle East news are located in the top of the news menu, whereas the other international news organized in the second place, which reflect the concerns of the Arabic users.
- The presentation of the local Arabian date in an obvious part of the web page, and the local time of the holy city of Makkah.
- The displaying picture's exhibition and the ads section shows people dressed in local Arabian custom.
- The existence of moving news strip in both web sites that affect the flexibility and efficiency of use.
- Aljazeera does not support the connectivity to the social networks (i.e Facebook, Twitter, and YouTube).
- Both sites provide mobile live broadcasting.
- The logo of Aljazeera web site totally disappears in all the inner web site pages, which partly violates rule of consistency.

Table 3. Usability Survey Results

Task		Task Usage Status
Description	**Category**	
Allow sharing the video shows, and other news in the social networks websites such as: Facebook, Twitter, del.icio.us	Connecting with social networks	*Frequent Tasks*
Providing users with frequently updated content via web feed data format **(9)** , while RSS (Really Simple Syndication) is a family of web feed formats used to publish frequently updated works such as blog entries, news headlines, audio, and video in a standardized format **(10)**.	RSS technology	
Facilitate the searching mechanism such as using the hierarchical form searching, to provide an easy access to the content of the e-TV web sites.	Easy access search	
Provide the viewers with a choice of reading a summary of a written report about the TV shows before watching them.	Written report	
dedicate menu to include the current operated TV shows	Operated TV shows	
Organize the TV shows menu according to the most watched shows.	TV shows menu	
Link with special program that facilitates and speeds up the live broadcasting operation.	Speeding up the broadcast	
Sort the TV shows menu according to the viewer's desires	Menu sorting	*Less Frequent Tasks*
Organize the TV shows menu according to the recent watched shows.	TV shows menu	
Provide the user with capability to comment on the presented reports.	Commenting on TV reports	
Allow the user to evaluate and rank the videos available on the site.	Ranking video	
Add the feature for receiving live broadcast on the mobile phones.	Mobile TV broadcast	
Inform the users with the latest news via SMS and email	Informing with updated news	*Infrequent Tasks*
Archive the old TV shows, which are not running any more	Old TV shows	
Organize the TV shows menu according to the top rated shows.	TV shows menu	
Associate a sign language presentation with all presented reports	Special needs accessibility	

7 Conclusion

Given the results conducted by the adopted user interface rules, the researchers proposed some essential characteristics of the focused Arabic e-TV web site. These

characteristics varied in their compatibility to the adopted heuristics. In addition to the integrated extensive survey results, which explored Arabic users' needs that concluded the specifying requirements. These requirements are identified based on the frequently, less frequently and infrequent used tasks.

Cultural effects have deep influence on the users and their needs which considerably affect the user interface. There is a significant need to perform more researches for creating, specifying and deploying usability guidelines applicable for different cultures.

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Animating Our Island's Culture – Spreading and Socializing Our Island's Culture through Digital Animation

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Abstract. In this paper we'll be presenting what is and the results of the project called "Animating our island's culture". The main idea behind this project is to produce animations that tells the history of the people from a city in Brazil called Florianópolis and that has contributed to create our culture. The name of this project came from the fact that the city is placed in an island. But besides aiming on producing cartoon animations, what differs this project from others projects with this same goal, is the fact that this project is focused on training young kids from low-income communities from our city, teaching them how to produce animation. This paper will show the result of the first year of this project when everything is just in the beginning and many problems have been encountered.

Keywords: learning animation, low-income communities, popular culture, cartoon animation.

1 Introduction

"Animating our island's culture" is a project that was born with 2 main goals: the first one is very common: produce cartoon animation telling story from the people that helped creating our city's culture in different areas like arts, music, popular culture, etc. The second goal is what make this project so unique: teaching young kids from low-income communities on producing animation. The city is called Florianópolis and is placed on a beautiful island in the south of Brazil, known as a touristic famous city with a combination of beautiful beaches and some small mountains. But, as in many other cities in Brazil, it have its not so beautiful side, with many low-income communities spread around the city, many of them concentrated on the center part of the city on the hills. Drug traffic is one of the biggest problem in these communities, when young kids starts working for the drug dealers helping them out. This project is trying to give another option of future for these young kids, teaching not only animation but also trying to fill some gaps on their basic education introducing many of them to computers for the first time.

Since this project has in its first goal produce cartoon animation, it was proposed creating a studio for this and hiring professionals to work on it. Since we have the

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kids learning animation, the idea behind this studio is to show to these kids how an animation is done on a real production environment, and also to put them in touch with professionals that works with animation. But in this first year of project we have faced many problems, starting from the bureaucracy coming from the government that haven't bought the equipments required for the studio, to the lack of professional animators in Brazil available for this project. This last problem showed that we could also help fulfilling this lack of professionals in animation when we teach kids on how to produce animation, expecting to some of them become professional animators in the future.

Even though this project is focused on the entertainment industry, what will happen is that young kids, from communities in risk of social exclusion, will be trained for being prepared to work in the development of cartoon animation, working with local cultural references. And since they are coming from low-income communities, they have no computers at home so the training will begin with basic computer knowledge, making them as familiar with computers as other kids from middle to high classes.

But before going on with the details of this project, it will be presented the environment where it is happening, the city of Florianópolis.

1.1 The City of Florianópolis

The project "animating our island's culture" come from the fact that the city of Florianópolis is placed on an island in the south of Brazil and it is also the capital of the state of Santa Catarina. It's the second largest city in the state and its one of the small capitals in Brazil with a population of 421,203 citizenships in 2010 [1]. Even though it can't be considered a big city with this population, it have experienced a major grow in 30 years, coming from 187,770 people living in this city in 1980. This represents a grow of 124% while the average grow in Brazil from 1980 to 2010 was 58% [1]. This fast population growing, more than doubling in 30 years, have also grown the social problems at the same speed, expanding some of the low-income communities while creating many new ones, even though some numbers shows the city as one of the best in the country.

Compared to the others states in Brazil (excluding the federal distric), Santa Catarina had the best Human Development Index (HDI) in 2000, when it got an index of 0.822 while Brazil had an index of 0.766. Florianópolis also had the best index among the capitals, with 0.875, and it had the fourth best index from all the cities in Brazil [3]. These good numbers compared to the others cities and states in Brazil, doesn't mean that the city doesn't have some problems. Florianópolis is surrounded by other cities that creates the metropolitan region of Florianópolis. These small cities, sometimes, attract some low-income communities, bringing the whole metropolitan region to and HDI of 0.859 in the year of 2000, down from the 0.875 of Florianópolis alone. Also, some statistics from the year 2003 indicates a 23,49% of poverty incidence in Florianópolis, when the population was around 230,000 people, resulting in around 54,000 people living in poverty [1].

All these numbers shows that, even though Florianópolis and the state of Santa Catarina are above the average in Brazil in terms of life quality and economical indicators, it have the same characteristic of inequality as the rest of the country, with

part of the city having a good life quality, while other parts of the city having people facing poverty, sometimes concentrated in low-income communities. Many of these communities are located in the center of the city placed around the hill called "Morro da Cruz", that means "Hill of the Cross". Around the major hill there is a group of smaller hills that all together are called "Maciço do Morro da Cruz" (Hill of the Cross massive). There is placed 17 different low-income communities that are the home of the kids we'll be trying to bring to this project

1.2 The Entities behind this Project

There are several entities behind this project, starting with the Federal University of Santa Catarina (UFSC – Universidade Federal de Santa Catarina), a university placed in Florianópolis with 50 years of existence, it had in 2009 a total of 27,222 undergraduate students divided in 62 courses. It also had, 8,185 students in master and doctorate courses divided in 81 courses [5]. Related with this project there was the undergraduate course in Design and animation and a master degree course in Design. Also participating on this project is a laboratory that works with animation in UFSC called DesignLab.

This project was proposed by the Florianópolis City Hall, with the main executor being an institution from UFSC responsible for supporting research and projects outside the university called FAPEU. There is also contribution to the technical aspects from the city institution of culture called "Fundação Franklin Cascaes" (with main focus on the cultural aspects), with many others institutes and companies willing to help in the way they can

Most of this first year of project was in the hands of an institution called SENAI (Serviço Nacional de Aprendizado Industrial), that means "National Service of Industrial Training". This nonprofit organization is a network of secondary level professional schools, maintained by the Brazilian Confederation of Industry. The courses are divided in 28 industrial areas and the numbers from 2008 shows that it is formed by 738 operational units divided around the country with 454 fixed units and 384 mobile units. It has a total of 1,263 industrial courses, 825 high school professional courses, 68 undergraduate courses and 74 postgraduate courses [4].

2 How the Project has been Executed

Idealized by Milton Luiz Horn Vieira, a professor from UFSC and coordinator of design lab, it was proposed to the Florianópolis City Hall which was responsible for getting funds for buying equipment and supplying a place where the courses should had been. On the other side SENAI took the place of providing teachers and helped creating the courses that had never been taught by SENAI.

From the Federal University of Santa Catarina (UFSC), it came professors and students, some of them whom had worked with animation in the past, to decide what equipments should be bought after the city hall approved a total of R$695,781.95 (around US$416.635) for this purpose together with some expenses for the adequacy of the place where it should be. The full list of equipments that had been chooses to create both a studio to produce animation and a place where the kids could learn,

included workstation computers, servers, non-linear edition systems, printers, cameras, projectors, audio equipments, together with lightbox tables with disc for handmade animation, a lot of paper and scanners. Since it was a total unique project, it had to start everything from scratch with no previous project to reference, so the list of equipment was, at first decided by the maximum amount of money available, and at last by the past experience in professional studios the participants had.

The project was approved initially by the city hall and then, by the last quarter of 2009, SENAI also joined in offering their facilities and professors, to begin the courses in 2010. After the approval, another technical committee was created, in a partnership between professors and students from UFSC and the professional staff from SENAI, which would be responsible for the training. In the end of 2009, this committee decided what grades would be part of the course, divided in basic education and animation. Since the courses was aimed at kids from low-income communities, the committee decided to help on fulfilling some gaps on these kids basic education, adding some basic disciplines coming from courses SENAI already had in their base grade.

While the whole grade was being discussed, in the end of 2009, a selection process was started to choose which kids would be part of this project in the first year. It started inviting kids from low-incoming communities of Florianópolis to know about this project and find those interested in learning computer animation and about 30 kids, ranging from 12 to 14 years old, were selected to start the classes in the beginning of march, 2010.

By the beginning of December, 2009, the technical committee finished building a grade of different disciplines, shown in table 1.

Table 1. Disciplines grade for the first year of the course

Disciplines Grade		Hourly load
Curriculum Units		Total
Basics	Oral and writing communication fundamentals	52h
	Mathematic fundamentals	52h
	Work's health and safety	24h
	Basic computing	32h
	Organization and preparation to work	20h
	Ethics, citizenship and environment	20h
Animation	Drawing	160
	Script	40
	Storyboard	40
	Creating characters	40
	Digital drawing	100
	Creating background and environment	40
	Animation	120
	Audio production	20
	Post production	40
Total		200h

Since it's a one year course and it had to fill some gaps on this kids basic education, it was not able to go deep in every aspects when producing cartoon animations, therefore it was decided not to include 3D animation in this course, remembering that for many of these kids was going to keep in touch with a computer for the first time with this project. But trying to create a second part of this project with another year of course that includes 3D animation and could fill any other gaps that could be found during this first year of project.

3 What Happened in the First Year of the Project

To support this project, all the equipments that where necessary to work with animation where supposed to be bought, from basic computers so that all the kids have its own computer to work to a non-linear edition workstation, lots of papers and scanners, file server, render farm and a basic audio studio, so that they can all understand the whole process of producing digital animation. The city hall was responsible for this purchase, but they spent most of the whole year of 2010 inquiring us about about every piece of hardware and, by the end of the year when they finally release a public edict, a common procedure for finding suppliers with the lowest price when buying anything for the government, they changed some specifications themselves at their own will. What happened by the time this article was published is that the edict was cancelled by the coordinator of the project and a new one, with the original description was about to be released. So the first year of this project was finished and not a single equipment was bought.

Even without any new equipment, the classes started in the SENAI's facilities, located around 10 miles from the communities where the kids come from, so the city hall provided a school bus to take them in and out of the course. When this project was created and approved, it was supposed to be in a home located inside the local community, but for some political and also safety reasons, the city hall started to look for another place and decided to use a historical house located in the city's center, but it needed to be reformed to change into classrooms and a studio to produce the animations. Since there was a commitment with 30 kids selected to be part of this project, it was decided to avoid any postponing, the classes started in the beginning of May, 2010, in SENAI's classrooms with their own equipment while the old house was being reformed and the equipments supposed to being bought.

The final place for the project was ready by de middle of 2010, and the second semester of the project started in this nice old house, now very close to many of the communities where the kids lived, but with no equipment bought they had to mix some provided by SENAI with some provided by the city hall but only what was necessary for the training. The studio where the production of the animations should take place where not built until the end of the first year, and the designlab at UFSC was then responsible for this task, postponed to the year of 2011.

One of the very difficult tasks in this project was finding professor with professional experience in animation available. After keeping in touch with some of the studios in Florianópolis, none of them could send one their professionals to teach in this project. After all another teacher not working for one studio was hired, but in the other hand a visit to one of these was hired, and the kids was divided in two

groups of 15 students each, to spend an afternoon in a company called midiaeffects, a motion graphics studio that also works with 2D and 3D animation [2]. Even without an own studio for this project, this meeting was reported by the kids as a great experience where they could see how you work with animation in a day-to-day job.

4 Results

After fighting with many obstacles, some of them coming from the situation of poverty that many of the kids was facing in their lifes, and some many more coming from the bureaucracy when dealing with politics in Brazil, the 30 kids selected could finish this first year of project by December, 2010. It was not only an animation course, but as showed in table 1, it involved putting them in touch with computers, some of them for the first time, and also helping them improving some of their basic education. Then it was clear that the animation part of this course was more an introductory part, with great focus on drawing with 160 hours of classes in this topic, with 100 hours more in digital drawing. The 120 hours of classes on animation could sound enough, but animation is a very long process of learning, as Richard Williams shows in his book, "The Animator's Survival Kit", the main reference in animation for this project [6]. We showed how hard is to become an animator, but at the same time how great is to create an animation and how the computers can help them in this task. But in the end, all 30 kids finished the course and SENAI decided to start another group for 2011 with 30 other kids, starting the process again.

For the 30 kids in this first year of course, we are planning for this year of 2011 a second part of this course, going deeply in 2D animation and start them in the 3D animation field but as part of a new project being executed.

Even though it was a main goal in this project to produce and animation made by undergraduate student from UFSC's design and animation course, with the help of the kids doing their studies, no animation was done in this first year of project because of the delay on building the studios and buying the equipments. It was postponed to 2011 in a collaboration with the UFSC and the students from this first year of project, to be presented in a future paper.

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The Impact of "Device" in Social Networking: An Explorative Study with Turkish Social Network Site Users on the Nature of Interactions through Personal Computers and Smartphones*

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Abstract. The purpose of this study is to explore the nature of interactions that develops around social networks through two major device categories: PC and smartphones. This study specifically aims to focus on the reasons for the preference of PC and smartphones distinctively and tries to reveal the significant patterns of usage for social networking through both platforms. This quantitative research employs a survey conducted with a sample of 203 Turkish people who are using PCs and smartphones for accessing social networking sites regularly.

Keywords: Personal Computer, Smartphone, Social Network Site, Interaction.

1 Introduction and Theoretical Background

Social networking sites (SNS) encourage audience participation through computer-mediated discussions with other members of the community, called "friends" or contacts [1]. Boyd and Ellison [2] define SNS as web-based services that allow users to share a public or private profile with common users and explore connections with others within the site. People who engage in social networking on the Internet are both audience members and active participants at once, as users share information and content with each another. New technologies have helped ordinary users learn how to generate and distribute their original content through various channels on the Internet [3]. Through online socializing, users become part of larger publics and social networks, and develop into members of virtual communities [4]. Users create personal profiles that consist of different kinds of biographical information, personal preferences, pictures, music, blogs and comments from friends [5].

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Research on SNS is an area of growing interest in human-computer interaction and social sciences. Social networking sites are popular online communication forms among adolescents and emerging adults. Yet little is known about young people's activities on these sites and how their networks of “friends” relate to their other online and offline networks [6]. Although research on young people's use of social networking sites is emerging (e.g., [2]; [6]; [7]), questions remain regarding exactly what young people do on these sites, with whom they interact and how their social networking site use relates to their other online (such as instant messaging) and offline activities. At this point, the literature reveals that surveys are employed as efficient instruments to investigate social networking thoroughly.

There are surveys conducted on mobile internet and social media use among different user categories. Pew Internet [8] investigated the social media and mobile internet use among teens and young adults. The research revealed that in the last two years, both teen and adult use of SNS has risen significantly, yet there are shifts and some drops in the proportion of teens using several social networking site features. Adults are increasingly fragmenting their social networking experience. As a majority of those who use SNS have two or more different profiles. Facebook is currently the most commonly-used online social network among adults. The specific sites on which young adults maintain their profiles are different from those used by older adults: Young profile owners are much more likely to maintain a profile on MySpace but less likely to have a profile on the professionally-oriented LinkedIn. Wireless internet use rates are especially high among young adults and the laptop has replaced the desktop as the computer of choice among those under thirty (Pew Internet, 2010). Teens are not using Twitter in large numbers. While teens are bigger users of almost all other online applications, Twitter is an exception. However, there is a significant increase in Twitter use and three groups of internet users are mainly responsible for driving the growth of this activity: social network website users, those who connect to the internet via mobile devices, and younger internet users – those under age 44 [9].

The survey of Ericsson Consumer Lab [10] presents findings on the internet and social media use of Turkish users both on desktop and mobile platforms. Data is derived from a field study based on structured interviews with 760 participants and online survey with 763 participants. The findings showed that SNS are the most popular services on the internet for all user categories. 54 % of the participants connect to SNS daily whereas 21 % connects weekly. Contrarily, the participants mostly declared negative attitudes about SNS. 56 % of them declared that users caused the exploitation of their privacy by sharing too much personal information on SNS. 45 % of them thought that SNS have negative impact on the users’ communication skills and their abilities to express themselves in Turkish. 48 % of the participants are content of mobile high-bandwith and use it mostly for personal needs. 16 % use mobil internet for more than 6 hours a day whereas 17 % use it for 3 to 6 hours and 25 % use it 1 to 3 hours a day. Today’s smartphone market is mostly dominated by cell phones with 2G connection. The 3G phones have a penetration ratio of 24 % whereas smartphones constitute only 5 % of the overall market. However, future projections point out to the dominance of 3G phones (42 %) and smartphones (17 %). Web surf, access to SNS and status update on SNS are the first three most popular services on mobile phones. Facebook and MSN are the most popular mobile websites followed by Youtube and Google Talk [10].

Besides, some online surveys focus on usability issues in SNS. As a significant example, user experience consultancy, Webcredible [11] carried out a social network usability poll. The research polled more than 1,100 online users between December 2009 and March 2010 on which social networking site they find easiest to use. The study revealed that Facebook and Twitter are considered the easiest to use SNSs but a substantial number of Internet users feel that no social networking sites are easy to use.

The purpose of the present study is to explore the nature of interactions that develops around social networks through two major device categories: PC and smartphones. This study specifically aims to focus on the reasons for the preference of PC and smartphones distinctively and tries to reveal the significant patterns of usage for social networking through both platforms in Turkey. Departing from a user-centered design approach, the study also investigates if the nature of interactions in social networking differs due to the capabilities and constraints specific to each device category. Thereby, our empirical analysis aims at addressing, among others, two research questions of the study that may be summarized as follows: (1) what are the reasons for the preference of PCs and smartphones distinctively for a specific interaction in social networking? and (2) how do capabilities and constraints of different devices affect user experience in SNS? Besides these main research questions, we are interested on the effects of different characteristics of SNS users, such as age and gender. In order to accomplish this task, we perform a battery of statistical and econometric tests based on a survey that we designed specifically for the present study. More precisely, to conduct our research, after constructing the database from the survey, principal component analysis (PCA) is employed to reduce the dimensionality of the data set (having many items for each question), and then different model specifications are considered to assess possible relationships between the variables of interest. In a multivariate framework, the fact that respondents use a given application from SNS (e.g. sharing videos, updating status, commenting on photos or links, etc.) whether on a PC or a smartphone is considered as a dependent variable, while personal characteristics are taken for independent variables together with frequency of visiting SNS and other patterns. From such an analysis, it is possible to detect interactions between SNS user characteristics, choice of devices and usage patterns. Applying the same methodology but in another framework, it is also possible to investigate differences in motivation of different choices made by the SNS users. This allows us to figure out which sites and which applications are preferred to be used on smartphones or on the PC, thus increasing our understanding of the way how social interactions take place on SNS.

The rest of the paper is organized in the following way: first, Section 2 presents the data providing some summary statistics and describes the methods used in the study. Then, the results of the empirical analysis and their interpretation are given in Section 3. Finally, Section 4 concludes the paper.

2 Data and Methodological Aspects

In the first step of our empirical study, we conduct our analysis by means of the statistical techniques of factor and principal component analysis. Since this method provides a very useful and simple approach for multivariate survey data analysis, it

has been used so far in several areas of social science and engineering applications. The main idea of principal component analysis (PCA) is to reduce the dimensionality of a large data set having an important number of interrelated variables. By doing so, this analysis enables us to retain as much as possible the variation present in the data set. Basically, it consists of a linear transformation of the original data set into a smaller number of uncorrelated principal components which are ordered so that the first few give the maximum residual variance, retaining thus most of the variation present in all of the original variables. In other words, PCA provides an alternative set of coordinate axes given by the principal components representing the original data set. Furthermore, these principal components are orthogonal to each other so that their ranking gives the relative amount of information that each one carries[1]. The second step of our analysis consists of using the factor scores obtained during the PCA as dependent variables of the ordinary least square (OLS) regression models in order to show that different variables may have different impacts on each of these factors.

A sample of 203 Turkish SNS users was surveyed on various topics on social networking, such as use of SNS, attitudes about the choice of devices, and the content shared on whether PC or mobile phone. It should be noted that sample sizes vary much by item depending on the number of survey participants who answered the relevant questions. But for each question the number of respondents is at least 80. The data gathering was done anonymously in January 2011 by means of an online questionnaire using *SurveyGizmo* (a survey host for building online forms and collecting data). Some summary statistics giving average scores for each item of different questions and cross-tabulation reports from the survey are given in Table A1 in Appendix A. We use this table and the information it provides in the next section.

Since for a given question there is a number of items, in order to determine subsets of items that fall into different dimensions of the information searched by that question, principal factor analysis produces factors, which can be then easily analytically categorized. Another important advantage of our methodology is that since the inclusion of correlated variables (i.e. items in each question) in the same regression would create a multicollinearity problem, the PCA can transform a set of correlated variables into a set of uncorrelated principal components, which is thus a way to resolve this multicollinearity problem [14]. In consequence, based on the resultant factor analysis, one can calculate factor score variables to be used in the regression models having no severe multicollinearity[2].

3 Results and Discussions

In this section first we report and discuss the results obtained from the PCA, and then we summarize the estimates of the regression analysis[3].

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[1] To conserve space we do not discuss in detail the methods based on factor and principal component analysis which are well documented in the literature. See for instance [12] and [13].

[2] For further discussion on multicollinearity bias in regression parameter estimates see [15].

[3] Space limitations prevent us from reporting all the results obtained in this paper. All unreported results of this and the following section are available from the authors upon request.

3.1 Factor Analysis

As briefly discussed in the previous sections, the aim of conducting factor analysis is twofold: (1) factors reduce number of items in the questionnaire and make it possible the identification of different types of motivations in choosing applications and devices; and (2) these resulting factors may be then used as the predictors of interest in analyzing both user preferences and characteristics (i.e. age and gender).

In this way, we determine subsets of items for each question that represent different dimensions of the concept in question. This method enables us to see whether preferences of PCs and smartphones change for a specific interaction in SNS. To begin, consider the following question (Q1 in Table A1): to which SNS you connect? Our results indicate that items (internet sites) listed above this question cannot be used to construct factors that contain the essential information in the data set. In other words, sharing no common variance, these items cannot be empirically distinguished. However, a descriptive analysis reveals that Turkish SNS users prefer connecting at SNS on their PCs rather than their smartphones. This general rule seems to be valid for all SNS included in the questionnaire. Furthermore, differences in the preferences between PC and smartphone are higher for the case of Youtube, Picasa and Flickr. We should underline at this point that the survey results show that Turkish SNS users do not prefer to use a wide range of SNS. Facebook, Twitter and Youtube are the most widely used SNS among Turkish users.

Consider now the items shared in SNS (Q2 in Table A1). When we apply the same technique, two principle factors emerge, one related to a passive multimedia activity – video, music and link sharing – and another related to a more interactive information sharing activity – posting photos, status updating or writing comments. The behavior of SNS users do not vary whether they use PC or smartphone. The meaning of this finding is simply that, independent of the choice of device, sharing picture, comment or status updating should be considered as actions "different" than sharing video, link or music. We will discuss this conclusion in the light of the regression results. Taking into account the content of activity on SNS (Q3 in Table A1) all items are found to be in the same factor for both PC and smartphones, that is, no preference between these items. However, motivations in connecting to SNS are found to be different with respect to PCs or smartphones. More precisely, in Q4, although for the case of PCs, there is a principal factor that includes all items, for the case of smatphones, the first four items constitute the first factor while the last item constitutes the second. This means that "to meet new people" is a motivation that differs whether using PC or smartphone. This point will be further clarified in the following section. Finally, note that factor analysis gives some other interesting but not that surprising results. To give some examples, consider the content shared in SNS (i.e. Q8) for which, for the case of PC usage, location updating is found to be in the same principal factor as group or event activity (items 10-12), while passing to smartphone usage, the same item appears to move from this factor to another consisting of profile and status updating. On the other, for another question (not reported here) survey participants are asked for the activities that they make with people outside of their friend list. The results indicate that while for the case of PC usage, all items (i.e. viewing his/her profile, reading activities on his/her wall, looking his/her pictures, watching his/her videos and playing game with him/her) build a unique factor, for the case of smartphones, first three items give the first factor and the last two give the second.

3.2 Regression Results

In this section, in order to provide further information about the SNS usage we perform some econometric tests. In the first step, we estimate by OLS the following multivariate regression model:

$$Y = bX + \varepsilon \tag{1}$$

where Y is a vector of observations on the dependent variable, X is a matrix of explanatory variables that are hypothesized to influence the dependent variable in quesiton, b is the vector of coefficients to be estimated and ε is the error term.

Recall that from the factor analysis we found out that, for the question Q2 (i.e. what to share in SNS), two factors distinguish the items listed below the question. Now we put each of these factors on the left hand side of Eq. (1) as the dependent variable. On the right hand side, we test different combinations of some explanatory variables, namely, age, gender and frequency to connect SNS (which constitute thus the matrix X). Some interesting results have been found through the OLS regression. On PCs, taking into account the frequency and regardless of the factor, sharing activity of women is significantly higher than that of men. On the other hand, for the case of smartphones, the frequency has no effect on the factor related to the passive multimedia activity (described above). However, irrespective of gender or age, frequency has a significant positive effect on the second factor representing a dimension of a more interactive sharing in SNS.

Returning back to Q1, which is, connecting to different SNS, we run both OLS and tobit regressions considering the scores for each SNS as dependent variable and the above mentioned covariates as independent variables. Our results indicate clearly that, after controlling for frequency to use and spending time on the SNS, for the case of PC, Facebook is mostly visited by women and young users, Twitter is preferred by again women and Youtube is a site that is mostly visited by young people. On the other hand, for the case of smartphones, the difference in gender disappears and only young people seem to visit mostly Facebook.

We analyzed the activity of SNS users according to their interaction with other users. Two questions help to understand the user preferences on the choice of device. The first question (Q10 in Table A1) asks how often user interact with (i) a friend, (ii) a group of friends, (iii) someone out of the list, and the second question explores by which activity they choose to often interact with other user, (i) viewing the activities on their wall, (ii) viewing their photos, (iii) viewing their videos, (iv) viewing their profiles, (v) gaming. We first analyzed for each device separately which of the preferences to interact with others are interrelated. The multi-equation mixed modeling[4] helps to analyze, by computing the residual covariance structure between interaction preferences, the effects of gender, age and frequency to use SNS on the dependent variable, that is, the frequency of interacting with others. The regression

[4] We use STATA module cmp for multi-equation mixed modeling with OLS. The dependent variable is the frequency to interact with others (3 preferences) and common covariates are age, gender and frequency to use SNS. A residual covariance between 3 equations, significantly different from zero, reveals that preferences are correlated. Further references on STATA module can be found in [16].

results show that while PC users' preferences with respect to whom they interact are (positively) correlated, smartphone users' preferences are interrelated except the interaction with someone not on the list. A simple check of this pattern can also be verified with Q4 in the survey. The smartphone users do not prefer to use SNS to meet and interact with new people. This pattern might be related to three major factors: meeting and interacting with someone out of the list is a (1) time consuming and (2) costly activity for smartphones in comparison to PCs (see in Table A1, Q7). Another explanation might be (3) the poor performance of smartphones related to multitasking. If we assume that to be interested with others is not a major activity but an accompanying activity, smartphone users might not use different applications at the same time (multitasking) or cannot open multiple tabs inside one application (e.g. being not able to view others' profiles or walls on Facebook while watching a video on Youtube). These results bring us to the second question mentioned above. In fact very few people (only 16% of the respondents) interact often with other users on smartphones. Furthermore, in case of preferring to interact, for both PCs and smartphones, viewing profiles and photos found to be the most common way of interaction with other users.

4 Concluding Remarks

In this paper, we have provided some descriptive and econometric analyses based on a survey that quantified the preferences of Turkish SNS users. Our results indicate that there exist several differences between the use of PCs and smartphones for a specific interaction in SNS. However, the device choice does not seem to be decisive in most of the cases. For Turkish SNS users, at least for the survey respondents, based on the result that SNS usage is rather limited by Facebook, Twitter and Youtube, the range of activity is not wide and seems to be limited to only power users. It should be noted that there are also some specific constraints in the use of smartphones which do not provide a multiple application environment (multitasking). The connection cost of mobile phones might be another concern for Turkish users. While their usage patterns for a specific application appear to be similar, multiple application usage differs between PCs and smartphones due to these constraints.

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Appendix A: Statistics of SNS Usage

Table A1. Summary Statistics

Q1. To which social networking sites you connect?			Q2. What to share in SNS			Q3. Content of your activity on SNS		
	PC	Mobile		PC	Mobile		PC	Mobile
Facebook	6.05	5.38	Photos	4.23	3	Comments on recent events	3.93	3.11
Twitter	3.95	3.55	Comment	4.64	3.84	Personal / emotions/ reactions	3.24	3.25
Friendfeed	1.68	1.31	Status	3.39	3.34	Information about work/school	2.86	2.44
Myspace	1.81	1.11	Information/News	4.1	3.1	Information about your activity	3.18	2.86
Picasa	2.03	1.12	Video	3.54	1.92	Comments on liked events	3.76	3.14
Flickr	2.1	1.19	Music	3.45	1.98	Comments on yours friends activity	4.58	3.57
Youtube	5.15	3.05	Link	4.06	2.58	No. Resp.	84	84
Linkedin	2.25	1.4	No. Resp.	89	89			
No. Resp.	91	91						

Q4. What is motivation in connecting to SNS			Q5. Hours spent in SN			Q6. Frequency to connect to SN		
	PC	Mobile		PC	Mobile		PC	Mobile
To interact with my friend	5.8	5.18	< 1 hour	28.1%	70.5%	1-5 times a day	40%	56.3%
To read recent comments on current events	4.74	3.97	1-2 hours	31.5%	17.0%	6-10 times a day	26.7%	23%
To read recent news	5.02	4.27	2-3 hours	21.3%	4.5%	11-20 times a day	16.7%	10.3%
To enjoy	4.93	4.27	> 3 hours	19.1%	8.0%	>20 times a day	16.7%	10.3%
To meet new people	2.28	1.78	No. Resp.	89	89	No. Resp.	90	90
No. Resp.	89	89						

Q7. What are the advantages of Smartphone usage	Blackberry	Nokia	Samsung	IPhone	Others	total
Availibility to connect any time any where	6.82	6.5	6.42	6.64	6.89	6.63
Keyboard or Touch Screen	5.36	5.3	5.08	5.07	5.44	5.21
Small Screen	3.27	2.2	2	2.5	2.89	2.5
One-handed Usability	5.09	4.1	3.75	4.54	4.33	4.36
Flexible Screen Position	4.09	4.15	3.42	4.93	4.78	4.38
Automatic Location Information	3.64	3.7	3.42	4.75	5.11	4.17
Smart and Simple Page Design	5.36	5.15	5.08	5.68	5.22	5.36
Speed of Connection	5.82	5.5	5.67	5.86	5.67	5.71
Page Design is limited to certain Tasks	3.64	2.45	2.58	2.61	4.67	2.94
Not to Personalise the page according to needs	4.18	2.1	2.92	2.86	4.22	3.01
The Connection Cost	2.09	1	1.42	1.39	2.89	1.56

Table A1. (*Continued*)

Q8. What to share in SNS						
	Blackberry	Nokia	Samsung	iPhone	Others	Total
Photos	3.09	2.9	1.67	3.47	3.2	3
Comment	4.45	3.9	3.67	3.77	3.6	3.84
Status	3.45	3.76	3.17	3.13	3.2	3.34
Information/News	3.27	3.52	3.25	2.83	2.8	3.1
Video	2.09	1.62	2	2.03	1.93	1.92
Music	1.73	1.86	2.25	2.13	1.8	1.98
Link	2.73	2.38	2.58	2.73	2.47	2.58

Q9. Your activity in SN		
	PC	Mobile
Recents events on my wall	4.92	4.05
Share photos on my wall	3.36	2.8
Creating photo album	3.39	2.02
Post videos on my wall	3.46	1.8
Creating video album	1.63	1.23
Post a link to my wall	3.78	2.43
Update my profile	3.71	2.49
Update my status	3.57	3.34
Update my location	1.95	2.22
Create a new group	1.67	1.18
Participate to a group	2.47	1.59
Create a new event	2.13	1.34
Participate to a new event	3.22	2.35
Gaming	2.19	1.46
Use applications	2.61	1.89
No. Resp.	83	83

Q10. With whom your activity on SN is related		
Myself	5.33	4.94
One of my friends	3.77	3.24
A group of friends	3.4	2.64
Someone out of my list	1.71	1.29
No. Resp.	80	80

Notes: In questions Q1, Q2, Q3, Q4, Q9 and Q10, 1 stands for "Never" and 7 for "Very Frequently". In questions Q7 and Q8, 1 stands for "Not an advantage" and 7 for "A big advantage".

New Development of Mobile Instant Messaging: Virtual Body Communication Interaction

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Abstract. People's non-verbal communication, accounting for as high as 70 percent in daily communication, can deepen interpersonal communication and convey what cannot be conveyed in language. It, however, has not been fully used in present mobile instant messaging. The author of this paper tries to integrate virtual body communication interaction into mobile instant messaging through analyzing mobile instant messaging and its user distribution. Under this mode of communication, mobile phones will be used as the communication channel with cartoon comic and supply varied applications for different genders as its main style and hence achieve interaction and diversify the ways of interpersonal communication.

Keywords: daily communication, body language, mobile instant messaging, gender.

1 The Current Situation of China's Mobile Instant Messaging

1.1 The Scale of China Mobile IM

With the development of the internet and mobile telecommunication, modes of daily communication in the physical world have been simulated into the virtual world. IM (short for Instant Messaging) is among the most important modes of internet interpersonal communication. According to the forecast of iResearch, IM users of China will reach 490 million in 2012, accounting for 80.3% of all netizens. It is reported that China mobile IM users had arrived at 98 million, demonstrating a 44.1% year-on-year sharp increase.

1.2 The Users of China Mobile IM

The survey of the age distribution of IM users in 2010 shows that mobile terminal users, as a whole, tend to be young and people aged 18-24 are the first principle part of users, accounting for 56.7%, among which, the students occupies the overwhelming proportion. (see Fig. 1). Meanwhile, the data shows that, in terms of the gender proportion of IM communication users in 2010, the male is higher. The male user is 84.6%-it's the vast majority of users, while the female one is15.4%. Therefore, this research has taken collage students, one of the main user groups of IM, as the subject of the research and carried out further sort research based on gender-specific users.

P.L.P. Rau (Ed.): Internationalization, Design, HCII 2011, LNCS 6775, pp. 483–489, 2011.

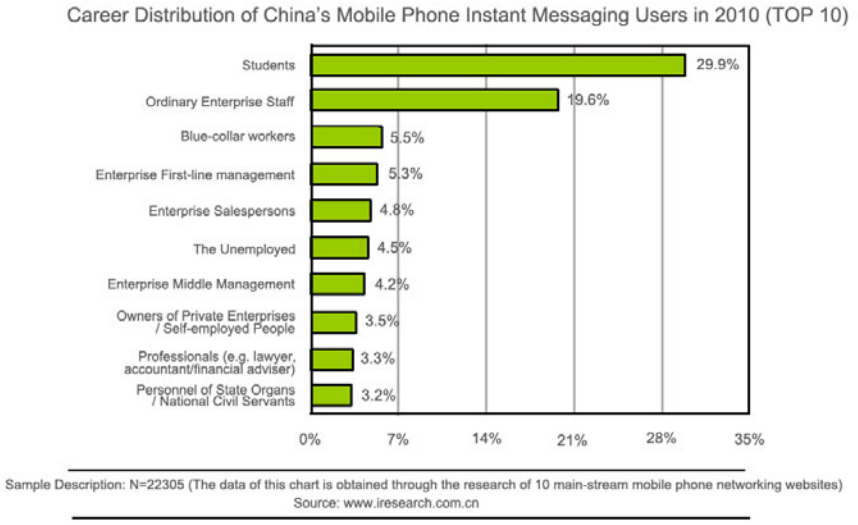

Fig. 1. Distribution of China's Mobile Instant Messaging Users in 2010[1]

1.3 Software Supporting China Mobile IM

For China's young people nowadays, work and life greatly rely on the network and mobile telecommunication. Particularly in the aspect of communication, logging in QQ (this IM software accounts for 76.2% in the Chinese market) at any time, and any where has become one of the necessary interpersonal interaction means for them. (see Fig. 2). The findings of iResearch also shows that in the current mobile IM market of China, 83.5% users are using mobile QQ on their mobile phones, so the design application part of this study has chosen China QQ as the software carrier.

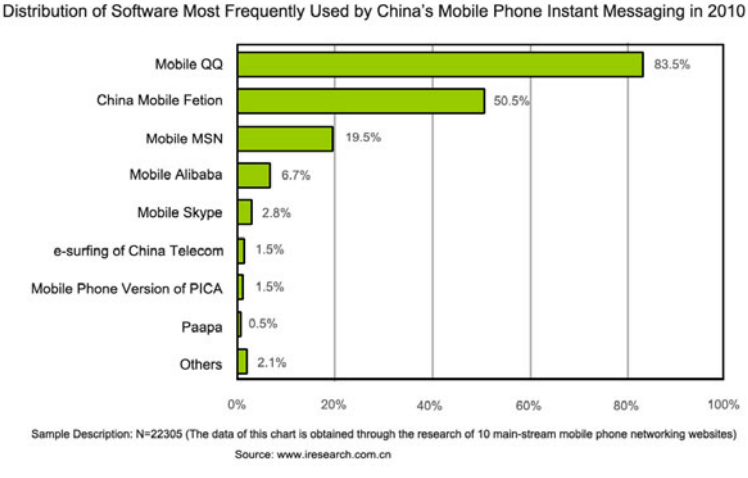

Fig. 2. Distribution of Software Most Frequently Used by China's Mobile Phone Instant Messaging [1]

2 Daily Interpersonal Communication

2.1 Non-verbal Communication and Interaction Communication

Psychological and communication science research shows that 70—80% information in communication is transferred via body language and facial expressions. Compared with dialogue language, it can express richer thoughts, and express the subtle emotion in an easier way.

However, in the modern interpersonal communication mode with the IM as the leading approach, text input with a few smileys and facial expressions are the main communication mode, which greatly lacks of non-verbal interaction. This one-way mode of communication is confined to text input and hence cannot serve the purpose of interactive communication.

2.2 Body Interactive Communication of University Students

In the research, 110 university students are surveyed, among whom 58 are male and 52 female. It has been found through observation that university students in daily communication, compared with adults, pay less attention to rituals and are not good at accurate communication via written language. Also they are more likely to resort to body language for communication and use it more frequently than adults. (see Fig. 3).

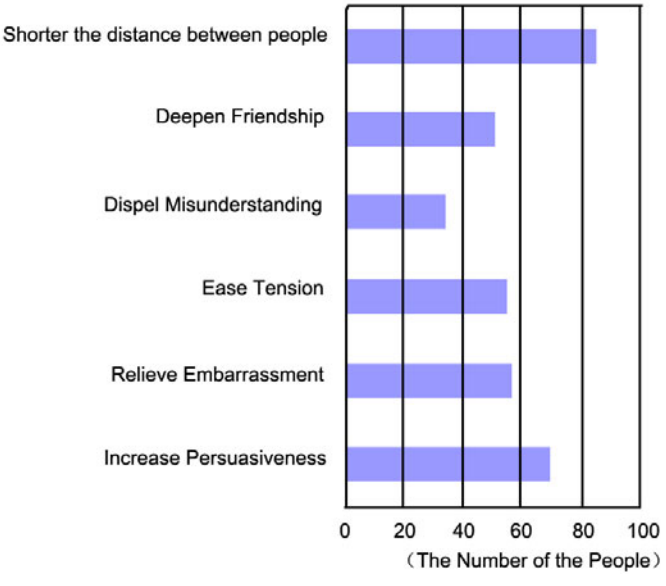

Fig. 3. University Students' Ideas about Body Language Communication

It can be seen in Table 3 that university students holds that communication via body language can bring people closer together and make convincing what is communicated. It can, therefore, ease embarrassment and tension and deepen

relationships and dispel misunderstanding. For indoorspeople (i.e. those who prefer to stay at home doing a lot of things through the internet), interactive communication via body language is a good and important way of forming healthy interpersonal relationships.

2.3 University Students' Opinions about Communication via IM

University students, we find through interview and questionnaire, generally agree on the fact that considerable problems may arise with communication via Mobile QQ in the form of written language. It is complicated and fatiguing to type in letters and words alone cannot fully express feelings and may thus lead to misunderstanding. Likewise, a few smileys of Mobile QQ cannot convey complex feelings, and nor can it simulate real interaction.

2.4 Effects of Gender on Communication

The respective research on different genders shows that communication via body language has a more positive effect on male University students (hereafter referred to as male students) than on female University students (hereafter referred to as female students).

Characteristics of Male Students' Body Language Communication

- Preference for lots of body expressions in the daily body language communication.
- More big and rough movements which allows more intensity and room for acts and are furious on some occasions.
- Significant difference in their ways of dealing with males and females. Their movements tend to be bigger in amplitude to the most intimate male friends. (see Fig. 4,5). But when facing the female, they will be more prudent with their body language. Especially in the case of meeting unfamiliar female, tentative movements with small amplitude are in the majority.

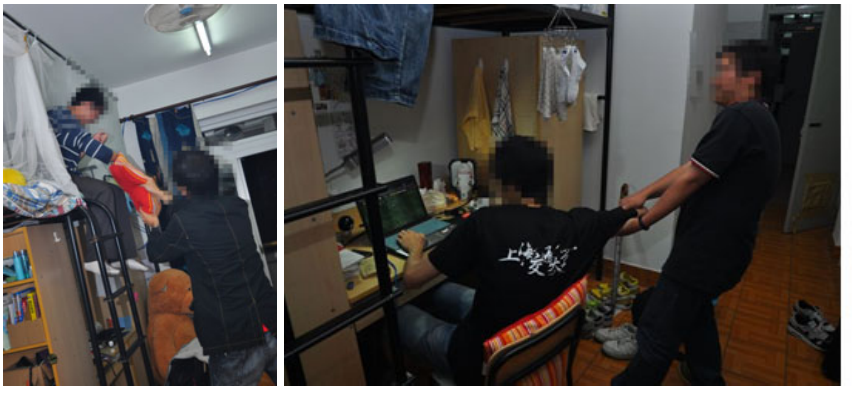

Fig. 4 - 5. Male students often do big and rough acts to their roommates, which shows their intimate relationship and meanwhile improve their relationship

Characteristics of Female Students' Body Language Communication

- Comparatively subtler and more sensitive body movements
- More use of body language when expressing feelings like remorse, gratitude or excitement which are embarrassing to mention.
- Increasing amplitude of body communication with the intimacy degree of relationship, regardless of gender.

2.5 Effects of Gender on Communication via Written Language

Many researches indicate that female is superior to male in language ability. According to the statistics from US Ministry of Education, boys are 1-1.5 years behind girls of the same age in reading and writing [2]. China's research on language shows that the fact that female students score higher than their male counterparts in content grading is linked, in some degree, to more frequent use of attributive adjectives and adverbs. [3]

In terms of the gender proportion of China's IM users, the vast majority of users of IM in China are male netizens, most of whom are not good at communication in written language. If their body language communication in daily life can be transferred to Mobile IM, demands of IM users will be greatly gratified and bring prosperity to the IM market.

3 The Future Development of Mobile QQ

University-student users are chosen as the subjects of this research so that a new mode of Mobile QQ—body language interactive communication— is designed in place of traditional one-way discrete design of Mobile QQ.

3.1 Definition and Features of Users

Logging on the internet through mobile phones, those city university students usually have access to enough web resources.

Because of this feature of this user group, new IM mode is designed to cater to their feature, presenting them the media in the form that is familiar to them. With their daily life and the times being taken into consideration, the future development of China Mobile QQ design can be characterized by three expressive features: animation, game, and joke.

3.2 Design Ideas about Mobile QQ Show via Body Interactive Communication

Following the development trend of future mobile phones, this research uses touch screen mobile phone as the carrier to design the concept product of Mobile QQ. The following part will give a brief introduction of some design ideas about Mobile QQ via body interactive communication:

- Design brings both parties of IM to the same scene to establish an interactive state;
- Introduce body interactive communication by doing acts to the image of the other party or to oneself;

Fig. 6. Icons Images of Mobile IM Originating from Animated Films and Games

- Use animation or game as much as possible. (see Fig. 6) and try to avoid ambiguity in understanding by doing the acts that have generally accepted meaning;
- Protect privacy, prevent misuse like spreading porn or violent content and take network ethics into consideration;
- Give some thoughts to gender factors;
  Factors can be considered in designing male movements:
  i. The amplitude of body movements should be big in terms of intensity and interaction;
  ii. Take as themes computer games, martial arts novels, wars and weapons;
  iii. Signify interesting and exciting topic by shaking or nudging the other party;
  iv. Show the close relationship with new male friends by shaking hands or hugging;

  Factors can be considered in designing female movements:

  i. Show more head or hand movements and nestling to each other is more common among the body movements;
  ii. Complement the outlooks of the other party (e.g. hair, skin or figure) by caressing hair, face or body parts;
  iii. Show friendship by holding the other party in the hand when meeting new friends.

Besides differences in body movements between male and female, mobile QQ of body interactive communication can take into consideration allowing more body touching for the same gender and meanwhile set more restrictions to body interactive communication between different genders.

- Further develop sensory communication (e.g. touching, auditory) by integrating some physical expressions such as music, vibration, temperature or air-blowing

4 Prospects and Limitations of Body Communication Interaction of Mobile IM

The mobile IM with body communication interaction integrated can compensates the deficiency of one-way traditional input mode, that is, text input with facial

expressions. It plays an important role in emotional communication. Especially when people are in motion or in other situations which are inconvenient for writing, such as on bus, or hoping to express their complicated emotions in a quick way, they can communicate with each other via body communication interaction of mobile IM.

Besides, it will be more convenient to use new mobile IM to express richer meanings for those who are less literate, more emotional, or those who seldom use computer or have difficulty communicating in language (e.g. one party of the communication know little about the language of the other party), or those who are not good at thinking in images.

We, however, also notice that there have been ever-increasing potential problems with body communication interaction concerning network ethics, privacy protection and cultural-related offence. Undue use of violent body movements will have negative effects on communication. And too many icons will be a strain on users' memory because it is difficult to seek icons on small mobile phone screen and the difficulty in communicating will increase logging-on time and hence increase the cost.

Furthermore, there are big differences in understanding body language among people from different cultures. Once the mobile IM with the function of body communication interaction is launched in the market, it will be easy to attract consumers with its novelty and fun operation, but when their passion for the new stuff has gone, then how body communication interaction, an unnecessary auxiliary function, can retain customers for life is a question that needs in-depth study.

Acknowledgments. The author also appreciate the work of other project team members including Xiaogang Ou (group leader), Yezhou Dai, Jiaying Lu, Kaicheng Qiu, Bowen Shen and Le Meng. All group members, including the author of this paper, are from Media and Design School of Shanghai Jiantong University.

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An Investigation on the Relationship between Informal Networks and Organizational Performance

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Abstract. By mapping both social related (energizing) and functional (information) related informal networks and collecting the performance data correspondingly in one of the biggest Express Company in the world, this paper showed: (1) There is significant relationship between organizational performance and informal network indices, which means we can predict orgniztions' performance by the informal network patterns. (2) Emotional network showed stronger relationship with social aspects of organizational performance and functional network showed stronger relationship with functional aspects of organizational performance, which implies that we need to choose different informal networks to predict different kind of performance.

Keywords: Social Network Analysis, Organizational Performance, Information Network, Energizing Network.

1 Background

The relationship between social network structure and performance has been a hot research topic for decades. Recent researches have showed there was significant relationship between social network indices and organizational performance. However, we found two issues in this area after reviewing the existing literature: (1) Most literatures only adopted one dimension to build up the social networks. And most of them only collected one performance indicator, which limited the possibility to differentiate the influence of different kind of networks on different performance. (2) Most existing literatures that focused on organizational performance were mostly based on inter-organizational networks. Since organizations could different from each other by structure, size, revenue, business and so on. The result they got might reflect these differences.

To address the above two issues and get a better understanding on the relationship between informal networks and organizational performance, we collected multiple organizational performance from the 22 Chinese branches of Company A. Company A is one of the biggest Express companies in the world. Because all of the branches have the same structure and strategy, the network indices and performance are much more comparable. We also adopted 2 different dimensions to build up the informal social networks within Company A in China.

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2 Methods

Both online and paper based (only for those who did not have an Email) Social Network Survey was sent out to all of Company A's 25 hundred employees in China in December 2009. They were asked to select a group of employees on each social network dimension from the predefined employee list in the online survey and to write down a group of employees' names for each social network dimension in paper-based survey. 1995 responses were collected after two weeks, so we got a response rate of 80%.

We argue that there are naturally two kinds of relationships in organizations. The first one is functional relationship. People will use functional relationship to get information, work related material, and search for expertise help. Another kind of relationship is social and emotional relationship. People will use this kind of relationship to share personal issues, to make friends and so on. Based on the above argument, the following 2 dimensions mapping both functional relationship and social relationship were adopted in the survey (see table 1).

Both 2009 and 2010's performance data was collected from all of the Company A's branches in China. 4 kinds of organizational performance were collected and they are customer satisfaction index (CSI), financial performance(FP), operational performance(OP), and turnover rate (TR). Customer satisfaction is the aggregated index from Company A's monthly survey, which includes 7 questions, that captures the most important dimensions, such as value for money, professionalism, complaint handling capability, overall satisfaction and so on. The financial performance is the percentage of the budget that each branch completes for that year. The operational performance is defined by the controllable operational errors for each branch. Turnover rate is the ratio of volunteer-leave employees for each branch.

Table 1. The two informal social network dimensions

Dimension	Domain	Survey question
Information	Functional	Please choose people you typically get work-related information from.
Energizing	Social	Please choose people you feel energized by when you interact with them.

3 Result and Discussion

We normalized all 4 kinds of performance data for both 2009 and 2010 and aggregated two years data together for data analysis.

UCINet 6.289 and Pajek2.0 were adopted for network data analysis. The network density was calculated by UCINet for each branch on each network. Individuals' Indegree, Outdegree, and Constraint were calculated by UCINet on each network and then were averaged for each branch. All 5 kinds of brokerage for each individual were calculated by UCINet and added up and then averaged for each branch. Tradic census were run for each branch by Pajek and Tradic ratio was calculated as the ratio of the

patterns that connect all 3 individuals without considering the direction of connection to all trads/dyads for each branch.

Since the network indices varied much with the size of different network, partial correlation was adopted for data analysis. The number of people participating this program for each branch was taken as the controlled variable. 4 branches' data were excluded from the data analysis because of one of the following reasons. (1) Branch size were too small so there were less than 10 people participating this research program. (2) The turnover rate was more than 20%. So, there were 18 branches data were put into the calculation. Table 2 showed the correlations between the organizational performance and network indices.

Table 2 showed that there is significant relationship between informal social networks and branch level organizational performance. Financial Performance(FP) and Turnover rate (TR) showed stronger relationship with all network indices and Operational Performance (OP) and Customer Satisfaction(CSI) showed weaker relationship with network indices. Even though some of the correlation (marked as [a] in table 2) did not achieve significant level ($0.05 < p < 0.08$), we are arguing that they do reflect the potential relationship between performance and network indices by considering the small sample size (18) and the magnitude of the correlations.

As we argued, we assumed that different kinds of informal networks would show different level of predicting power for different kinds of performance. This assumption is also supported from the table2. Firstly, financial performance only showed significant relationship with network indices on information network and showed no significant relationship on energizing network. Secondly, operational performance only showed significant relationship with constraint on information network but not for energizing network. Thirdly, Turnover rate only showed significant relationship with brokerage on energizing network but not for information network. We believe that the financial performance and operational performance reflect more functional aspect of organizational performance and turnover rate reflect more social aspect of organizational performance. So, it clearly showed that the functional network (information network) can predict the functional aspect of performance (financial performance) better and the social related network (energizing network) can predict the social aspect of performance better.

Table 2. The correlations between organizational performance and network indices

Network	Performance	Density	Triadic ratio	Indegree	Outdegree	Brokerage	Constraint
Information	FP	0.49[a]	0.54*	0.37	0.61*	0.51*	0.04
Information	OP	0.00	0.04	-0.34	-0.15	-0.23	0.59*
Information	CSI	0.27	0.20	0.49[a]	0.32	0.21	-0.51*
Information	TR	-0.63*	-0.45[a]	-0.45[a]	-0.55*	-0.39	0.33
Energizing	FP	0.41	0.27	-0.14	0.01	-0.11	0.10
Energizing	OP	0.08	0.09	-0.42	-0.18	-0.10	0.44a
Energizing	CSI	0.10	0.22	0.73**	0.56*	0.36	-0.24
Energizing	TR	-0.58*	-0.49[a]	-0.49[a]	-0.55*	-0.49[a]	-0.08

[a] $0.05 < P < 0.08$ (means the correlations were approaching to significant level.)
* $0.01 < P < 0.05$
** $P < 0.01$

4 Conclusion

In summary, through mapping both social related and functional related informal networks and collecting the performance data correspondingly, this paper showed: (1) There is significant relationship between organizational performance and informal network indices. Financial performance and employee turnover rate showed stronger correlation with network indices. (2) Emotional network showed stronger relationship with social aspects of organizational performance and functional network showed stronger relationship with functional aspects of organizational performance.

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Designing for Social Urban Media: Creating an Integrated Framework of Social Innovation and Service Design in China

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Abstract. In recent years, social media and social networking are increasing the global crucial topics. More and more people in China begin to merge into this virtual networking. Meanwhile, the continuous expediting of urbanization also occurs in the real world. It is a big challenge for designers to coincide with the new trends of city and media. New design thinking frameworks and methodologies will be needed to solve the emerging problems in the cities of China. As being designers with social responsibility, we have a critical quest that is how to design for the social innovation, sustainably for the most people and improve the social life in the context of developing local and cultural city environment. The trend of service innovation leads a new round of economic growth, which is happing in China. We developed a new framework with three perspectives about social innovation, i.e., social interaction, social integration and social inclusion. To solve the problems brought from urbanization, we need the holistic perspectives with the integrated methods of social innovation and service design. The case studies, which devoted to create the innovated application and service for the urban life in China, show the power of integrating the urban and media together in design thinking and implementation.

Keywords: Social Media, Design Framework, Urban Media, Service Design, Social Innovation.

1 Research Background: Socialization Trends in China

1.1 Urban as New Platform for the Research

Due to the rapid development of urbanization, both the social and environmental have emerged many problems in China, especially in the large cities, e.g. Beijing, Shanghai. Some of the major issues are:

- **Traffic:** Beijing has become one of the world's most congested cities. Despite the government has introduced “odd-even” license plate traffic restriction and

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restricted the number of new car purchasing, travel is still a big problem. As a result, the traffic accidents, exhaust pollution are becoming increasingly serious.

- **Population Aging:** With the improvement of living conditions and sustainable family planning policy, China has gradually entered into an aging society. More elderly people living in the city and the number of empty nest families began to increase which, proposed new requirements to the social medical, health and service system.
- **Environment:** environmental pollution has become critical, the air pollution, noise pollution, heat island effect, water shortages, etc., are seriously threatening people's health and the quality of life.
- **Society:** As the economic is in the state of transition, people live in large cites feel more stressful and anxiety about their life and work. Social justice and other issues also lead to dissatisfaction. These problems reflect the current social situation. However, as more concern has been paid and new technologies development, it is possible to solve these urban issues by innovation [1].

1.2 Social Media as a New Way for Social Innovation

When the Chinese government mentioned the inclusive development in the government's conference in 2010, design disciplinary meets a new challenged future in China. Design practice will be more focused on the social inclusion and public service. Particularly, based on the popularity and development of social media and digital media in China, the social network provided a new platform for service design in cyber space, which also enabled the feasibility for the social innovation.

The new technology platform are not only computers but also mobile and Internet. Most cyber service can be provided through these cheap and flexible devices, including mobile phone, portable devices, tablet PC or cloud client. However, the mobile network and Internet in China cannot satisfy the requirement of high bandwidth for so many users perfectly. The current situation in China includes a high popularization of smartphones, a large number of clients and low bandwidth. Restricting Interaction and service design by these Chinese technology characteristics, it is a starting point for participants to design for China. Appropriately designed applications on healthcare, education and entertainment will create a new market and shorten the distance between information societies with low-income by utilizing new technology all over the world.

1.3 Mixed Social Life in China

We focus on exploiting the social media innovation topic. Social media innovation is design for the people and will have extensive and intensive impact of society. The social media is in the profound change now. The change is pushed forward specifically by the revolution of Internet media and mobile media. It reflects on following points: the revolution of social media advances the communication processes by the social group center, enhances the relationship among the groups and improves the activity of social individuals. New social media has become a bridge bringing real social life and cyber space closer. It has brought the possibility of creating a 'flat world', which passes off as much of statement as possible and gives

the equal power of speech to everyone. The new generation Y[1] is very familiar with the new technology and social media. Meanwhile the improvement of information infrastructure in China has provided a mobile and cross-media platforms and applications to serve the social interaction. The most important social networking is *Renren*, *Tencent, kaixin001and Sina* In China . There are 140 million user registered in *Renren,* 100 million concurrent users in *Tencent.* The social networking games is very popular in 2010 which cause the concern of the whole society and a strong response. It can be seen there is a large target group for social media app and service.

2 Research Methodologies and Process

Research Plan. This paper is interested in find a new way to bridge the social communication with the real city life, and then, create an innovated application and service for inclusive development. With the blooming mobile and social computing technology, the content generating, information collection and attitude sharing in the social network website become a daily life status for most young citizen. People can connect with each other not only by location or event, but also through shared information and attitude about special topics on the SNS platform. Mapping the abstract attitude and relationship based on the social graph will be the fundamental research for design practice. Following the methodology of "research through design" [2], we divided it into two parts: research and prototype design.

Survey and Visualization of Social Communication Pattern. Based on the survey on the social media application in China, we will visualize the social pattern of the user preference and the influence of different topics, and explore the model about how does the hot topic cycle and transform in social network through the support of data mining technology. Research will try to reveal the patterns of collective attitudes and experience expression and transformation through the collaborated collecting, sharing and transferring actions in the SNS platform [3],[4]. Few specific topics which related to city will be selected for the investigation process. We will build a special website or a special topic group in the social network site, such as *Facebook, twitter, Renren, Douban or Sina micro-blog* to explore and capture the data about cross-cultural communication.

The achievements of this part will involve the survey of collective interaction patterns in the SNS platform, visualization of the transformation and circulation model of hot topic based on social graph, exploration of journey mapping on cross-cultural collective attitudes and experiences in online community. For example, our

[1] In mathematical sociology,interpersonal ties are defined as information-carrying connections between people. Interpersonal ties, generally, come in three varieties: strong, weak, or absent. Weak social ties, it is argued, are responsible for the majority of the embeddedness and structure of social networks in society as well as the transmission of information through these networks. Specifically, more novel information flows to individuals through weak rather than strong ties. Because our close friends tend to move in the same circles that we do, the information they receive overlaps considerably with what we already know. Acquaintances, by contrast, know people that we do not, and thus receive more novel information.

project “I see Beijing” mapped collective attitudes of the modern and traditional architectures in the cross-cultural context. Project “Flow” will study the media transformation and pass information through cross-culture context.

Social Media-based Prototype Application Design. Based on the findings from social media research, we will design an application prototype on the selected topic of cities. The impression of the city means the reflective experience of the real urban culture, life and landscape. However, these are very hard to produce a prototype and be visualized. Therefore, a special medium, such as smart product, that can connect the virtual and real world is needed. Alternatively, we can select topics on info-structure of city, such as Transportation, care, security, help, etc. as a thinking strategy and breakthrough point to present the new application and service about the specific perspective of the city. The patterns and prototypes developed in this research will be the reference for the further research on social communication; the practical deliverables also can promote the social innovation in the context and culture of China [5], [6].

3 Framework of Our Research

3.1 The Model of Communication

Based on the SNS design a method and theory of communication are needed. In the traditional model of network communication, users use the tools to post and receive the information in the communication platform. It can be noticed that the communication platform collect the personal opinions and form a subject to attract more audiences when it became a large scale it will be a public opinion and will break the old balance and get more respond, shown as Figure 1.

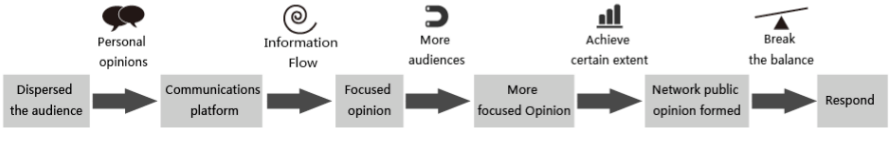

Fig. 1. The model of communication

3.2 From Individual to Social Communication

In terms of the media experiencing from individual communication to mass communication and social media communication, compare with the impact and the participations, we can see that the weak tie and the strong tie play an important role in the communication and the weak tie create the new opportunities so the people can contact with each other in position, time, event or attitude. There are design gap for service application. In the urban media, users are aggregate together and form small communities for communication. The traditional communication studies: “symbolic interactionism theory” believes individual selves are generated from interaction with

others and during the interaction, people shaping themselves based on other people's perception (the looking glass self). The community is a background of individuals and, therefore, forms primary group. People are connected through weak ties and strong ties In the varying environment, people are generating, connecting, managing, and sharing which forms the top level of social interaction (see the figure below) The first level of the framework map represents individual, the second level is media and the third level is location. These three levels are corresponding to the social interaction, integration and inclusion respectively. In the first level, we study commutation between individuals and groups through information generation, sharing and social network in a virtual space. In the second level we exploit how to combine individuals with urban media to produce applications and services, meanwhile, meet the requirement of social life, work and entertainment. Finally, the third level is in a real environment and we consider from commercial, society and technology aspects to achieve the inclusive social innovation.

3.3 Integrated Framework of Social Innovation and Service Design

Through social media, individuals can share their own information, and they can experience and share the public information together. Social integration means to connect people with media and environment, integrate systematic urban basic installation platform and converge the power of trans-media. Social inclusion makes personal service transfer to public service for city. From the perspective of social responsibility, social fairness and social care, which represent the value of service by combining design, technology and business together. Thus, a new model based on social media innovation can be provided. According to the research mentioned above, an integration framework is created for solving the integration of social media and

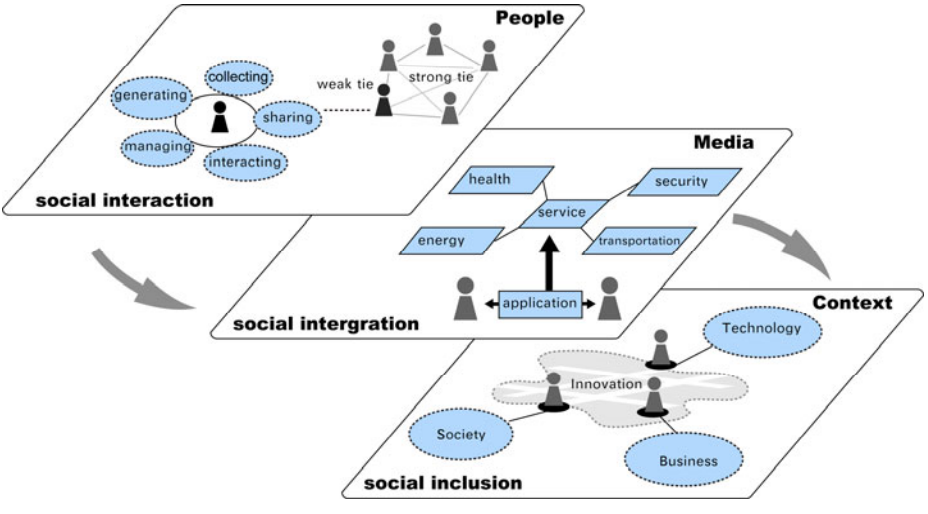

Fig. 2. Integrated frameworks

urban installation, which is also used for new social innovation application and service design reference point, shown as Figure 3. The framework includes personal service and shared service. The different weak tie circles have been integrated to be an urban service network by social media. These innovation applications provide the number of active interactive users, smooth the information system environment and widely applicable space and topics for social media, through which the social innovation is possible, shown as Figure 2.

4 Case Studies

Based on the research of social media, few projects were developed to implement the theory and framework, including the application of social communication model and service design through the platform of social network.

4.1 Visualizing and Transfer Social Mind Based on Social Networking

Mapping Collective Attitude through Social Media Application. In the social media application, people connect through media and content. Based on cross-cultural social media, the project: "I see Beijing" expressed the shared manner of community in the urban environment. The social media has provided an enormous participating space for the users, with the characteristics of high participating, openness, less barriers, easy to share, community, connectivity and so on.

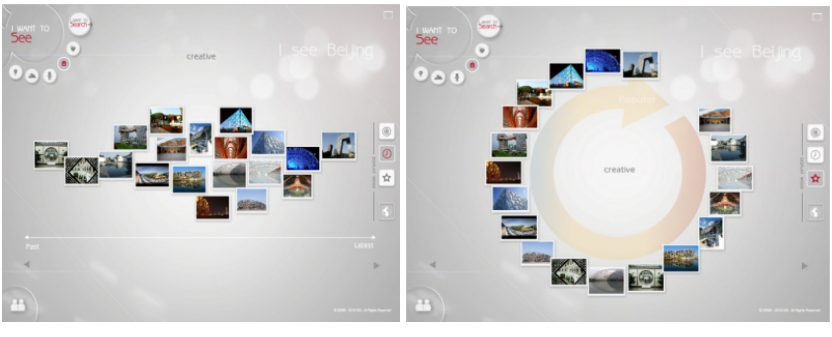

Fig. 3. Mapping collective attitudes through image

"I see Beijing" is based on exchanging innovative design on social media platform, and behalf of each person's different angle of view on Beijing. Choose to share your manner and observe difference between one's idea and others. After having collected more and more angles of view, the thing will become more three-dimensional and be close to the reality (shown as Figure 3).In the design process, attention has been drawn on the level of interpersonal interaction while the interactive mode and the interface design can well meet user's demand and behavior pattern [7].

Beijing~New York Flow
A collaborate project among Parsons The New School for Design in New York, Tsinghua University in Beijing and Yuanfen~Flow, this project is a cross-cultural dialog between China and the USA. It will utilize video/audio, multimedia and SMS text messaging to find similarity between these two ideologically and geographically distant cultures. The subject of the dialog is urban media: culture, art, fashion and technology. Through the mutual supplement, explanation, mark and share to eliminate the misunderstanding and the prejudice.

4.2 Service Design through the Platform of Social Networking

Connecting people by smart product and service. In the "Smart connector" project, we were going to find a new natural way to connect people within the social networking to share information and create co-experience. [8] With the extensively used social networking sites, been contacted by SNS has become a popular life style. The project aims to find a new kind of social experience, with more natural way and more concise interactive language and also enable to communicate with the virtual world.For the prototype, a four-wheel drive cars that controlled by a PC was made and an external load of two infrared sensors to make actions of a variety of movement. The sensor signal can also change the image content of social network server which is displayed on the PC. Sensor controls different content can be switched by the image [9] (shown at Figure 4).

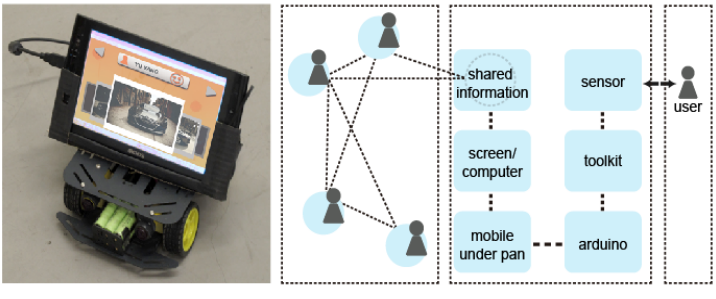

Fig. 4. "Smart connector" project

Design for Co-driving in Beijing. This "Easy Taxi" project is about how to use the social media for taxi drivers. People connect with the environment and are able to integrate the urban infrastructure platform and converge the power of trans-media and therefore, make a better service system. In this project we used the service design method through analysis. We found the main problem for the driver is communication, traffic condition & guide, park and toilet. In the analysis of traffic, focus on the weak tie between the different groups of taxi drivers in Beijing and the driver can sharing the information on the road (shown as Figure 5).

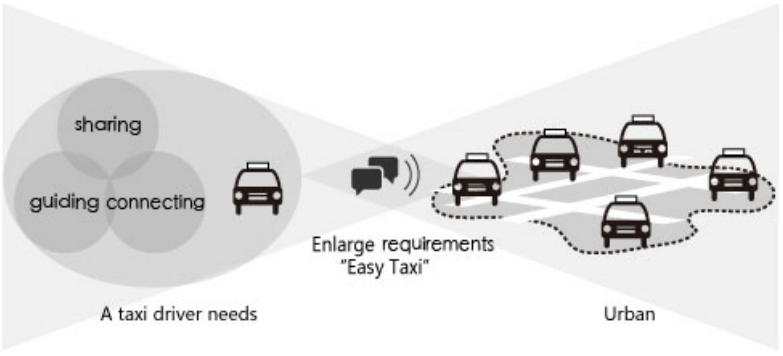

Fig. 5. "Easy Taxi" project for co-driving

Design for Urban Media: Security and Circulation. This research examined the inter-relationship between emergent digital media systems and existing urban infrastructure by studying the way the cities combined their media and infrastructure systems and we refer as Urban Media in this paper. "PublicEye" is a public service for the crowd security in a huge gathering. The system can help the organizer sense and monitor the crowd in specified area and broadcast message to people through mobile networking service on site, shown as Figure 6.

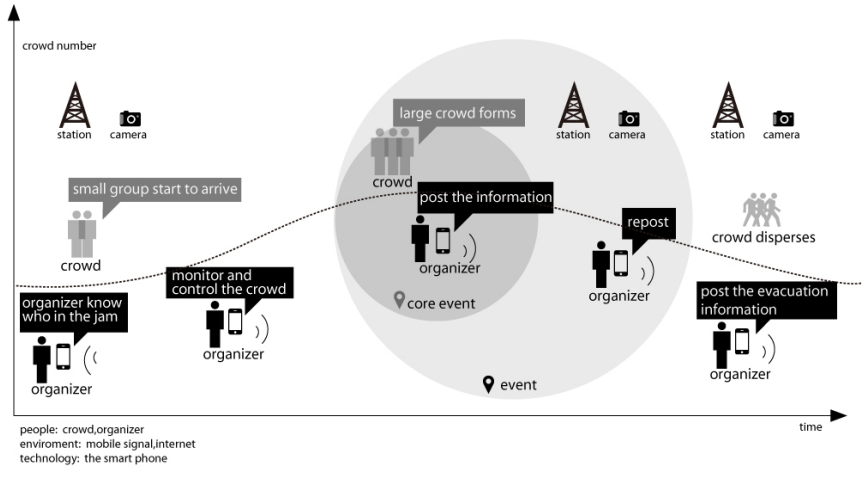

Fig. 6. Design for city security

5 Discussions and Future Work

Social media plays an important role in both integrating the real and virtual communities and servicing the society [10]. It also provides the possibilities to improve the ability of cities through design framework. Comparing with the product

renovation, it is more valuable for designers to innovate the whole system inside the business or public service industry. The future study should be more comprehensively and deeply focused on the following applications and services.

Mapping and Visualizing Info-structure. The new research combined the social graph with the data mining methodology, media model and the user study for further development. Inside the social information flow, all of the contents were come from users. It helps us understand the human emotion and culture [11]. Meanwhile, we can present the city from a new perspective, such as happiness, angry, sadness, fun, surprise, scare and sorrow. Through the result of this research, we discovered there were various forms of expression about sharing attitude and thought. The visualization can reveal the strategy and trends of Chinese urban development at a macroscopic level.

Research on the Co-design and Co-production. With the development of crowdsourcing, the service industry has paid more attention on co-design and co-production. With the perspective of co-working, we consider about how to share, translate and shape the valuable knowledge ultimately in virtual space. This study was better combined the innovation needs of the labor-intensive industries, rich culture and unbalanced development in China, the Chinese designers need to improve the public service innovation and satisfy the social requirement in Chinese city life. Our research leaves the designers large room to play.

Design for Public Service and Social Impact. Digital survival has become a part of people's urban life which has been involved in both working and entertainment. It does not only represent the social networking, but also some specific applications, e.g. location-based service, event-based service that really helped our life. The mobile SNS applications, such as iPhone app. Waze and Every Trail, provide the new extensions in cyberspace for Chinese cities. Based on co-design and co-production, the next direction of practice is to design applications that are focusing on social responsibility which includes health, safe, care, assistance, and environment.

Integrated Design Theory and Interdisciplinary Education. Due to the requirement of social interaction and service design, we need to integrate social innovation, user experience, service design, sustainable design and information design methodology to solve the urban problems by theory innovation and practice. With the current situation in China, training responsible designer through interdisciplinary program is vital for the inclusive development. Integrated design theory and interdisciplinary education will lead the development of social innovation to future.

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Mobilized Collaborative Services in Ubiquitous Network*

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Abstract. The paper inquires how collaborative services evolve in ubiquitous network. By comparison study in systems of solutions and interactions of services, it defines a conceptual framework of spaces of auras in mobilized collaborative services, proposing four kinds of network and interaction structures: *Peer-to-Peer (P2P), Role-to-Role (R2R), Peer-to-Common (P2C) and Role-to-Centre (R2C)*. The conclusion of discussion is that in MCS, the form of space of auras decides mainly the way of interaction, the structure of system and degree of relational quality.

Keyword: Collaborative Services; Social Innovation; Ubiquitous Network.

1 Introduction

The phenomena of collaborative services (Jegou &Manzini, 2008) and production are emerging and booming in two contexts by different ways: they emerge as *Creative Communities* (EMUDE, 2006; CCSL, 2007; Meroni, 2007), on one hand, in everyday life such as Car-Pooling and Co-Housing; on the other hand, in cyber space they appear as *Open Source Method* (Mulgan, Steinberg & Salem, 2005) initials, such as Linux and Wikipedia. The former are groups of people who creatively and collaboratively solve everyday life problems by themselves, and their behaviours imply environmental sustainability and increase the social fabric. The later are volunteer-powered, internet-enabled and geographically-dispersed *Networked Information Economy* (Benkler, 2006).

As matter of fact, with diffusion of *Information and Communication Technologies* (ICTs), the two spaces become nearer each other. In particular, high diffusion of *Mobile Communication Technologies* (MCTs) arise *Ubiquitous Computing* (Weiser, 1991), *Personalized Network* (Wellman, 2001) and *P2P Relational Dynamic* (Bauwens, 2005; 2008). The synergetic relationships between virtual spaces, physical spaces and social spaces evolve to a hybrid space, *Space of Auras* (Casalegno & Susani, 2005), which is more conductive to social interaction between people and their communities.

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The research starts with hypotheses: 1) Design could play important roles in promoting social innovation with new design paradigms; 2) The convergence between social innovations in everyday life and radical innovations in cyber spaces could generate new transformation of our lifestyles towards sustainability; 3) Mobile communication and ubiquitous computing, bridging physical spaces and cyber spaces, could be key enabling technologies in this convergence. The principle concerns of this research are: How MCTs enable collaborative services; what are the values of them; and how collaborative services evolve in this convergence.

2 Promising Cases and Design Proposals

Around these concerns, the research conducted three empirically-based research activities through mixed approaches between phenomenological and action research: one cases study and two research-based design projects. The cases study, Connectivity for Social Innovation, is research collaboration between DIS-INDACO, Politecnico di Milano (POLIMI) and MEL-Design LAB, Massachusetts Institute of Technologies (MIT). It aims to investigate the creative applications of mobile communication for social changes all over the world and identify the promising cases of collaborative services enabled by MCTs. The two design projects aim to explore

Table 1. Categories of cases and proposals

Categories	Promising cases	Design proposals	No.
Producers/consumers networks	Cell Bazaar	FINDING THE FRESH	2
Community-based initiatives	Neighbourhood Watch Wildlife	PRO.POST.E FINDING THE FRESH	4-1
Result-oriented encounters	Baltic Sea Alternetrides	LA MAGLIA MOMS TALK TAXI POOLING	5
Mutual-support circles		BIBLIOTICKET PRIDE HOUSE	2
Caring and support activities		AGORA’	1
Competences, time and products exchange	MCT-supported Time Bank	BOOKCASE	2
Mapping diffused information	People’s 311 Ushahidi Platial Maps	CANTASTORIE PRO.POST.E YESTERDAY ONCE MORE FOOTPRINTS	7-1
Mobilizing volunteers	BabyGoHome Amber Alert Baltic Sea The Extraordinaries Cell phedia Pedigree Fighting Avian	RITAGLI DI QUOTIDIANO	8-1
	15	13	28

the potential solutions of collaborative services in ubiquitous network society. The first one, LSF07: Digital Service and Collaborative Network, was synergized into the final synthesized Lab in master programme of service design at Design Faculty, POLIMI, in collaboration with Commune Sud di Milano and TeleCom; the second, Chita08: Collaborative Service and Mobile Communication, was organized at School of Design, Jiangnan University (JU) in China as a formal collaboration between POLIMI and JU.

As results, by cases study one hundred cases with an ad-hoc format are collected and fifteen of them are finally selected as typical promising cases of collaborative services in ubiquitous network. And they are defined as *Mobilized Collaborative Services(MCSs)* for their distinct characteristics; by design projects, thirteen design proposals are developed, based on the local contexts and real problems, as potential solutions or scenarios of MCSs. As table_1 the cases and proposals are complementary to fill in the different categories.

3 Space of Auras and Dynamic Social Ties

Comparing between MCSs and those from creative communities, they have strong common in the nature of being collaborative but as a whole they are different in what are possible to do and the way of interaction. In MCS the interaction happens in different spaces (cyber space and physical one) and in different way. Taking another example of city maintenance, there is a creative community, Public spaces renewal in Norway [1] (Meroni, 2007). In that case, the neighbourhood spontaneously work together to renewal their public spaces. By doing it, the social ties are reinforced between them. In this study, the case of "People's 311" is a MCT-enabled city maintenance system where interactions happen in different "spaces" and ways. Obviously, the elective community of former case is still based on the neighbourhood, a door-to-door network (Wellman, 2001). While in the second case, the elective community is largely based on person-to-person network (Wellman, 2001). The similar comparisons can be done between other service ideas like community-based agriculture, Car-pooling, Time bank, City Maintenance and etc. In a word, mobile communication and ubiquitous network change the processes and experiences of interaction in the collaborative services.

Ubiquitous network transcends spaces between geographical locations, moreover, between the cyber spaces and the physical and social spaces, which integrated into a hybrid space, space of auras: it is fluid, dynamic, intangible, but "liveable", and it serves as a catalyst for social relation (Casalegno, Susani & Tagliabue, 2003). In those cases and proposals, the interactions take place in sophisticated and multi-facets spaces where we can find the flow of social relation is very different from those creative communities. The social ties between the participants are flexible, dynamic and diverse. The relational quality (Cipolla, 2006) is proposed as a key element of collaborative services in EMUDE. And this idea indicates several characteristics: firstly "clients" and "providers" are interwoven; secondly they require mutual responsibility and high degree of trust; thirdly, they propose the achievement of

[1] Retrieved from www.sustainable-everyday.net/cases

wellbeing based on interpersonal encounter. This relational quality still exit in MCS, however it has been transformed into different forms of relationship. It's true that the "clients" and "providers" are interwoven, such as Finding the Fresh and Agora'. But in more cases, there is no difference between "clients" and "providers" at all. The relationship between the participants becomes peer-to-peer partnership such as Wildlife and Biblioticket. In some cases, the participants don't work for each other, but with common values, such as Baltic Sea and The extraordinaries. The different forms of relationships ask different ways of interaction and different degree of social ties.

Furthermore, the mutual responsibility and high degree of trust are still favourite conditions for MCSs, but the threshold of the condition largely decreases when the accessibility and identical trust increase, such as Neighbourhood watch, they don't have to know each other well. In some solutions, the collaborative services don't depend on the relational quality but on the common value between them, such as Baby Go Home or Pride house. The flexible and diverse social ties between participants generate much more possibilities to collaborate. Finally, interpersonal encounter is still an important way to achieve the wellbeing in most of MCS. But interaction in virtual space or virtual interpersonal encounter is also essential part of wellbeing, such as Wild life or La Maglia. In case of The extraordinaries and proposals of Ritagli di Quotidano, they shows it's also possible to achieve wellbeing by the collaborative action with common value instead of interpersonal encounters. The dynamic interaction brings dynamic social ties.

4 Relational Forms for Interaction

Mobile communication arises the spaces of auras in MCSs. In auras, the dynamic interactions generate dynamic flow of relation, and dynamic social ties. By looking

Table 2. Relational forms of cases and proposals

Relational forms	Promising cases	Design proposals
Peer-to-Peer	Neighbourhood Watch Wildlife Alternetrides	LA MAGLIA MOMS TALK BIBLIOTICKET TAXI POOLING
Role-to-Role	Cell Bazaar MCT-supported Time Bank	FINDING THE FRESH AGORA' BOOKCASE
Peer-to-Common	People's 311 Platial Maps BabyGoHome Cell phedia Ushahidi The Extraordinaries	CANTASTORIE PRO.POST.E YESTERDAY ONCE MORE FOOTPRINTS RITAGLI DI QUOTIDIANO PRIDE HOUSE
Role-to-Centre	Baltic Sea Amber Alert Pedigree Fighting Avian	

into the promising cases and design proposals, the research focuses on the framework of interaction between actors and systems and the flow of relations regardless of different services ideas and contents of interactions. It is found that there are several relational forms implicated in them, depending on the different structures of interaction, and catalyzing the different social ties between the actors. Those relational forms can be synthesized as: Peer-to-Peer, Role-to-Role, Peer-to-Common and Role-to-Centre as Table 2.

4.1 Peer-to-Peer

Peer-to-Peer relational form connects actors directly. Actors are usually in the same position of the system, forming a decentralized and flat network, an inter-personal network. By mobile communication, the actors can reach each other with interpersonal interactions, by acting or reacting. It's an extreme case of interwoven between clients and providers. There is no difference between actors.

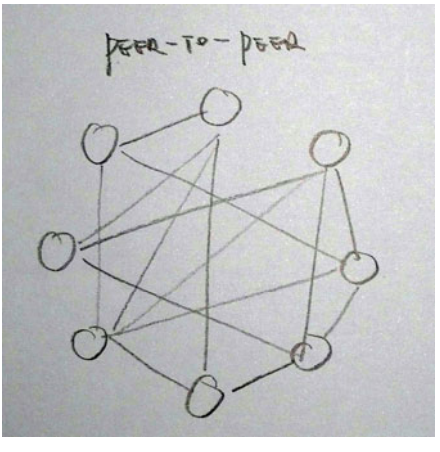

Fig. 1. Peer-to-peer

Since the interactions may take place between any of actors, it requires a certain degree of relational quality between them. As matter of fact, in most of solutions, they are based on certain communities. How much degree of relational quality they need depends on what kind of services they deal with. In the case of Wildlife, actors use it to post or receive the urgent and vital information, which calls a high degree of relational quality, while in proposals of Taxi pooling, actors use it for car pooling once, which calls much less. In most of solutions, the identities of actors have to be recognized and guaranteed in certain way, which is often empowered by mobile communication.

And the interactions both take place on the cyber space and physical space. In most of solutions, they keep in connection and keep ready, which provide a favourite context for the interaction in cyber space. The interaction may lead to physical encounter. And the interactions in cyber spaces are usually preparation of physical encounters. Whatever interactions in cyber spaces or physical spaces, they enhance to social ties effectively.

The direct interactions between actors promote the dynamic social ties. Actually actors have high autonomy in persons who they would like to interact with different reasons and motivations. Slowly there will be some tribal communities (Casalegno & Susani, 2005) appearing in the network. The social ties between them are relatively dense. The strong ties facilitate the interactions between them, and diffuse the density of social ties, so on and so forth. Finally the average social relations arise and the spaces of auras become denser.

4.2 Role-to-Role

Role-to-Role relational form means the actors specify their roles in the solutions. They also can connect directly but mainly between the corresponding positions in system. According to problems that solutions meet, the interactions are oriented to give the meaning of specific roles, and actors know their roles in system and how to act.

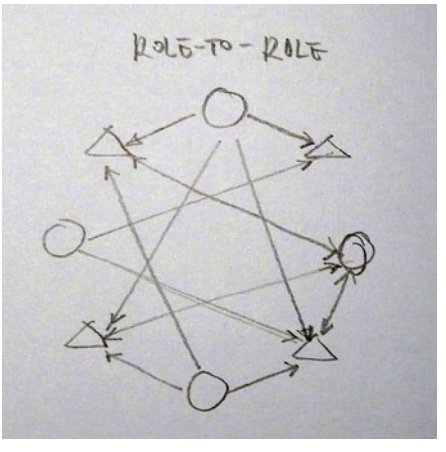

Fig. 2. Role-to-role

In this relational form, the relational flows between actors are not symmetrical and they are usually in two sides of problems. And actors in each side play a specific role in solutions. As they also connect directly, it also requires certain degree of relational quality depending on what specific tasks they collaborate. The actors with different roles can be interact in quite different way, for example, in the proposal of Agora', the actors with questions have to intend to propose request while the tutors have to wait the request. They have different autonomies in actions and need different degrees of trust.

As the actors with different roles are in the context of common problems, they have concrete targets to connect each other. The interaction between then may effectively enhance the social ties of them because of the complimentary between the roles. Even though the direction of interaction is oriented by role, there have rich possibilities in who to connect. Theoretically each actor in role A is open to all the actors in role B, and vice versa. Therefore the arising of interactions will also diffuse the dense social ties between the different "roles". The multi-facets of roles can catalyze the social ties to diffuse faster.

4.3 Peer-to-Common

The relational form of Peer-to-Common doesn't ask the direct interactions between actors. Individually actors involve the services with common interests, objectives or values. They are in the same position of system with peer relationship. By interacting with system, actors contribute their individual values to the common value. In the meaning time, they can share the commons that results in contributions from every one. Therefore, the indirect interactions take place between actors in the media of commons.

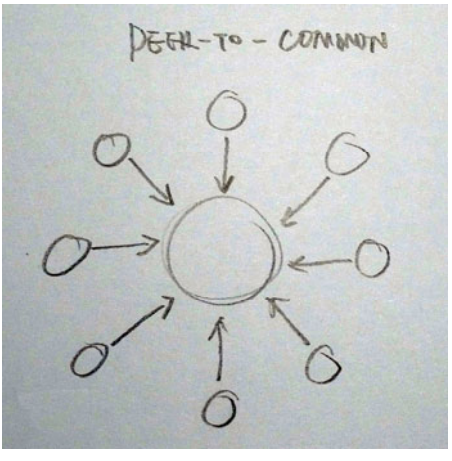

Fig. 3. Peer-to-common

Since actors are not asked to connect directly, it requires less relational quality between them. And the systems are relatively open. They welcome more participation without rigid identities certifying as it's not necessary that actors need to recognize each other. The priority of their focus is the common, so the more people involved, the stronger common becomes, in certain sense, regardless of the relational qualities between them as a precondition of network. But they understand well what they do for the common and the personal wellbeing in doing that.

In general, the actors don't need to ask anything from each other as necessary step in the process, but direct connections between them are not exclusive. In most of cases and proposals, the actors are visible each other in system. So if they want, they are able to interact with anyone of them. They have high autonomy in what they do and whom they want to connect. Because of that, with strong common value, even the direct connections are not asked, but instead they are enabled well.

The form of Peer-to-Common is based on the interactions between the system and each actor, but not limited by them. As matter of fact, it calls for physical encounters and co-actions. Because the commons usually have several levels to arrive, the interaction between the system and actors only can reach the basic level, where they get ready to second one. Once they arrive the basic common, the motivations of physical encounter become stronger. And interpersonal interactions and co-action are enabled.

4.4 Role-to-Centre

The form of Role-to-Centre looks similar to Peer-to-Common. Neither does it ask direct interaction between actors. And actors work for strong common values, in most of cases, they are vital or urgent problems and the interactions between actors and systems have to be so conductive that they are centralized by the institutional system and the connections between actors become less important.

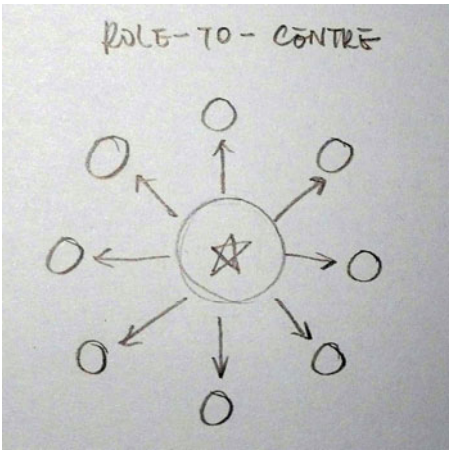

Fig. 4. Role-to-centre

The network of this form is centralized and usually the centre is institutionalized. So the collaborating of actors is based on the trust between actors and centre instead of that between actors themselves. Therefore, it doesn't require the relational qualities between actors. On the contrary, the problems will be solved by interactions between system and each of actors individually. In this form, the common value of actors is usually very strong and specific, so that they understand well what to do and how to do as the rules that are defined in advance. What actors mainly do is to follow the rules actively or passively according to positions in service systems. In those cases, the much less space of decision making leads much less necessary of interaction between actors and relational qualities.

There are two types of interactions in this form. The first one is quick response depending on commands from centre. In general, the actors are being connected. Unless messages come from centre, nothing different happens. The second one is vital information reporting depending on the situation of actors. According to the guideline of services, the participants will report information in situations where they are supposed to do. And the centre receives information from participants without commands. And the participants are much free to decide to report or not. Therefore, the first type of interactions focus on the co-actions to solve the problems that are un-expectable in when and where will happen; the second focus on the information collection of the problems that are un-expectable in when and where will happen as well, but the participants are not able to solve them.

For the interaction structures, in most cases, there are no direct social relations between actors, and the social ties between them are week. However, because of this characteristic, this network form can transcend between all the places and peoples where wireless communication are accessible. The centralized but flat structure and high diffusion capacity may generate strong bottom-up power to solve some problems which are difficult to do effectively and efficiently in traditional governmental system. As part of results, it may promote a large scale and diffused weaker social ties (Granovetter, 1978;1983), enhancing the social cohesion. In certain cases, physical encounters are asked as a way of co-action. Such as Baltic Sea, the participants are organized together to go to accident places. Through side-by-side co-action experiences, the weaker social ties become stronger.

5 Conclusion

To sum up, four interaction structures of network illustrate the four kinds of MCSs. They correspond different frameworks of interactions in services and empower the social ties of network in different ways (Table 3). They all have a flat structure without hierarchy system. Among them, both Peer-to-Peer and Role-to-Role are decentralized, and the interactions take place directly between actors. While Role-to-Centre is a centralized structure and interactions basically take place between centre and each actor. Peer-to-Common is between them: it has common that is not in the form of centre; the direct interactions between actors are not asked but enabled.

Table 3. Network and relational forms

Network	Peer-to-Peer	Role-to-Role	Peer-to-Common	Role-to-Centre
Structure	Decentralized	Decentralized	/	Centralized
Interpersonal interaction	Direct	Direct	Indirect	No
Interaction flow	Symmetrical	Unsymmetrical	Symmetrical+ radian	Radian
Relational quality	Middle	Middle	Lower	No
Social ties	Strong	Strong	Less strong	Weak

The different between Peer-to-Peer and Role-to-Role is interaction flow: in the former it is symmetrical and in the later it is unsymmetrical. Role-to-Centre illustrates a radian form of interaction flow, symmetrical with different meaning. Peer-to-Common is mixture between Peer-to-Peer and Role-to-Centre. It has radian form of flow between the actors and common, also has symmetrical flow between actors. The different structures of network and forms of interaction call for different relational qualities between actors. The first two structures call relatively high relational quality for direct interpersonal interaction; Peer-to-Common calls much less and there can be almost no such relational quality in Role-to-Centre. Except for the Role-to-Centre, all the network structures enable the dynamic social ties between the actors by the multi-facetted interaction in the space of auras.

Putting them in a wider phenomenon, it can be found that Peer-to-Peer and Role-to-Role are usually implicated in the cases of creative communities; whilst, Peer-to-Common and Role-to-Centre are usually implicated in cases of Wide Open. As it is mentioned at beginning chapters, there is a gap between the diffused bottom up creativities in everyday life and Wide Open innovation in cyber spaces. As matter of fact, our cases and proposals, as *MCSs*, cross the two spaces and bridging them in convergence.

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Design for All: Social Innovation and Service Design Education and Practice in China

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Abstract. This study focused on the role of design in urban and community development. A social innovation approach was applied to the design of city and rural community social services. The method of design involved in social innovation and the possibility for collaborative design by different designers were explored. We also explored how design can influence social and city innovation. About the social innovation and service design education and practice in china, the study provided a comprehensive judgement and assessment.

Keywords: Social Innovation, Service Design, Chinese Design Education.

1 Introduction

China is currently facing huge social and developmental changes, not only in its cities, but also in its rural communities. To aid this transformation, the government and various other social departments, organizations, and universities have promoted a number of social and urban innovation projects. Design is the key tool, method and strategy underlying effective social innovation. Accordingly, increasing numbers of design and research organizations and universities are now becoming involved in social and urban innovation. Furthermore, researchers are using social innovation itself to explore new methods, ideas and tools connected with design.

However, the concept of social innovation or service design has only existed for a relatively short time compared to the history of modern design. In his book Design for the Real World, Victor Papanek (1971) describes "social innovation" as a thorough rethink of the popular business design of the 1960s. In fact, consumption design developed at an amazing speed after 1945, when design became a tool for stimulating consumers' wants. However, design critics regard this transformation as having reduced design to the role of creating profit for companies. Experts such as Henry Dreyfuss (1955), Victor Papanek (1971), E.H.K. Henrion (1987), Nigel Whitely (1993), Jeremy Myerson (1990), John Wood (1990), and David Chipperfield (1991) complained that design simply became a tool for making money. In the preface to Design for Society, Nigel Whitely (1993) states that:

> 'Design' as a noun or verb was daily intoned - usually hopefully rather than purposefully - as a solution that was going to deliver us from all economic evils. 'Designer' as an adjective connoted prestige and desirability, sometimes desperately so; and 'designer' as a noun was the new celebrity profession, with the deeds and television chat shows.

P.L.P. Rau (Ed.): Internationalization, Design, HCII 2011, LNCS 6775, pp. 514–523, 2011.

However, the ideas, functions, objectives, attitudes and values of modern design have changed and adjusted throughout its 150-year history. While there are numerous reasons and factors behind these changes, two conditions are of prime importance. First, design must change with the times as a tool for making profit for business. Otherwise, design will encounter serious developmental obstacles. Second, social innovation and urban development need design to generate creative projects. Now is the time to give design the chance to embrace systemic and comprehensive social and urban innovation. Design-centered social innovation has been making positive inroads into global urban and social development. IDEO, a world renowned industrial design company, recently transformed its approach from designing good products to designing good societies. As Tim Brown (2009), the CEO of IDEO, explains:

> Design thinking will create unimaginable power to social innovation, as the company, it's a discipline that uses the designer's sensibility and methods to match people's needs with what is technologically feasible and what a viable business strategy can convert into customer value and market opportunity. Thinking like a designer can transform the way you develop products, services, process- and even strategy.

We believe that design thinking can have a huge influence on a range of problems, not only how to create great businesses, but also in relation to social and community innovation, and urban development. Design thinking involves a user-centered design approach to design innovation. We also believe that design thinking can make a huge contribution to the social, cultural, and economic challenges facing contemporary society. A design-centered service design approach represents a new method for social innovation.

2 What is Social Innovation?

According to Wikipedia, social innovation refers to new strategies, concepts, ideas and organizations for addressing social needs of all kinds, from working conditions and education to community development, health care, and anything that extends and strengthens civil society. The "Young Foundation" describes social innovation as new ideas that work to meet social goals. Geoff Mulgan (2006), the chief executive of the Young Foundation, provides a narrower definition of social innovation, as "innovative activities and services that are motivated by the goal of meeting a social need and that are predominantly developed and diffused through organizations whose primary purposes are social."

Eduardo Pol and Simon Ville (2009) argue that social innovation can be slightly redefined as any new ideas with the potential to improve either the overall quality of life or the quantity of life. This definition suggests a new viewpoint where social innovation is seen to provide systematic solutions for improving the quality of life. Manzini (2009) offers another definition of social innovation as, "a process of change where new ideas emerge from a variety of actors directly involved in the problem to be solved: final users, grassroots technicians and entrepreneurs, local institutions and civil society organizations." Heiscala (2007) contends that social innovation

represents changes in the cultural, normative or regulative structures (or classes) of society which enhance its collective power resources and improve its economic and social performance.

Social innovation explores two core ideas for changing the traditional approach to social development. First, design-centered social innovation applies the power of systemic design thinking to innovation. Second, innovation is based on a service design approach. Nonetheless, all of the different definitions of social innovation share the common viewpoint of emphasizing service system innovation and design.

3 Design-Centered Social Innovation

Rodolphe Dogniaux (2007) argues that the designers who research social innovation need to:

> … intervene in projects handling alternative life, sensitization, biological diversity, countryside, citizenship, civic engagement, communities, conflicts, consumption, culture, traditions, handicap, economy, education, environment, equality, ethics, fair trade, food, sexuality, safety, social advertising, social companies, leisure activities, town planning, globalization, health, medicine, housing, human relationships, justice, crime, language, styles of life, identity, migrations, mobility, networks, politics, populations, public places, religion, faith, precariousness.

Design-centered social innovation is based on the belief that the power of design thinking can provide more effective solutions and tools to help deal with social troubles and problems, and more effective ideas, methods, and solutions to affect social change and community development.

To resolve problems relating to public affairs, or matters of public interest, different governments, policymakers, professionals and the general public usually place different levels of emphasis on particular areas or aspects. Some emphasize policies and planning, some emphasize creative invention, design and implementation, and others emphasize matters of management and maintenance. While some may try to take a more comprehensive and inclusive approach, most of the time the results are not satisfactory as they lack a center or focus linking the different emphases together. Professor Michael Siu (2010) has proposed a user-centered approach to public design and developed a number of social innovation and public design projects and case studies. Professor Siu believes that social innovation and public design demand balanced consideration on three different levels: planning, implementation and management. Overall, however, the ‘users’ act as the center linking these three levels together, which represents a new user-centered model for public design and social innovation.

There is an extensive background to the design-centered social innovation and service design development currently taking place in China. Many cities in China are in a phase of high-speed urbanization, especially the huge cities of Beijing, Shanghai and Guangzhou. All of these cities are undergoing new urban development to improve the infrastructure and quality of life. They are also seeking new ways of promoting

urban development. Beijing's new goal is to become a world-class city. In fact, many cities in China now have an international focus.

Compared to urban and rural community development, the villages and towns in China urgently need systematic social innovation to avoid lagging behind the rest of the country. Many villages and towns remain undeveloped with poor living conditions. As Papanek (1971) said, it is very important that design sets the direction for underdeveloped regions.

4 Social Innovation and Service Design Education in China

4.1 Chinese Design

In fact, when discussing Chinese design, we need to distinguish between "Chinese design," "design for China" and "design in China." We can only gain a positive understanding of "developing" China and of the design of China by analyzing these different perspectives.

The concept of national design is a traditional means of describing the standard of a country's mature design practice in terms of good design, excellent products and positive support for design. With respect to the UK, the concept of national design is constructed from the names of many famous designers, such as William Morris, John Ruskin, Molly Keane, Gordon Russell and Scott Douglas. These names are associated with many classical designs, and developments in design styles and ideas. Similarly, the "made in Germany" brand signifies trust to the consumer. German design is well known as a symbol of good quality and classical style. However, Chinese design cannot be discussed in the same manner, as it is widely associated with poor quality and a range of complex problems. In this sense, "made in China" is understood as "copied in China." Nonetheless, design in China cannot be measured by the same standards as German or UK design. To understand design in China, we must place the concept within the context of China's modernization. Against this background, Chinese design is a continually evolving concept that is closely related to China's social, industrial, economic, political and cultural development.

In the 1960s, design researcher Victor Papanek (1971) called on designers to design for undeveloped regions. In support of the idea, a number of famous Western designers joined in a non-profit movement to design for developing regions. For instance, the industrial designer Emus traveled to India to support Indian design, and Raymond Rowey made detailed plans for the redesign of Japan after 1945. While China did not benefit from this movement for various ideological and political reasons, the situation began to change in the 1990s. Since then, many Western designers and design companies have entered China, not to support Chinese design, but to make huge profits. Accordingly, "design for China" has become a new slogan signifying the opportunities for Western designers in China. We do not want to refuse Western design, but we are against the current profit-centered motive behind "design for China." We would prefer "design for China" to be "design help for China" to support Chinese design and industry.

Compared to "Chinese design" and "design for China," "design in China" represents a more positive approach to the issue. "Design in China" is not a definition;

it is a description that emphasizes an understanding of the current situation in Chinese design. The concept of "design in China" reflects a rational stance towards understanding design, which does not deny the trouble with Chinese design and keeps a positive attitude towards Western design. As we are designing in China, we should respect and contribute to the country's current needs.

"Chinese design," "design for China" and "design in China" are the three core problems to understanding the relationship between China and design. Of course, such an understanding will also have an influence on Chinese design education and practice. The basic clues to the issue of Chinese design can be understood from another perspective: the development of modern Chinese design and design education in response to the changes in Chinese society and the global environment. This issue includes the three additional concepts of "modern design," "the modernity of design" and "the modernization of design."

"Modern design" in China has developed from the craft tradition. The concept emphasizes matching design methods with the processes of modern production. In fact, one of the core issues of modern Chinese design is to construct unique "design" concepts matched with modern production techniques and systems, while also accepting the unique value of design and confirming the design process as an independent innovative process.

The concept of "the modernity of design" originated from rethinking the cultural value of technology and modernity. The issue is therefore critical, as it requires us to rethink the contribution of the development of modern design to modern life. As for China, this concept provides a critical viewpoint from which to determine the modernity of Chinese design.

Strictly speaking, the "modernization of design" is an expectation about the future of Chinese design. Certainly, the expectation of modernization provides a goal for the design industry and design education in China. The "modernization of design" is an evolving process of cultural value that reflects the two competing directions of globalization and localization. Therefore, the modernization of Chinese design must rebuild these two different levels of design value. First, the modernization of Chinese design needs to develop an understanding of globalization and to construct an identity and value standard within the globalization of design. Second, the modernization of Chinese design needs to construct a relationship with traditional Chinese culture. We believe that the modernization of Chinese design should be sustained by Eastern culture, together with modern Western techniques and positive value, and be constrained by the moral principles shared by Eastern and Western cultures.

4.2 Current Situation of Chinese Design Education and Practice

According to our study of design education in China over five consecutive years, Chinese design education slowly developed after the 1950s. Then, a rapid change took place in 1995, when Chinese design education witnessed an amazing period of expansion.

In fact, since the 1990s, Chinese design education has expanded and developed so rapidly that an unprecedented situation of changes and challenges is now just around the corner. According to the statistics presented in the "Layout of Design Education Development Scale in China Higher Education Schools," there are about 1300 higher

education schools in China recruiting design students. We are also witnessing a rapid increase in student numbers, with around 360,000 new design students entering the country's design institutions. For example, Beijing had 122 design institutions in 2007, including schools for graphic design, industrial design, fashion design, interior design and multimedia design. These institutions accepted around 19,000 design students in 2007.

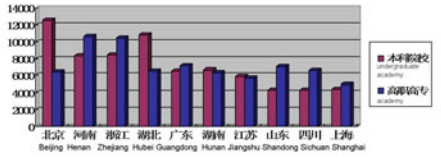

Fig. 1. Top ten institutions in terms of enrolled design students in 2007

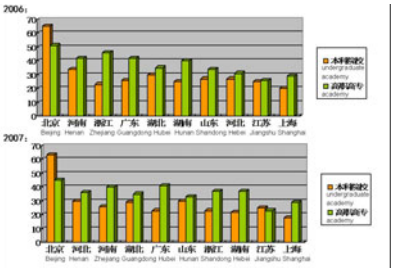

Fig. 2. Top ten provinces in terms of design institutions in 2006 and 2007

The figures relating to design education clearly illustrate the characteristics of the current educational situation in China. In the following, we reflect on the problems relating to the history of education and introduce a strategy for education reform extending from the current educational environment. While there are an estimated 1300 institutions providing design courses, there is a shortage of good teachers. Furthermore, there are a number of courses in industrial design in major universities that provide professional training in basic skills, although the standards vary. However, the scale of Chinese design education has rapidly expanded since 2008. Two large design projects were considered as good opportunities to rethink and adjust Chinese design education. First, the design of the facilities for the 2008 Beijing Olympics provided an international platform to showcase Chinese design. Second, the design of the 2010 Shanghai Expo provided another important opportunity for promoting the design of China. Of course, the ongoing transformation of Chinese industry needs further support from Chinese designers. Over all:

- Design is becoming a recognized discipline in Chinese manufacturing.
- There are designers who are capable of more complex work, but they need more effective management.
- Many designers, particularly consultants, are pushing to educate themselves.
- Copying is seen as a quick way to learn design skills.
- Consumers are becoming much more sophisticated.
- Younger, more sophisticated managers and entrepreneurs are showing great innovative spirit.

When we discuss Chinese design, we are always enquiring how design can contribute to a more innovative and competitive economy and enhance society. We believe that government policy needs to establish a framework of aims, purposes,

national organizations and standards. In addition, a new relationship needs to be forged between business and design, and design education needs to be upgraded to fit the developing trends.

4.3 Changes in Chinese Design Education and Practice

Since 1995, China has educated more design students than any other country. According to a report by Design Council (2005), there were around 23,000 individuals employed in the UK design industry in 2003. In 2002-2003, UK design institutions only recruited about 20,000 design students, while during this time Chinese design institutions recruited around 250,000 students. Since 1995, around 2,000,000 design students have graduated from Chinese design institutions. Nonetheless, numerous problems exist in the design industry and design education in China.

Design teachers are drawn from a range of backgrounds, often with little design training. Teaching is often a cover for personal consultancy activities. Moreover, industrial design courses in China generally lack workshop facilities. Students learn to use computers, although visualization is not designing. While there is heavy emphasis on imitating fashionable IT products, students are given little training in the fundamental aspects of a wide spectrum of products.

In large Chinese manufacturing companies, design generally functions at best at a middle level, buried in large marketing or engineering departments. The role of design is to give products an aesthetic veneer and not to be involved in conceptual work. While design is moving slowly away from the concept of cosmetic design, it still has little role in decision-making or proposing product concepts.

Now is the time to change Chinese design education. Change is not only about how to turn design students into good designers; it is also about rethinking the goal of Chinese design education. We must rebuild the standards for design capability, design knowledge, design thinking and design value in design education to fit the needs of new social innovation.

A number of well known design institutions in China have already begun to make changes and reforms, including the Central Academy of Fine Arts (CAFA), the Art and Design Academy of Tsinghua University, the China Academy of Arts, Guangzhou Academy of Fine Arts, Sichuan Academy of Fine Arts, the Hunan University School of Design and the Tongji University School of Creative Design. The main objectives of the CAFA are to cultivate high-quality professionals who are able to become elites in the arts field. CAFA has remained at a reasonable scale in terms of space and student numbers and has made a range of academic, experimental, and multi-disciplinary developments appropriate to an educational infrastructure for high art in the modern era. There are a number of trends arising from the changes in design education instituted by these design institutions:

- We must rethink the role of design education in light of the rapid social change and cultural transformation occurring in China. Design education needs to contribute more to these changes, by providing solutions to all new problems. For example, designers or design researchers should be able to effectively address social problems, regional innovation problems and cultural problems. Chinese design education needs to provide more design skills training and, most importantly, students need to be taught how to think in response to different problems.

- Social innovation has only recently begun to have an influence on design education. The role of design needs to be regarded as a key factor in the process of social innovation. Design-centered social innovation is an important direction in the reform of design education.
- The government has undertaken numerous public and social innovation projects with design institutions. We have witnessed a trend where the government seeks to have design institutions provide solutions to public affairs. In January 2011, the CAFA, Tsinghua University and the Beijing Government launched the Beijing public service design lab. The lab aims to research public service design, primarily in terms of how it can have a positive influence on public life. The lab is expected to take on numerous public service innovation and urban development projects.
- Future design education will emphasize the following two questions. First, what is successful design? The success of design is not only about good design ideas, but also about the success of the systems, strategies and methods employed. Therefore, we should teach students the methods, strategies and values for successful design. Second, how can we create greater success in terms of business, society, and culture success through design and design thinking? As Ideo, Google and Apple have recently demonstrated, design thinking has created huge successes for these big companies.
- Design for all, as an educational idea, has been accepted by many design institutions, especially those in the public design and non-profit design fields. In underdeveloped villages and communities, there are many problems that need design solutions. We believe that these design solutions provide the best possibility for regional social innovation.

4.4 Social Innovation and Service Design in Education

Social innovation and service design education have been introduced in a number of design institutions. Many of these design institutions provide social innovation and service design courses for students. At the CAFA, social innovation is the core educational concept guiding the structure of design education courses. Students are required to know how to observe, understand, and analyze social issues, and provide design solutions. For example, a course on the sounds of the city encourages students to explore the constitution of city sounds and to understand the city from a sound perspective. Information design courses about public safety analyze safety in regard to particular spaces and provide clear safety reports guided by information design. Public design research on bus stops emphasizes the possibility of upgrading bus transport systems.

The CAFA has engaged in numerous cooperative projects with the government, NGOs and companies over the past 10 years. The Design Culture and Policy Institute has completed a number of large projects for the government, such as the “Research and Programming of Design Industry of Yangzhou,” which focuses on the policy for design industry development. The research was the key reference for the Yangzhou Municipal Government in developing the design industry and promoting industry upgrading. The report is also regarded as a key reference for the Chinese government in managing and promoting the development of the Chinese design industry. We also finished a DRC(Design Resource Cooperation Center) project for Beijing Government

in 2005 that involved the construction of a design industrial park to cultivate design companies. The DRC now serves to demonstrate the development of Beijing's design industry.

A range of other design institutions also recognize the importance of social innovation and service education. The design school of the Yunnan Academy of Arts has engaged in close collaboration with the regional government. The school has promoted cooperation with a particular county every year since 2003, which sees students from different design disciplines join in a team to provide a complete design solution for innovation in the county. These cooperative projects provide a full design experience for students, and also make a huge contribution to the county governments.

The Public Design Lab of the School of Design, The Hong Kong Polytechnic University, headed by Professor Michal Siu, has carried out a series of public design and research projects in the past eight years. The lab's achievements include the design of public facilities and public space design research. The lab has already become an important public design research lab and has won a worldwide reputation.

Social innovation education has become an important design education goal. We believe that students should have the capability to understand social innovation and to provide appropriate design solutions. This capability will become increasingly important in the future. There are four main ways for students to develop socially innovative thinking:

- By including social innovation thinking in the process of the design course.
- By providing social innovation and service courses for students.
- By providing training for students through social innovation projects.
- By emphasizing social innovation and service design in many of the design competences and workshops.

5 Conclusion

We argue that design should take advantage of the past and contribute to formulating sustainable regional development that coexists with nature, history and regional resources. Design needs to partake of social innovation to allow various kinds of communities to develop more flexible social structures and to increase the social power of community networks (i.e., innovation, culture, design and social networks). Design education needs to be upgraded from a user-centered design approach to a community- and design-centered innovation approach. Design is currently experiencing huge changes. User-centered design, which means design for the individual, emphasizes the consumer's personal needs for using or enjoying design products or services. However, community-centered design and design-centered innovation emphasize the social needs of and interaction and collaboration among communities, and a design relationship, purpose and experience in which the user is regarded as both producer and resource. As for trends, design education needs to rethink the direction of development, and to provide more possibilities for design students, designers and the public. We have already witnessed some of the changes in Chinese design education, and we also expect further improvements to the standard of design education in China. This is the best opportunity to demonstrate the competence and standard of Chinese design education.

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Does Internationalization Have Its Own Face in Each Country? Measuring the Internationalization of Web Presence on Higher Education Admission Web Pages between USA and Taiwan

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Abstract. Developing sophisticated networks and facilitating its widespread use by the academic community is a powerful strategy to achieve the internationalization of higher education. But the content, structure, and responsive designate of collegiate websites can perform the most probabilities of Information and Communication Technology for communication and transaction still unexplored. We review the growing discussions on the internationalization of higher education and the website quality evaluate criteria to construct a measure template to help us analysis the web presence of higher education. This study measures top ranking of worldwide institutions with USA and Taiwan collegiate admissions web pages, to compare the differences and similarities on admission web pages presence. Fifteen top USA universities which intersected between three Worldwide Rankings and 15 top universities which got Top R & D grant from the Ministry of Education in Taiwan were selected. Content analysis method employed to measure the presence of internationalization on admissions web pages. Results present all the top universities of USA and Taiwan mention internalization in their mission statements, and have appropriate organizational structures in their institutions. And there are differences as it implements practically on web presence between 2 groups.

Keywords: Internationalization, Higher Education, Admission Web Pages.

1 Introduction

Internationalization of higher education has been a trend in quite many developing countries. Lo(2009) argues that this trend together with a few other phenomena, such as increasing international competition, pursuing higher ranking in global university league tables, and the quest for creating world-class universities, has generated significant impacts on the higher education systems in Asia.

Academic and professional requirements for graduates increasingly reflect the demands of the globalization of societies, economy and labor markets and thus higher education must provide an adequate preparation for that.

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Owing to the above phenomenon, school performance, and student achievement become important indices of parents and students choosing their future school.

In global educational marketing, Qiang (2003) pointed out the recruitment of foreign students has become a significant factor for institutional income and of national economic interest.

The use of new information and communication technologies in the delivery of education and the involvement of private actors in this mean that national borders and the role of national governments in education become blurred.

University must identify what is important to students, inform students that they intend to deliver, what is important to them, and deliver what they promise.

Thune & Welle-Strand (2005) assumed that information and communication technologies (ICTs) are pivotal for globalization of higher education and in internationalization processes. Moreover, it is claimed that globalization and new technologies have opened up a global market for education, in which new providers of higher education operate, and that this competition poses significant threats to traditional campus-based universities and colleges.

But the literature on technology and internationalization is fragmented and chiefly occupied with conceptual issues. Empirical research studies on the use of information technology for and in international activities are rare [Mason 1998, Thune & Welle-Strand 2005].

2 Literature Review

2.1 Higher Education and Globalization

In the last two decades, the international dimension has become one of the key paradigms in higher education development worldwide [Lanzendorf & Teichler, 2003, p.220]. The same period is also characterized by a rapid growth of the global market for higher education, which, in turn, puts strong pressure on universities to implement similar internationalization strategies.

Based on Qiang (2003) review of the literature, a number of elements have been identified which play an important role in the internationalization process [Harari, 1989; Audas, 1991; Aigner et al, 1992; Norfleet & Wilcox, 1992; Scott, 1992; Francis, 1993; Knight, 1994].

Qiang concludes the elements for internationalization in different cases. In most cases, the elements are different types of academic activities, e.g. student/faculty exchanges, curriculum, recruiting/hosting international students. In other cases, organizational factors such as policy statements, annual planning and review systems are identified as the elements.

Knight (1999) proposed two generic types of strategies, program strategies and organizational strategies, both are needed to internationalize an education institution. While they are very different in orientation they need to complement and reinforce each other. [11]

Program strategies refer to those initiatives which are academic in nature or are related to the teaching, learning, training, research, advising or supporting activities of the institution both at home and abroad. And it can be divided into four major

categories: academic programs; research and scholarly activities; extracurricular activities; external relations and services.

Organizational strategies include those initiatives which help to ensure that the international dimension is institutionalized through appropriate human resources, policies and administrative systems. By stressing the importance of integrating the international dimension into the institution's mission statement, planning and review systems, policies and procedures, hiring and promotion systems one is working toward ensuring that the international dimension is institutionalized.

2.2 The Applying Tasks and Web Interaction

The choice of which university to attend has been characterized as a highly complex decision that is subject to multiple influences [Briggs and Wilson 2007]. Eduventures Inc. surveyed in 2007, most students surveyed (84 percent) said they used colleges' web sites most heavily in their research, followed by personal recommendations (75 percent), campus visits (64 percent), and college viewbooks (64 percent). Most students (71 percent) said a campus visit was their most trusted source of information, followed by college Web sites and personal recommendations.

In general, the higher the involvement with the purchase, the higher is the product's perceived risk [Dowling 1986; Dowling and Staelin 1994; Mitchell 1999]. Risk in the buying decision is related to the notion that consumers make decisions under a certain degree of uncertainty regarding a specific product or service; thus, risk refers to the chance of negative outcomes and the possibility of loss [Taylor 1974; Murray 1991; Conchar et al. 2004]. To reduce risk perceptions, consumers employ strategies such as searching for information [Cox 1967; Urbany, Dickinson, and Wilkie 1989], the higher the degree of perceived risk, the greater is the tendency to search for information [Murray 1991; Choi and Lee 2003].

Developing sophisticated networks and facilitating its widespread use by the academic community is a powerful strategy to achieve the internationalization of higher education. But the content, structure, and responsive designate of collegiate websites can perform the most probabilities of information technology for communication and transaction still unexplored.

Many believe that when it comes to marketing, the Internet is the ''great equalizer,'' permitting service-based organizations, no matter how successful or well known, the ability to promote their products and services in a more-or-less equal manner. [9]

Since web-based marketing is relatively inexpensive and widely available, all organizations enjoy similar abilities to use the Internet to their marketing advantage. In reality, however, interactive technology has transit into web 2.0, when it comes to the marketing of Academic institutions. In this study, we understand how top-ranked schools provide an ''interactive edge'' when it comes to promoting their services to students.

2.3 The World Ranking Matters of U.S. and Taiwan

Unlike for-profit businesses, universities and colleges are judged by students and others on the merit of their academic services. The major sources of the fund of

higher education come from the government and the students' tuition. By reducing government funds gradually, the government urges universities and colleges to work hard to increase economic benefits. Whereas the internationalization of U.S. universities is driven by the market without doubt, the better the university is, the more tuition it will charge.

Over the past 10 years, Taiwan's higher education has expanded impressively with the increase in the number of institutions as well as that in the number of students. The quantitative increases shows that Taiwan's higher education has transformed from elite type into universal education, and the system is moving towards openness and autonomy, too.

In Taiwan, the national policies push universities to catch up with regard to internationalization, universities and colleges spare no efforts to improve their quality of education and highlight its unique features. In this way, they attract both domestic and international students.

And in response to the quest for world-class status across the globe, the Ministry of Education (MOE) of the Taiwan government has made a series of attempts to pursue quality excellence in higher education since the late 1990s. In 1998, for example, the MOE launched a 5 year program for Promoting Academic Excellence of Universities, aiming primarily to enhance research capacity of Taiwan's universities. (Chen and Lo 2007).

But, as Lo (2007) portrays that most today's world-class universities are in the major English-speaking countries, the impression of internationalization of higher education is to transplant the Anglo-American standards and practices in Asia. With the tendency, researchers are curious about, whether or not the institutions are moving from a monolithic model to take account of pluralistic needs?

3 This Experimental Study

The purpose of this article is to realize the current situation of the web presence on university web-pages for students recruiting between USA and Taiwan.

Therefore, we propose the following hypothesis: The USA top-ranked universities have higher interaction presence of internationalization strategies on admission web pages than Taiwan tops.

3.1 Instrument

Base on literature reviewed, the internationalization strategies items employed from Knight(1999) and constructed by 4 dimensions includes in 2 Strategies, each dimension has its own items. And then, the interactive types of ICTs measured by five scales (see Table 1) constructed.

A quantitative and qualitative content analysis was employed examining university homepages with the menu of admission or prospective student pages at the first, and reviewing from the pages for international students or English version secondly. After series of intensive sessions, two coders were trained to code the websites under the checklist. If the measured item cannot be found on the pages, then we archive it from website map or search engine.

Table 1. The scale of measurement

Items	None	Static Document Link	Text-Graphic Highlight	Portal site	Web 2.0
Score	0	1	2	3	4

McMillan (2000) emphasizes the importance of building on prior research when performing web-based content analysis, adding that it builds rigor into variations on traditional methods.

Content analysis method is originally developed for static, printed texts such as newspapers, where text is arranged in a more sequential and contained manner. To overcome the more dynamic nature of websites, the HTML of each organization homepage was downloaded from November 11 to 26, 2010 and the time frame of analysis was between January 26-February 13, 2011, which permitted the authors to correct coding issues and check the reliability of the collected data against the results of other studies as the analysis progressed.

3.2 Sample Profiles

To study and compare the level of internationalization web presence between USA and Taiwan, 15 university websites were selected from each country.

By intersecting three world ranking lists - the Webometrics Ranking of World Universities 2009 (WR), the Academic Ranking of World Universities 2009"(ARWU), and the Times Higher Education-QS World University Ranking 2009 (THES) - a sample of fifteen USA universities assessed in top forty were thus obtained as the US group of top universities (Group A).

As for Taiwan universities, all the 15 universities which have ever been granted into the 5-year Program for Developing First-class University and Top Research Centers, launched in 2006 by the Ministry of Education (MOE) in Taiwan are selected as Group B.

4 Results

Table 2 and 3 shows the program and organizational strategies of internationalization web presence means and group means of admission web sites that were judged to be in each category. T-statistics were calculated to identify significant differences in the internationalization of each component at the interaction level.

After reviewing the Sig. (1 tailed<0.05), parts of components shows there are significant differences and parts are no between two groups.

Both two groups, have not neglected any of the internationalization components. But researcher finds out some components present on the additional linked web pages, not direct present on admission pages, especially by Taiwan groups. The components present on the project of grant audit website.

Table 2. The outcome of program strategies measurement

Program strategies	Groups Mean		Mean	t	Sig. (1-tailed)	<α
	U.S.	Taiwan				
Academic Program category components						
International students	3.07	3.13	3.10	0.81	0.21	
Student exchange programs	3.13	3.00	3.07	3.25	0.00	*
Area of thematic studies	3.07	2.87	2.97	0.75	0.23	
Internationalized curricula	2.67	2.47	2.57	1.34	0.10	
Work/study abroad	3.00	2.00	2.50	2.42	0.01	*
Foreign language study	2.93	1.93	2.43	(0.45)	0.33	
Visiting lecturers and scholars	2.73	2.13	2.43	3.26	0.00	*
Link between academic programs and research, training and development assistance	2.80	1.73	2.27	0.16	0.44	
Faculty/staff mobility programs	2.33	2.00	2.17	3.93	0.00	*
Joint and double degree programs	2.07	2.00	2.03	0.79	0.22	
Teaching/learning process	2.20	1.07	1.63	2.01	0.03	*
Cross-cultural training	2.20	0.87	1.53	2.85	0.00	*
Research_and_scholarly_ collaboration_category items						
– Area and theme centers	3.00	2.87	2.93	1.47	0.08	
– International research partners in academic and other sectors	2.93	2.67	2.80	1.02	0.16	
– Researcher and graduate student exchange programs	3.00	2.53	2.77	1.61	0.06	
– International conferences and seminars	2.73	1.73	2.23	3.25	0.00	*
– Joint research projects	2.67	1.67	2.17	2.54	0.01	*
– Link between research, curriculum and teaching	2.87	1.47	2.17	4.02	0.00	*
– International research agreements	2.67	1.20	1.93	4.36	0.00	*
– Published articles and papers	2.47	1.27	1.87	2.95	0.00	*
External_relations_and_ services_domestic_and_ abroad_category items						
– Community-based partnerships and projects with non-government groups or private sector companies	2.80	2.27	2.53	1.60	0.06	

Table 2. (*continued*)

– International development assistance projects	2.80	1.80	2.30	2.80	0.00	*
– Customized/contract training programs off-shore	2.47	1.67	2.07	1.90	0.03	*
– Link between development projects and training activities with teaching and research	2.67	1.60	2.13	2.78	0.00	*
– Community service and intercultural project work	2.67	1.67	2.17	2.46	0.01	*
– Off-shore teaching sites and distance education	2.73	2.33	2.53	1.18	0.12	
– Participation in international networks	2.87	1.73	2.30	3.07	0.00	*
– Alumni development programs abroad	3.13	2.33	2.73	2.32	0.01	*
Extracurricular_activities						
– Student clubs and associations	3.20	2.73	2.97	1.25	0.11	
– International and intercultural campus events	3.13	2.27	2.70	1.92	0.03	*
– Social, cultural and academic support systems	2.67	2.47	2.57	0.52	0.30	
– Peer groups and programs	2.53	2.00	2.27	0.90	0.19	
– Liaison with community based cultural groups	2.27	1.33	1.80	1.74	0.05	*
N	15	15				P=0.05

Table 3. The outcome of organizational strategies measurement

Organizational strategies	Groups mean		Mean	t	Sig. (1-tailed)	<α
	U.S.	Taiwan				
Governance category items						
– Expressed commitment by senior leaders	2.73	2.73	2.73	0.00	0.50	
– Active involvement of faculty and staff	2.73	2.13	2.43	1.57	0.06	
– Articulated rationale and goals for internationalization	2.67	2.53	2.60	0.42	0.34	
– Recognition of an international dimension in mission statement and other policy documents	2.67	2.00	2.33	1.73	0.05	*

Table 3. (*continued*)

Operations category items						
– Integrated into institution-wide and department planning, budgeting and quality review systems	2.80	2.87	2.83	(0.34)	0.37	
– Appropriate organizational structures	3.07	3.00	3.03	0.27	0.40	
– Communication systems (formal and informal) for liaison and co-ordinator	2.93	2.20	2.57	2.42	0.01	*
– Balance between centralized and decentralized promotion and management of internationalization	2.80	2.53	2.67	0.91	0.19	
– Adequate financial support and resource allocation systems	2.87	1.73	2.30	3.31	0.00	*
Support_services category items						
– Support from institution-wide service units, i.e. student housing, registrariat, counselling, fund-raising, etc.	3.00	2.73	2.87	1.17	0.13	
– Involvement of academic support units i.e. language training, curriculum development, library	2.87	2.47	2.67	1.20	0.12	
– Student support services for international students studying on campus and domestic students going abroad, i.e. orientation programs, counselling, cross-cultural training, student advisors, etc.	3.00	2.60	2.80	1.57	0.06	
Human_resource_development category items						
– Recruitment and selection procedures which reorganize international and intercultural expertise	2.93	2.00	2.47	2.61	0.01	*
– Reward and promotion policies to reinforce faculty and staff contribution to internationalization	3.00	3.00	3.00	0.00	0.50	
– Faculty and staff professional development activities	3.07	3.00	3.03	0.56	0.29	
– Support for international assignments and sabbaticals	-	-	-	-		-
N	15	15				P=0.05

5 Discussion

Today's America still enjoys the most advanced science and technology and highly developed economy because of its emphasis on education, especially higher education. In Taiwan, the national policies push universities to catch up with regard to internationalization. For much of the twentieth century Taiwan universities were striving to "catch up" with what were perceived as advanced standards elsewhere. Now finally in the early 21st century they are reaching a position of strength, where they may come to be seen as equal partners with universities in other parts of the world.

We can see Taiwan universities present their internationalization well performs on the project of grant audit website. But if academic institutions like to recruit student from web distribution, the best way is let them present on the easy find place for prospect international students.

Any organization can create web site, but not all are committed to making it an essential and effective tool for marketing. Future research could use questionnaires sent to university and college ''Web Masters'' to understand the level of commitment their schools have to using the web sites as marketing tool, or high school students to assess their satisfaction from admission web services.

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Exhibition User Experience Research and Design for Applications of Context Awareness Technologies

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Abstract. Exhibition Context Awareness User Study and UI Design for Growth Markets is a collaborative practice of Tsinghua University Industrial Design Department and Nokia Research Center Beijing. The task of the project is to study the user needs and user experiences in exhibitions for the application of uSD card being developed in Nokia, and probe the directions for other possible applications of context awareness technologies. After the key findings of user values and design opportunities concluded from the background studies and field observation, our team have developed several conceptual solutions for application of context awareness technologies, which inspires the Nokia team a lot for their further research.

Keywords: context awareness, exhibition, experience, uSD Card, volunteers.

1 Introduction

Mobile devices enable users to use them in different types of contexts. Context awareness refers to the ability that a device being aware of its using condition and adaptively promoting user experience. Schilit et al. (1994) defined context awareness systems "*adapt according to the location of use, the collection of nearby people, hosts, and accessible devices, as well as to changes to such things over time. A system with these capabilities can examine the computing environment and react to changes to the environment*"[1].

The objective of this collaborative project of Exhibition Context Awareness User Study and UI Design for Growth Markets between Tsinghua University Industrial Design Department and Nokia Research Center (Beijing) is to foresee and design examples of future mobile user experiences or form factors for context awareness functions by understanding the effects of context awareness technologies on future mobile UI and user needs in some identified contexts.

[1] Schilit B, Adams N, Want R (1994). Context-Aware Computing Applications. In Proceedings of IEEE Workshop on Mobile Computing Systems and Applications: 85-90.

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2 Process, Methods and Problems

The overall process of this project is divided into four steps: background studies, user research, design analysis, concept development and improvement. (Fig. 1).

Fig. 1. The overall process the project adopts

2.1 Background Study

The background studies and literature reviews had been conducted at three aspects: exhibition, people and technology.

Exhibition. Exhibitions can be classified by their natures, contents, scales; by time and space to be held etc. Such as, we can classify exhibitions into trade exhibition, consumer exhibition, professional exhibition and comprehensive exhibition. We can also classify them into indoor exhibition and outdoor exhibition; domestic exhibition and international or abroad exhibition, and so on.

Based on the classifications of exhibitions and analysis of different kinds of exhibitions[2], the project team concluded that relative long term exhibitions and museum exhibitions are more meaningful to the applications of the context awareness technologies, and decided the world expos would be the target for this practice in this time. This is not only because the world expos are extreme long term exhibitions, but because Shanghai World Expo will be held in 2010 as well, which would be more practical and specific to activate the study and research of the project.

The following is the characteristics of world expo we conclude from the above exhibitions and World Expo analysis:

- Large-scale, large area, new exhibition halls.
- Large number of visitors, crowded in the hall, and difficult to guide.
- Recruiting and training large number of volunteers.
- Language communication is still a question, as the visitors come from all over the world.
- Mainly relying on tickets as well as economic impacts for revenue.
- Although the factors such as environmental protection and energy saving are considered during the expo hall construction, but the removal of the halls has to spend a lot of money and waste a lot of materials.

[2] We analyzed three kinds of exhibitions: Industry Exhibition: International Fashion Week, Air Show, the Beijing Auto Show, CES, CeBIT; World Expo: Aichi Expo, Hannover World Exposition; Museum: Capital Museum (Chinese Memory - Treasures Exhibition for civilization in 5000 years).

- Lasting 3-6 months, belong to the very long-term exhibitions.
- A large number of services provided in the hall, including leasing and information checking, etc.
- Exhibition promotion: with each expo's theme and mascot.
- Exhibition sales of mascots, souvenirs and other entertainment performances.

People. Exhibition can be divided into three stages: before exhibition, during exhibition and after exhibition. We classified the people related to each stage and summarized their activities and requirements in every stage.

We concluded three general sorts of people related to exhibitions: organizers, exhibitors and visitors. For the details to see Fig. 2, we work out to show the relationships among organizers, exhibitors, visitors and media. In Fig. 2, you can see we divide organizers into three subgroups: organizing committee, companies for setting up booths, and property & venue providers, though sometimes one exhibition host may cover three functions in the same time. We also draw media visitors out of general visitors, as media play a very special role in the exhibition show.

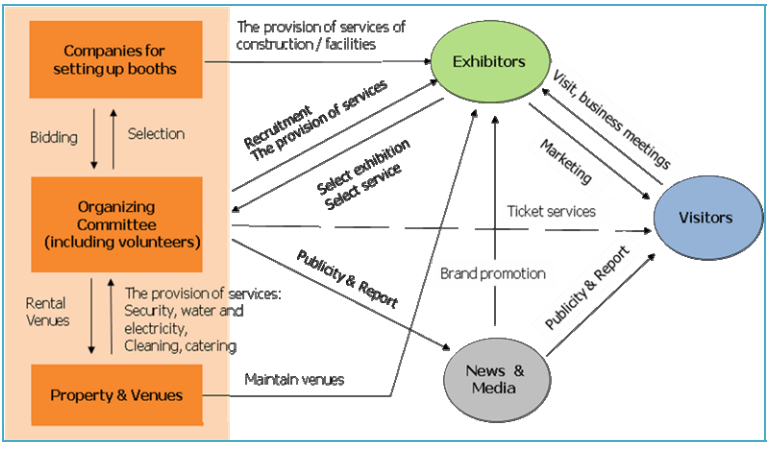

Fig. 2. The relationship among organizers, exhibitors, visitors and media

Fig. 3 shows the activities in three stages of exhibitions and the needs of different people associated with the exhibitions. The main activities for exhibitions are classified into exhibition planning and setting up before the exhibition, showing on during the exhibition, and exhibition dismantling after the exhibition. Then sub-activities supporting people and their needs associated with these four main activities are identified.

Technology. We conducted the investigation into applications of current technologies and possible technologies in and for exhibitions. The hardware technologies we studied are displaying technology, navigation technology, and other technologies & concepts that may inspire the future solutions. Displaying technology study is to find technical support for the idea of some possible future design solutions through understanding of displaying technology. Navigation technology study is to understand

the technology of existing products and services provided by products through researching the existing navigation products. We also studied the hardware technologies and services employed in Expo 2005 Aichi. The services provided in Aichi World Expo are as below:

- Booking the booths
- Provision of business invitation
- Assist with business visas
- Booth Design
- Storing exhibits
- Hotel or flat reservation during the exhibition
- Accommodation arrangements (including meal and room services)
- Vehicle arrangements (shuttles to and from airport, exhibits transportation)
- Professional translation (German translation, English translation, etc.)
- Large-scale promotion and exchange fairs during the exhibition
- Arrangements for business related discussions after the exhibition
- Arrangement for tourism activities during and after the exhibition

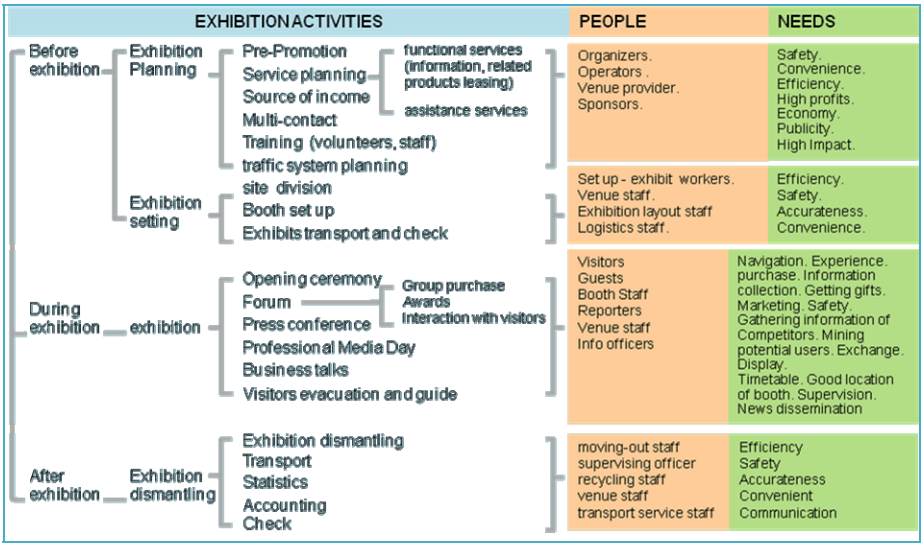

Fig. 3. Activities, people, and needs during three stages in exhibitions

2.2 Field Research

Method. The method for the field research of this project is the interviewing with questionnaires and user observations (field observation + interview+ questionnaire):

Per the conclusion of literature reviews and background analysis, the project team designed 3 sets of interviewing questionnaires upon the different needs of organizers, exhibitors and visitors. At the beginning of the questionnaires is basic information of respondents; afterwards are the 4 parts including information before, during, after exhibition, and observations on the spot.

Upon different respondent groups, each part of the questionnaires lists the interviewing outlines to remind researchers not to miss important issues during the interviews. Most questions in the questionnaires are open, and designed to be mainly filled by the interviewers.

Samples. The project team had interviewed 50 respondent samples, among which there are 22 visitors, 14 exhibitors, 8 organizers, and 6 volunteers. They are mainly young people with ages from 20 to 35, and among them there are 39 males and 11 females. Their occupations include salesmen, engineers/teachers, administrators, ordinary staff, and others.

Problems Found on the Spot. Most of the interviews were conducted on the spots of the exhibitions, which allow our researchers to have opportunities to observe the contexts of the exhibitions, the user needs, and the problems. Following are the problems found by our researchers in the field observations:

- Registration form is confusing, pens not enough, desk messy & lack of clear information.
- Missing information in the form causes visitors to be asked to refill and re-queue for the long line.
- Trade tickets need forms and identity cards. Dropping cards, brochures, wallet, etc. make trade visitors feel hurry-scurry.
- The equipment insensitiveness at entrance causes visitor's entry very slow.
- Poor design for booths index and floor plans makes visitors difficult to find relevant information.
- Navigation is a big problem in the exhibition hall.
- Some visitors' bringing minors into the halls may cause security risk, though prohibited.
- Interval model shows, quiz and free gifts cause crowded.
- Touch screens of info KOISK in a Jewelry exhibition cannot be used, though phone is OK.
- Many visitors were always holding their phones in hands in case of missing the important calls in this noisy exhibition environment.
- Some visitors were handing cameras to capture the exhibits in time.
- Some exhibitors were handing keys to promptly open exhibits drawers for some visitors.
- Many visitors' taking their jackets, luggage and all kinds of gifts during visits may decrease their pleasurable visit experience.
- There are no places for rest, relaxation and sharing experiences. Visitors have to gather anywhere, which may cause some passing problems.
- After the exhibition, most of the facilities are dismantled and may waste a lot of materials.

Summary of the Field Work. All problems found in the field research are analyzed and classified with 3 categories of people (organizers [including volunteers], exhibitors, and visitors), and process stages of exhibitions (before, during, after exhibitions), which form a foundation of the key findings concluded later on.

2.3 Key Findings and Opportunities

Key Findings. Key findings are concluded from the integrated background study and the summary of the field research. See Fig. 4.

Key findings of people before, during and after exhibitions				
	Visitor	**Exhibitor**	**Organizer**	**Volunteer**
Before exhibition	Search for exhibit info (TV, internet, newspaper, other media or acquaintances) Locate exhibit and search for traffic info	Search for exhibition info (organizers, trade associations, others) Design booths,displaying Invite VIP visitors	Exhibition Planning (time, place, scale, form, etc.) Exhibition publicity, organization, operation (media campaigns, manuals, tickets, recruit, ad, etc.) Facilities preparing (like water, electricity, communication etc.)	Training volunteers (based on different positions)
During exhibition	Enter to exhibit hall (parking, talk & line up, or fill out intricate forms) Navigate (locate booths of interest, best path, etc.) Position (companions, or one self for revisit etc.) Acquire, carry or store data (photo, video, pic, or note, data trans tech, etc.) Communication (exhibitors, cards, translation, etc.; problems in noisy settings) Services and facilities to the elderly, disabled, kids Outdoor service facilities (eg, traffic between halls) Rest, food, goods management, etc.	Publicity, marketing, contact for feelings (interact with visitors; disseminate brochures, gifts; explain exhibits, performance; exchange cards, pictures, etc.) Gather update info of industry development Tech exchange (formal discussion or seminars with customers, partners, or ordinary visitors)	Publicity campaign (media reporting and follow-up) Exhibits safety, facility maintain Mechanism for unexpected accidents & incidents Provision of advisory services Provision of leasing equipment Services for indoor and outdoor traffic, prevention from rain, sun, etc. (particularly for large-scale exhibition like EXPO) Collect info and data, as well as advices, complaints	Professional advice Social Info advice Booking service Translation service Media service Exhibit explanation Logistic support Goods storage, lease, return, or pay for lost Service to locate or care kids Aid to special visitors Emergency handling Communicate among volunteers Convey notifications Manage volunteers' activity scopes
After exhibition	Share info & experience (by internet, Blog, BBS, etc.) Collate business cards, contact partners or friends Report to leader	Move out Collate business cards, Analyze data Contact key customers	Move out (resource re-use) Exhibition summary Data statistics and analysis	Assist to move out Summary Incentives

Fig. 4. Key findings concluded from background study and field research

Opportunities. Opportunities are design directions induced from the key findings, or it can be viewed the target experiences of exhibition related people. Below in the Fig. 5 are the general design opportunities, which will be the core needs of the people related to the exhibitions.

Opportunity	Visitor	Exhibitor	Organizer	Volunteer
1. fast, easy and safe access to exhibition hall	●	●	●	●
2. visit route navigation and booth search	●	●	●	●
3. positioning and finding friends	●	●		
4. convenient data acquisition	●	●		
5. communication, interaction and cards exchange	●	●	●	●
6. communication problems in exhibition hall	●	●		●
7. release of and search for exhibition news	●	●	●	●
8. exchange platform for visitors on the spot	●	●		
9. service system for the elderly, disabled and kids	●		●	
10. system for managing and serving volunteers	●	●	●	●
11. system for managing exhibition facilities			●	
12. exhibition data statistics and analysis		●	●	

Fig. 5. General design opportunities for exhibitions

3 Concepts and Solutions

The concept development is based on the opportunities induced from the key findings. Each concept solution will cover one or several of design opportunities. After a comprehensive discussion, our team put forward many ideas according to the key findings and design opportunities above, and finally focused on four design concepts: uSD Card, Smile, Wrist-let, and Popi.

uSD Card. The concept of uSD Card is an immediate application of the card of uSD (universal Sensor Data), which can connects to and exchanges data with the sensors and sensors network that can sense the conditions and context of a space. This technology has been being developed in Nokia Research Center, but not being known to which specific directions. The purpose of this concept is to help navigate the research to an appropriate user preferring direction.

uSD Card can be easily inserted to a normal mobile phone, and provide users (based on log in) features of space navigation, information sharing, positioning & locating, voting for user's favorites, etc., which covers the opportunities of visit route navigation and booth search (opportunity 2), locating and finding partners & friends (3), convenient data acquisition (4), communication, interaction, & digital business

Fig. 6. Some features and interfaces for concept of uSD Card

cards exchange (5), exhibition news release and search (7), exchange platform for visitors on the spot (8), and exhibition data statistics and analysis (12). See Fig. 6.

Smile. The concept of Smile is an independent device solution covering the opportunities of visit route navigation and booth search (2), locating and finding partners & friends (3), convenient data acquisition (4), exchange platform for visitors on the spot (8), and service system for the elderly, disabled, & kids (9), which make it have the features of grouping, map positioning, locating and finding a person in the group, getting and sharing information, first aids, accident navigation, and parent & kids linkage. In fact, Smile is set of devices consist of three kinds of devices for the normal adults, for the elderly, and for the kids. See Fig. 7.

Fig. 7. Devices appearance and some use cases & interfaces of Smile

Wrist-let. Wrist-let is a concept solution to make visiting exhibitions much easier. It combines a exhibition ticket of paper board with a holder of a small device, which is connected to a mobile phone everyone can afford to own one. This can save much time and energy for visitors to purchase tickets of exhibitions and carry more stuff during the visit to the exhibitions.

The target users of Wrist-let are supposed young exhibition visitors who are hate to line up for purchasing the tickets on the spot. So they can book and/or buy the tickets online at offices or homes, then they can easily take the tickets from the ticket machines at the gates of the exhibition halls with their mobile phones with the information of their tickets (device holders) purchased previously without lining up for a long time. Then they can rent a device with deposit from device rent machines and insert it into the holders to be used with mobile phones together, which will make the exhibition visits much convenient. Besides, the device working together with the mobile phone can easily acquire and collect the information of exhibits with sensors in the space, and then send the information onto the visitors' accounts on the exhibition websites. The visitors can download in ten days after that. The device can also help enhance the awareness of a phone call by vibration if a lost friend calls. See Fig. 8.

The concept of Wrist-let covers design opportunities of fast, easy and safe access to exhibition hall (1), visit route navigation and booth search (2), convenient data acquisition (4).

Fig. 8. Wrist-let and its user case

Popi. The concept of Popi is a service system provided only for the use of volunteers, and it covers many design opportunities, which are fast, easy and safe access to exhibition hall (1), visit route navigation and booth search (2), communication, interaction, & digital business cards exchange (5), communication problems in exhibition hall (6), exhibition news release and search (7), system for managing and serving volunteers (10).

The works of volunteers for the large exhibition or World Expos are very complex. So the features of devices for them could be sophisticated. In this case, the project team went much further to conception of extreme advantage technology in the near future, and empower it many features, including mainly volunteers' status identification, 2d to 3d map positioning and route navigation, medical emergency aids, identifying rare foreign languages and connecting language translation volunteers, and danger or facility emergency reporting, etc., some of them show in Fig. 9.

Fig. 9. Popi features of identification, navigation, and medical emergency aids

4 Conclusion

Traditionally, technology comes firstly, then, its application follows (Norman, 2009). But nowadays the process is reversed, or technology development and user needs study go concurrently; as giant global companies do not know what to make, though they know they could nearly make everything (Whitney, 2002).

This project of exhibition context awareness user study and UI design for growth markets is a joint practice of Tsinghua University and Nokia Research Center. We hope that our research outcomes and concept proposals will inspire the researchers in the research center for their further development of context awareness technology from user perspectives. As the user and their experience & needs are the eventual goal of any technologies and tools, though technology can truly go first.

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Design and Construction of SNS Platform and "Working Room" for Making Community for Fostering Japanese Teachers

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Abstract. In this report, we introduce the Japanese teacher training program at Kyoto University of Foreign Studies. We explain our SNS platform which contributes to the program's success and "Working Room" which support the communication among students and teachers. We think that the combination SNS with "Working Room" is very effective for making community. Students can post a variety of information on the SNS, such as self-descriptions, blogs, BBS entries, and reports of practice teaching. They can share information on Japanese teaching and communicate with teachers and other students. As an additional advantage, they can treat the SNS as a daily journal reflecting their teaching training progress. Students come to "Working Room" with some purposes such as prepareing trial lessons. Some freshman can see work of senior students in the room, some changes happen gradually; senior students give advice to freshman students; freshman students read others' diary and write comment in SNS.

Keywords: SNS, Japanese Teaching, making community, reflection.

1 Introduction

In recent years, Social Networking Services (SNS) such as Facebook have gained popularity among the youth. Some universities have developed their own SNS for education and service for two primary reasons: One is that many students use SNS to communicate with friends and obtain a range of information. The other is that we can construct an SNS site to use OpenPNE, a free, SNS platform software. Tokushima University manages the "Shikoku Campus SNS," which supports collaboration among universities in Shikoku (Sagayama et al. 2008). Nihon Fukushi University conducts an international collaboration project, where students communicate with foreign students on an SNS (Sato et al. 2007). The alumni association of the university opens their SNS to communicate with alumni of several universities, such as the University of Tokyo and Kyoto University.

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Japanese language education extends around the world; up to 135,000 students study Japanese in Japan, and there are another 2.98 million students in foreign countries. However, there is a shortage of Japanese teachers outside Japan. It is important to train Japanese teachers who operate in multicultural societies, thus, we should design effective Japanese teacher training courses. Kyoto University of Foreign Studies began its SNS in April 2007, based on OpenPNE (Murakami et al. 2008). In June 2008, some professors utilized the SNS for supporting eight courses and approximately 100 users consisting of professors, officers, and students. In this SNS, we tried to support communication between Japanese students who wish to be Japanese language teachers and Chinese students studying Japanese. This practice is extremely effective for both types of students, however, problems did exist.

In this paper, we introduce the Japanese teacher training program at Kyoto University of Foreign Studies. We explain our SNS platform which contributes to the program's success and "Working Room" which support the communication among students and teachers. The aim of the program is developing Japanese language teachers who can teach in an increasingly multicultural world.

2 Japanese Teacher Training Project Corresponding to Multicultural World

In this chapter, we introduce our new project to train Japanese teachers in this multicultural society(Murakami et al. 2009). The Kyoto University of Foreign Studies (KUFS) aimed at fostering Japanese teachers and commenced their "Japanese teacher training program" in 2000. This program emphasizes educational experience in teaching Japanese by giving various opportunities to the students. They support non-native Japanese students to learn Japanese in a regional school, practice-teach Japanese with foreign students at KUFS, and teach Japanese in a foreign university for a month or a year.

However, some problems did arise through these practices. The main problem was insufficient communication among students and between students and their professors. They maintained a teaching diary that they gave to their professors after practicing, but they could not communicate during practice teaching and share their experiences. It is important for students to express their experiences, share their perceptions, and exchange their views. This process could calm their worries and allow them to compare their experiences with one another. Another problem was the lack of teaching material corresponding to various needs. We needed a space where students and professors could discuss teaching Japanese and share resources for making the materials that they required.

In order to solve these problems, KUFS started the "Japanese Teacher Training Program Corresponding to a Multicultural World" in 2008, which is supported by the Ministry of Education, Culture, Sports, Science and Technology. This project supports teacher training in several ways. We prepared a "Working room" at KUFS with research associates and several books, where students can study, discuss, and ask questions to the research associate in the room.

3 SNS for Japanese Teacher Training

3.1 Overview of SNS "JapaS"

As part of the “Japanese Teacher Training Program Corresponding to a Multicultural World,” we constructed and managed an SNS platform to solve these problems. We named the SNS platform “JapaS” as an abbreviation of “JAPAnese teacher training Sns.” JapaS is written in Java. Students who wish to be Japanese teachers, students who study Japanese, and professors use JapaS. In May 2010, users of JapaS numbered approximately 600 students, 10 professors, some officers, and some alumni who work as Japanese teachers abroad.

JapaS provides functions such as writing profiles, sending private messages, writing personal blogs, viewing lists of friends, organizing schedules, and so on. We show an example of a personal page in Figure 1. Users write their name, nickname, department and self-description in their profile. They can choose an access level: open to the public, friends only, or closed. Personal blog space can be used for writing something freely and informally, such as daily life, a hobby, or their general thoughts. They can create a community for any purpose. A Bulletin Board System (BBS) is available in each community. They can be informed of updates on a friend’s blog and BBS of the community by Really Simple Syndication (RSS).

3.2 Community of Japanese Teacher Training

The main community is the “Japanese Teacher Training Project,” to which users belong. The function of the community is to provide discussion space, messages to professors, a community blog, general information, and a common resource for material. The community pages are shown in Figures 2 and 3.

“Discussion space” is a multi-purpose BBS: to search resources, deliberate teaching plans, and share information on conferences and jobs.

The function of the “Message to professor” feature is that students can consult with professors about teaching Japanese. The value of this function is that professors can check their message list and understand the student’s situation. The messages can be viewed only by the student who posts them and their professor, so students can securely and honestly express their concerns to professors.

The “Community blog” is written by research associates, professors, and teaching assistants. In this blog, they write pieces on Japanese teaching and daily life. The content of this blog is extremely useful for students as it contains expert knowledge. Frequent updates to the blog provide current information and motivate students to participate in JapaS.

“Common resource for material” is a space where students upload photos, picture cards, sentence pattern practices, and practice exercises. When they upload a resource, they annotate it with a short explanation to facilitate searching

3.3 Community of Teaching Practice

The “Teaching Practice” community in JapaS is the space where students enter their daily teaching portfolio during practice-teaching. They enter the teaching content,

good points, improvements needed and made, and their impressions of cultural differences. They conduct self-evaluation on teaching practice on five levels based on the following six evaluation points. We also show an example of the evaluation page in Figure 4.

- Did you sufficiently prepare the teaching plan?
- Did you speak loudly and clearly during the lecture?
- Did you write an appropriate explanation on the whiteboard?
- Did you prepare the teaching material well?
- Did you sufficiently interact with the students?
- Did you conduct the class well?

Fig. 1. Snapshot of the personal page

Fig. 2. Snapshot of the community page

Fig. 3. Example of the teaching portfolio

Fig. 4. Evaluation Sheet of Teaching Practice

Students can reflect on their experiences, express their understanding as it evolves, and reorganize their knowledge when they write their teaching portfolio. When they view teaching portfolios of their peers, they understand differences among them and rethink the characteristics of their own teaching plan or style. In addition, they get accustomed to communicating with other students about Japanese teaching.

Moreover, they search and read the journals of senior students in order to obtain useful information before beginning their own teaching practice. We believe that first-hand information from senior students is extremely useful for new students.

4 “Working Room”

In chapter 3, we explain the SNS for Japanese teacher training. We believe that using SNS for education has some merits, but we understand the existence of the demerit. The main problem is that students don’t login SNS. Because, they feel bother of using SNS which we prepare for educational purpose. We think that there are two reasons. One is that the connection among them is very important. It is difficult for them to communicate unknown people. The other is that they feel nervous when their comments are seen by the other students and teachers. They are conscious that they have to write good comments and diary, so that makes them hesitant.

We try to design to construct community of Japanese teacher training, and prepare the “Working Room” to make face-to-face communication. We think that the combination SNS with “Working Room” is very effective for making community.

In “Working Room”, there are a researcher and some Teaching Assistants. The researcher can give advices to students because he has experience of Japanese teacher and his major is Japanese linguistic. Teaching Assistants are graduate students of Japanese teaching, so they can support the researcher and follow students. And there are many books of Japanese teaching and some computer for using SNS.

Students come to “Working Room” with some purposes. Main purpose is to prepare trial lessons. Most senior students have to conduct trial lessons, so some senior students usually conduct preparation of lessons because they can discuss among them and take some advice from the researcher.

Some freshman or sophomore students come to “Working Room” in various reasons, such as professors’ suggestion. They can see work of senior students in the room, some changes happen gradually; senior students give advice to freshman students; freshman students read others’ diary and write comment in SNS.

Fig. 5. Snapshot of “Working Room”

5 Practice and Evaluation

5.1 Practice Overview

We use JapaS beginning in the spring semester of 2009. Students wrote about the process of preparing a teaching plan and their impressions after observing a class with

the help of professors during lectures. They commented on other students' entries and discussed teaching plans progressively as the teaching practice came to a close. When they performed their teaching practice, they suggested good points and points requiring improvement to each other.

Feedback from one another motivated the students. If a student thinks alone he/she may feel isolated and depressed, and this was prevented by the ongoing peer communication. It is clear that communication on the SNS supported the student's learning and improved their teaching practice.

We conduct questionnaire about JapaS for freshman students in 2010. The questionnaire contained seven questions. The respondents comprised 66 students.

5.2 Using Frequency and Writing Diary

As the response to "How much do you see JapaS per Week?", 12 students see JapaS more than 3 times and 19 students see 2 times per week. We get the result that about half of students usually see JapaS. About the other half of students, 28 students see 1 time, 7 students see less than 1 time per week.

58 students(88%) write diary after every lecture according to questionnaire. The result of response to "writing diary is very useful for preparing trial lesson?" is Figure 6. 82% students give good evaluation for writing diary.

Figure 7 show the result of "How do you take into account writing diary when you look at others' lecture?" 29(44%) students usually look at lecture with conscious of writing diary.

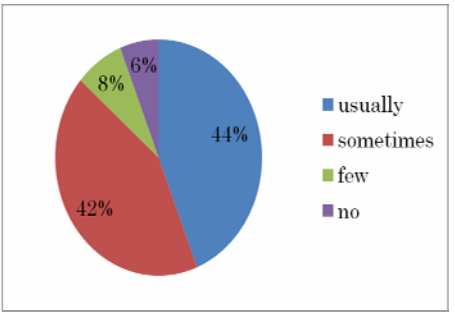

Fig. 6. "Writing diary is very useful for preparing trial lesson?"

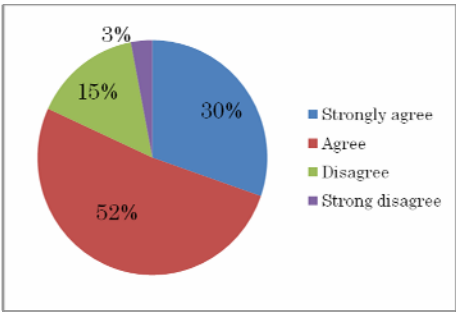

Fig. 7. "How do you take into account writing diary when looking at lecture?"

5.3 Writing Comments to Other Students' Diary

Figure 8 shows the result of "How much do you write comments to other students' diary?". About 60 % of students usually write comments.

The result of response to "reading diary and comment is very useful for preparing trial lesson?" is Figure 9. 80% students give good evaluation for reading diary and comments.

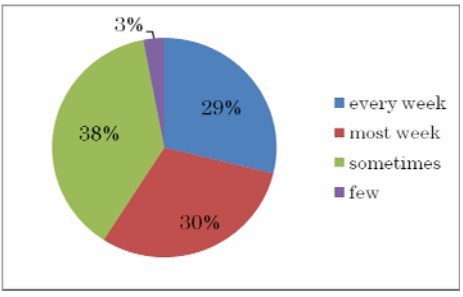

Fig. 8. "How much do you write comments to other students' diary?"

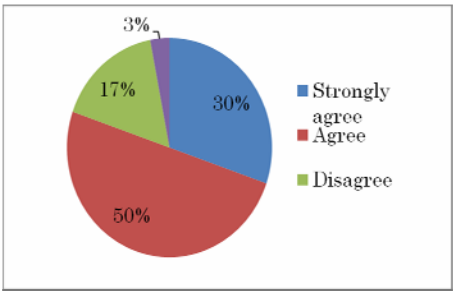

Fig. 9. "Reading diary and comment is very useful for preparing trial lesson?"

6 Conclusion

In this report, we introduce the Japanese teacher training program at Kyoto University of Foreign Studies. We explain our SNS platform which contributes to the program's success and "Working Room" which support the communication among students and teachers. We think that the combination SNS with "Working Room" is very effective for making community. The program's goal is developing Japanese teachers who can teach in a rapidly evolving multicultural society.

Students write various types information on the SNS such as self-descriptions, blogs, BBS entries, and reports on practice teaching. They can share information on Japanese teaching and communicate with teachers and other students. As an additional advantage, they can treat the SNS as a daily journal reflecting their teaching training progress.

Students come to "Working Room" with some purposes such as prepareing trial lessons. Some freshman can see work of senior students in the room, some changes happen gradually; senior students give advice to freshman students; freshman students read others' diary and write comment in SNS.

We conduct questionnaire about JapaS for freshman students in 2010. As a result, Students give high evaluation, they use JapaS positively.

In the future, we will conduct an evaluation of the learning outcomes of students. Moreover, we will research the effect of combination JapaS and "Working room" in detail.

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On the Design of Organizational Network Analysis Software

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Abstract. This paper describes the design of web-based software for visually exploring organizational social networks. The software's target user group consists of business professionals and organizational design consultants who wish to apply network analysis to a practical problem but lack the sophistication required to use advanced software packages. Particular emphasis is placed on using multiple layouts, aggregation and filtering to reduce cognitive complexity and improve usability. Implementation details will also be briefly discussed.

Keywords: ONA, SNA, Network Analysis, Graph Layout, Data Visualization, Web Application.

1 Introduction

This paper describes the design of software for visually exploring organizational social networks (Lantern). Organizational network analysis (ONA) is increasingly of practical concern to business leaders and numerous usability challenges make ONA a rewarding HCI research topic. From a technical standpoint the scale of corporate social networks tends to overwhelm simple visualization algorithms. Additionally, making effective decisions requires a level of detail that rules out methods designed for extremely large networks. From a user experience perspective there is enough inherent ambiguity in the data to preclude fully automatic interpretation. At the same time the users best equipped to provide relevant context typically do not have (or wish to have) a solid grasp of the fundamentals of network analysis. The combination of problem complexity and domain expert skill gap necessitates a software-assisted exploration approach. The Lantern software includes multiple presentation modes to support different analysis goals. Each presentation format shares the same data model based on an organization's social graph. The social graph data is filtered, aggregated and transformed to emphasize patterns of interest, while hiding less significant parts of the data. While the majority of this paper will describe the four topics above, some implementation concerns such as the tradeoffs necessary for web based delivery, including offline processing of computationally complex algorithms and platform alternatives will be also be discussed.

2 User Profile

Lantern software has been used within the context of organizational change projects, where a company wants to shift their collective behavior or formal structure. The

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Lantern software targets two distinct types of users. The first type of user is a management consultant with a solid grasp of fundamental network analysis principles. It is important to note that these are not scientific researchers and thus are not expected to be familiar with standard network analysis software such as UCINET, ORA or NodeXL [1].

The second type of user is a business leader or manager. While these users have little to no experience with formal network analysis they have a strong intuitive understanding of the social networks within their own organization and can provide the context necessary to draw meaningful insight from the data.

3 Data Model

Lantern is designed to visualize social graphs comprised of employee-to-employee relationships. Examples of relationships include functional connections such as information flow or collaboration and also emotional connections such as trust and shared motivations. Typically the social graph is collected through a web-based survey taken by all members of an organization once or twice per year. In addition to graph data, categorical attributes such as Location, Department or Tenure can be used to group individual employees. The values and assignment of categorical attributes are typically obtained from an HR or IT function independent of the web-based survey. Standard measures of individual and group centrality, cohesion, etc. are computed using subgraphs of the social graph.

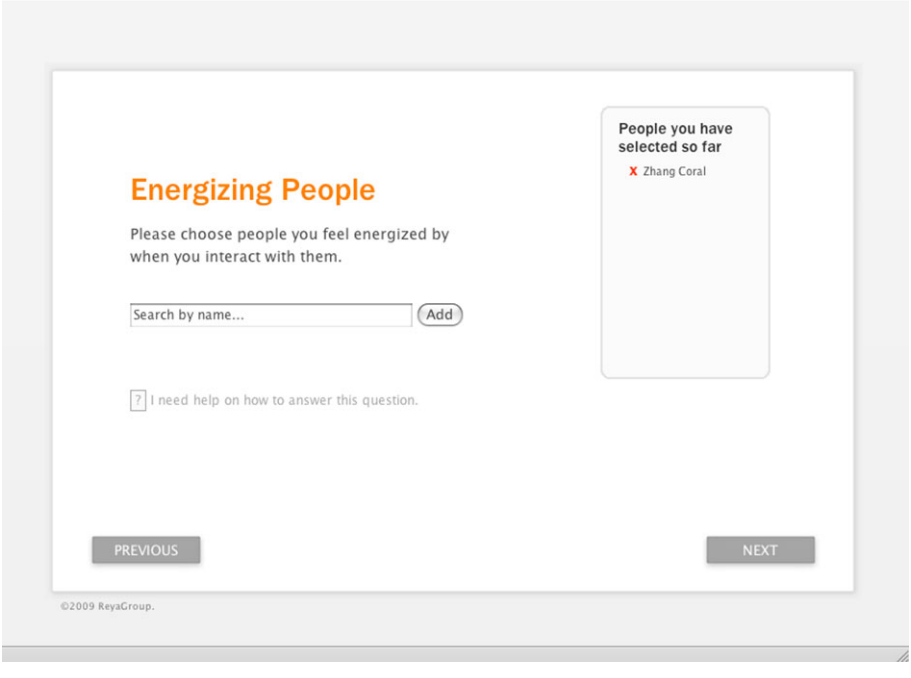


Fig. 1. Survey Interface

4 Patterns of Interest

Organizational network analysis borrows a number of ideas from graph theory. Fundamental to ONA are the concepts of centrality [2], density and modularity [3]. Most algorithms in expert level software packages such as UCINET are variations of these three ideas. From a non-expert perspective (and thus the Lantern user perspective) delving into the details of esoteric centrality measures is more confusing than helpful. The typical business leader thinks in terms of high-level goals such as identifying potential new leaders, domain experts, information bottlenecks and especially tight knit groups. One of Lantern's key design decisions is to focus the exploration of social network data around high-level business goals and hide unnecessary technical detail.

5 Presentation

The presentation format of data has a major impact on interpretability. Lantern supports three major presentation modes. The first is a standard graph visualization built out of circles and lines (to represent nodes and edges respectively). This format is ideal for capturing the overall complexity of an informal social network and provides a good model for interactive navigation of the network, e.g. drilling down, rolling up both have intuitive implementations. The major drawback with graph layout is visual and algorithmic complexity, users have a hard time processing the sheer volume of information being presented at once and convenient implementation platforms have difficulty displaying thousands of nodes and edges at once while maintaining interactive speeds.

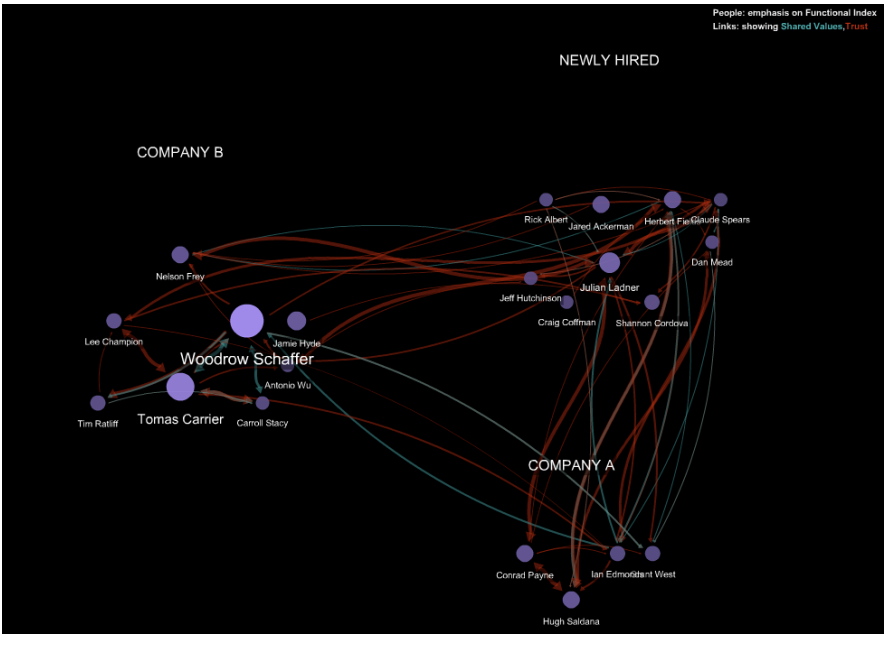


Fig. 2. Graph Presentation

The second view, scatterplot layout, is visually much simpler than the graph view since it removes relational data and is ideal for comparing individual or groups along 2-3 dimensions.

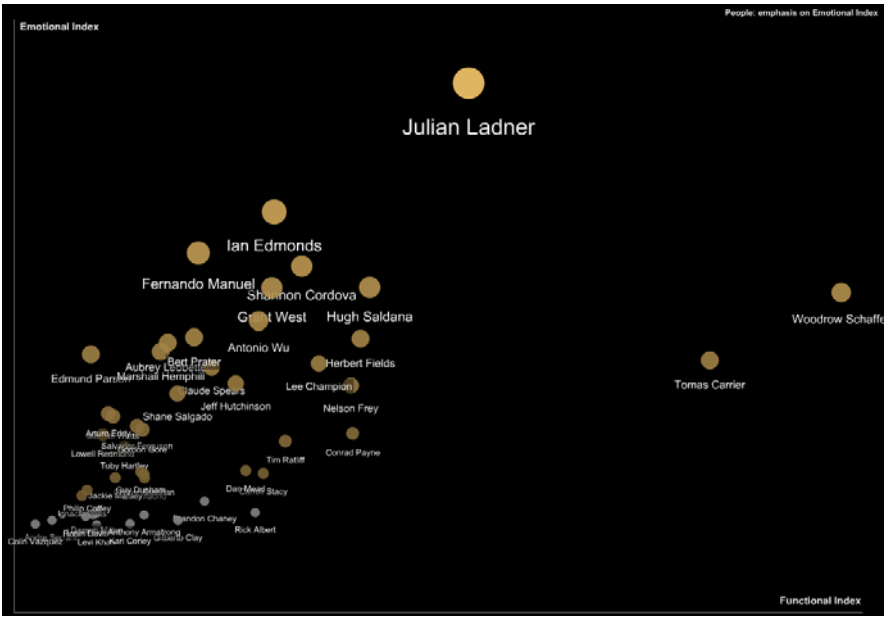
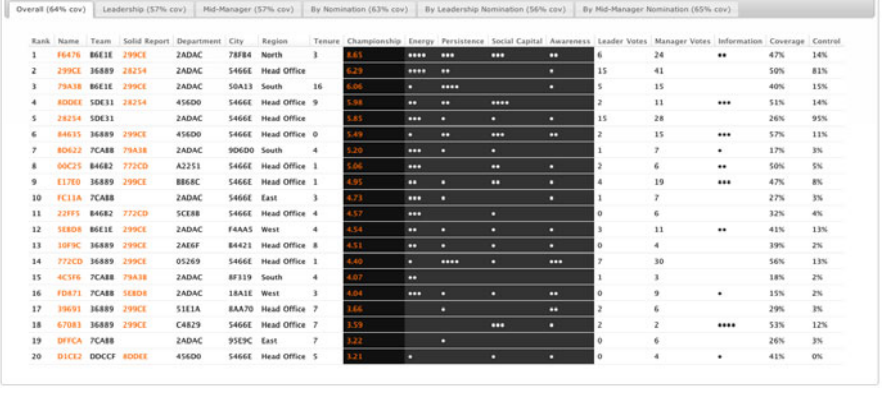


Fig. 3. Scatterplot Presentation

The simplest and most traditional view is the table. A table is ideal for ranking nodes on one dimension while still allowing the user to scan multiple attributes at a glance. With spreadsheets in common use, the table metaphor is also one of the most intuitive and comfortable views for novice users.



Rank	Name	Team	Solid Report	Department	City	Region	Tenure	Championship	Energy	Persistence	Social Capital	Awareness	Leader Votes	Manager Votes	Information	Coverage	Control
1	F6476	86E1E	299CE	2ADAC	78F84	North	3	8.65	****	***	***	**	6	24	**	47%	14%
2	299CE	36889	28254	2ADAC	5466E	Head Office		6.29	****	**		*	15	41		50%	81%
3	79A38	86E1E	299CE	2ADAC	50A13	South	16	6.06	*	****		*	5	15		40%	15%
4	8DDEE	5DE31	28254	456D0	5466E	Head Office	9	5.98	**	**	****		2	11	***	51%	14%
5	28254	5DE31		2ADAC	5466E	Head Office		5.85	***	*	*	*	15	28		26%	95%
6	84635	36889	299CE	456D0	5466E	Head Office	0	5.49	*	**	***	**	2	15	***	57%	11%
7	8D622	7CA88	79A38	2ADAC	9D6D0	South	4	5.20	***	*	*		1	7	*	17%	3%
8	00C25	84682	772CD	A2251	5466E	Head Office	1	5.06	***		**	*	2	6	**	50%	5%
9	E17E0	36889	299CE	BB68C	5466E	Head Office	1	4.95	**	*	**	*	4	19	***	47%	8%
10	FC11A	7CA88		2ADAC	5466E	East	3	4.73	***	*		*	1	7		27%	3%
11	22FF5	84682	772CD	5CE88	5466E	Head Office	4	4.57	***		*		0	6		32%	4%
12	5E8D8	86E1E	299CE	2ADAC	F4AA5	West	4	4.54	**	*	*	*	3	11	**	41%	13%
13	10F9C	36889	299CE	2AE6F	84421	Head Office	8	4.51	**	*	*	*	0	4		39%	2%
14	772CD	36889	299CE	05269	5466E	Head Office	1	4.40	*	****	*	***	7	30		56%	13%
15	4C5F6	7CA88	79A38	2ADAC	8F319	South	4	4.07	**				1	3		18%	2%
16	FD871	7CA88	5E8D8	2ADAC	18A1E	West	3	4.04	***	*	*	**	0	9	*	15%	2%
17	39691	36889	299CE	51E1A	8AA70	Head Office	7	3.66		*		**	2	6		29%	3%
18	67083	36889	299CE	C4829	5466E	Head Office	7	3.59			***	*	2	2	****	53%	12%
19	DFFCA	7CA88		2ADAC	95E9C	East	7	3.22		*			0	6		26%	3%
20	D1CE2	DDCCF	8DDEE	456D0	5466E	Head Office	5	3.21	*		*	*	0	4	*	41%	0%

Fig. 4. Table Presentation

6 Filtering

Filtering nodes and edges by their graph centrality is a convenient way to reduce complexity while preserving important patterns. In Lantern the user may hide nodes that fall below a certain threshold of centrality. Centrality percentiles are used to avoid unexpected behavior due to variable distribution. As Lantern is typically used on multi-modal networks, centrality scores for each network are averaged together as higher-level combinations. For instance centrality on functional networks such as information flow can be combined with scores on collaboration networks, while emotional networks such as shared motivation and emotional trust may be combined into a single overall emotional influence index. In addition to such high-pass filtering, low-pass filtering can also prove useful, removing the most central nodes first may expose critical hubs within the graph. Metrics for edge centrality are not as diverse as node centrality so Lantern combines the edge based analogue of node betweenness centrality with the source and target node centrality along with a reciprocity bonus to estimate how critical an edge is the overall network.

7 Aggregation

Another way to simplify the network is to combine related nodes or edges instead of hiding them. With most organizations having some form of departmental or branch office structure an obvious choice is to combine the nodes and edges of a formal entity into a single aggregate node or weighted edge. Optionally Lantern allows the new aggregate node or edge to take on the properties of its constituent parts via average or count operators. Edges are particularly tricky, since their naive representation as a line with uniform thickness will be misleading if the source and target aggregate nodes are very dissimilar. Tapered splines can help indicate differences between end points, but are difficult to efficiently implement and take up more display space. A more exotic solution, edge bundling, was explored during the development of Lantern, but this resulted in un-interpretable diagrams where it was impossible to decide what groups an edge really connects.

8 Transformation

Filtering or aggregating nodes and edges work well as lossy visualization techniques, but sometimes a lossless approach is required. To pack as much data on screen at once, nodes and edges can be transformed to highlight more important details and minimize (but not hide) less important details. Lantern can resize or alpha blend nodes and edges based on their centrality metrics. This results in a much more legible visualization while retaining as much original information as possible. Layout algorithms are also employed to maximize the usage of display space while also preserving the user's intuition that objects that are close to each other a related to each other and objects towards the center of clusters are more central in real life. Lantern uses a hybrid tree/radial layout instead of the common force-directed layout. Force directed layouts tend to not work well with extremely non-planar graphs (most social

networks) and are too slow for real time layout of large networks (when additionally constrained by a relatively low performance delivery platform). The tree/radial layout first estimates the size of the formal and informal groups being displayed and allocates adequate screen space to each group, then uses a radial layout to display each group, with central players near the middle of the group. A negative side effect of this algorithm is that groups are not positioned next to each other using cross group connectivity information, they are simply ordered by size.

9 Implementation Details

Graph algorithms tend to have rather high algorithmic complexities, O(N^2) or O(N^3) is quite common [4]. Luckily the network data processed by Lantern changes relatively slowly, so background pre-processing can be employed. As truly open-ended exploration of data is not the main use case for this software, pre-computation doesn't unduly restrict the user. Algorithmic complexity wouldn't necessarily be a problem for highly optimized native implementations, however the additional requirement that installation of the Lantern software not require involvement from the end user's IT department necessitates web delivery platforms such as Flex with lower performance than optimized C or even Java. The benefits of using Flex and web based delivery seem to outweigh the performance penalty, but for the upper end of network size, alternative solutions such as WebGL may be required as Flash player has difficulty rendering thousands of edges while maintaining interactive frame rates.

10 Conclusion

Lantern software attempts to allow non-expert users to manipulate complex network data with the intention that can generate accurate, useful insights that lead to increased organizational performance. A number of usability challenges due to user inexperience, large data sets and low performance delivery vehicles were overcome through alternative presentation formats and both lossy and lossless data visualization techniques.

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Human-Computer Interaction as an Instrument for Strengthening Culture and Language of a Colombian Native Community

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Abstract. This paper is about the relationship between culture and human-computer interaction. Cultures are live, open and in continuous change. Computer and information technology, as external factors for non-Western-industrialized societies, may trigger transformations, that sometimes, could be considered as negative or unwanted. For example, the usage of Western word-processors modified the Japanese writing system when Japanese people faced a number of unfamiliar concepts introduced in those computer tools [8]. At the same time, minority societies around the world are in danger of extinction. The Nasa people, our target population, struggle to revitalize their mother tongue and cultural traditions. This text presents an experience about developing or adapting computer tools to help the revitalization efforts. The use of the computer could lead to positive effects, or at least, to effects aligned with the policies of the society.

Keywords: Culture, Language and culture preservation, Nasa native community, HCI.

1 Introduction

The main motivation of the project presented in this paper is the impact that HCI and the culture of users may have on each other. We believe that it is a reciprocal relationship, with repercussions in both directions: the development and use of a certain technology is impacted by the users' culture, while, technology may modify cultural characteristics of a society. Through this project, we aim to develop computer tools for a Colombian indigenous community, called Nasa. As technology providers, we would like to avoid, in our users' context, a similar impact to the modifications suffered by the Japanese writing system when "Western" word-processors were introduced in Japan. Furthermore, we would

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like to take advantage of the possible power of transformation of digital devices. Thus, we address this effort to support the campaigns and policies of the Nasa community to revitalize their language and traditions.

Language-oriented processes seem to be insufficient. An earlier experience showed that the translation of the main computer interface into the Nasa language was highly complex and unsuitable for that time [2]. Internationalization/localization processes commonly used for other languages and contexts were unfruitful when dealing with the Nasa language. That experience also concluded that the adaptation or the development of information tools should be done taking into account other cultural particularities. Our first challenge was to comprehend this culture, and select from it the elements that may have an impact on interaction with computers.

Before going any further, we need to come to an agreement about what we understand by "culture." For the moment, we take the definition proposed by Hofstede [6], and used by Hoft in her HCI and Culture-related work [7]. For them, culture is "learned behavior consisting of thoughts, feelings, and actions." Thus, *developers should have an understanding of how their users might think, feel and react to their products* And further, *how their products would affect the environment and context of users.*

To achieve our goal, we need to understand the Nasa context, from its social, educational and even political perspectives. Through the paper, we briefly describe our apprehension about the Nasa culture. We introduce the community in the following section, then, we present a short outline of culture and HCI-related work. In sections 4 and 5 we briefly describe our approach: our development framework, based on the design of three different tools, and the cultural characteristics that have impacted them. Finally, we present some user reactions and conclusions.

2 The Nasa People

The Nasa people[1] are an indigenous community of the Colombian territory. To be more precise, they inhabit the Southwestern Andes of the country, in the section crossing the Cauca department. There, they live in *resguardos* [2], communal lands of collective ownership, where Colombian indigenous people can exercise their traditional activities. For most of the Nasa, agriculture is the main economic and living activity. Different kinds of products, such as maize, coffee, potatoes, and sugar cane are produced thanks to the diversity of temperatures found in the mountains [16].

These mountains have helped to preserve the Nasa's mother tongue: Nasa Yuwe. A unique and complex language, that seems to have no clear relationship with the other 60 native languages exiting in Colombia today. It is important to

[1] The Nasa are also know as Paez, as they were named by the Spanish. We prefer to use the name they use when referring to themselves.

[2] *Resguardos*: The Colombian Constitution grants some rights to native communities over these special territorial units.

note that the Nasa were, until recently, an oral-tradition society. As far as we know, there is no evidence of writing systems produced by Amerindian communities before the arrival of Europeans on the American continent. In the case of the Nasa Yuwe, the current writing system was approved by the community in 2001, as the product of the unification process of three different efforts to give the Nasa people an alphabet. It is a rich alphabet based on Latin, formed by 32 vowels and 37 consonants, which is now learned by children in schools. From our point of view, it could be seen as a strategy for preserving this language: now, they can write their own history in their own language.

According to the number of speakers, the Nasa Yuwe is the second language in the country. From around 150,000 people, i.e. the whole Nasa population, two thirds speak the language. Sadly, this number decreases from time to time, especially among young people. According to interviews carried out in the *Resguardo* de Novirao, adults consider that factors such as a lack of teaching, a lack of importance, social stigma and the influence of technology are some of the reasons why people no longer speak Nasa Yuwe[3].

The Regional Indigenous Council of Cauca (CRIC), the main indigenous organization in the region, and its Education Program (PEBI), manage most of schools in the north of the Cauca department. Among their policies, they demand the revitalization of Nasa Yuwe and Nasa traditions through school [3]. They seek to provide bilingual education, focused on agricultural activities, taking into account the Nasa traditions and methods.

We will show other characteristics of this culture when we describe our work in the following sections.

3 Related Work

Culture in HCI is a topic that has been taken up in recent years. Since 1996, Elisa del Galdo and Jakob Nielsen identified some cultural issues and variables taken into account by most international products in that time, such as: language, format of dates and numbers, character sets and notations, among others [5]. Such variables, according to the Iceberg Model presented by Nancy Hoft [7], are visible and easy to study by an external observer, since they are "above the surface." However, del Galdo and Nielsen proposed to explore more levels of software localization.

To go below the surface of the Iceberg, and take into account other cultural variables, Hoft proposes the elaboration of a Cultural Model. Since then, some work has been done [12], including a model for "cross cultural game design" [1]. However, Heike Winschiers-Theophilus affirms that current Cultural Models are missing the impact of culture on some stages of the whole design process [19]. We have developed our version of a Cultural Model [17], that is briefly outlined in this paper.

From a lower level point of view, issues found during interaction between different cultures through the interfaces are clearly explained by semiotics.

[3] Personal communication, with Marta Corrales and Tulio Rojas, 2010.

Computer interfaces are full of signs, such as words, icons, movements, actions, among others, that make possible the human-computer interaction, and whose interpretation largely depends on the users' culture. According to the Semiotic Engineering theory, proposed by Clarisse de Souza [4], HCI is a Metacommunication process, between (a deputy of) the developer and the user. As a consequence, the developer must need to talk the same "language" as the user, selecting suitable signs in the interface design.

Our experience with the Nasa people has driven us towards the development of educational tools for children from that culture. The work of Matthew Kam, Anuj Kumar *et al.* [9,11] seems to be the most exhaustive and serious about mobile games design for kids in a rural context. We take some elements from their work, such as the strategies to observe local games and extract from them suitable information to design computer tools. Medhi *et al.* have done an interesting work on Text-Free interfaces for illiterate and semi-illiterate users in Bangalore slums[13]. We have found a couple of similar observations about users' behavior and preferences that we will describe on the text.

Among the work specifically designed for the Nasa people, we found the "Web community to support Nasa ethno-education processes"[4]. It seems that there exist other isolated efforts, for which we have not been able to find documentation.

4 Our Development and Application Framework

At present, the "tangible" outcomes of the experience described in this paper have been the development processes of three tools, focused on Nasa children and their schools. While the first has reached maturity, the other two are in their first development cycle:

1. *Çut pwese'je*, the maize game
2. *Çxuga pwese'je*, the spinning top game
3. and, the design of a "global" interface, as an alternative to the Desktop Metaphor.

The main objective of the maize game is to help Nasa children (and adults) to learn the Nasa Yuwe alphabet, identifying its 69 graphemes[5]. It is a *hangman*-like game adapted to the Nasa context. Instead of a condemned man, *çut pwese'je*'s central stimulus is a field of maize plants, main staple of the Nasa diet [17].

The second tool, *çxuga pwese'je*, is planned to be a competitive game where four children have to make their spinning tops spin for as long as possible. To do so, they have to continuously solve challenges in Nasa Yuwe. However, we have not been able yet to determine the adequate type of questions. We have thought

[4] Comunidad virtual de apoyo a los procesos de etnoeduación nasa: http://www.ewa.edu.co

[5] Grapheme: the unit of a writing system. Nasa Yuwe has graphemes of one, two and three letters, i.e: ĩh, aa, çx, pxh.

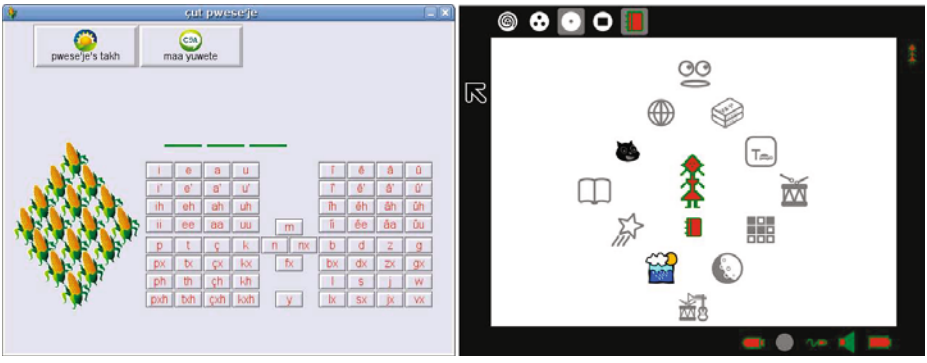

Fig. 1. *Çut pwese'je*, the maize game (left). Individual space in our adaptation of the Sugar learning environment (right).

about asking for arithmetic operations in the Nasa language, but the way they should be done is still unclear, and linguistic research is needed first.

Besides these two tools, we have also looked for an alternative interface to the Desktop Metaphor, to be used in the computers of Nasa schools. According to the designs made collectively with Nasa students and teachers, we have decided to adapt the Sugar learning environment, which offers an alternative to traditional office-desktop software. It has been originally developed for the OLPC XO-1 laptop computer and is now supported and maintained by Sugar Labs [6].

4.1 Development Processes

The design of the maize game started in 2006, then it followed an iterative process. Each cycle allowed us to comprehend Nasa characteristics, through the design and evaluation of prototypes. The three current cycles are described in [17].

The spinning top game and the global metaphor have been designed collectively with students and teachers in two Nasa schools. During an in-field work-period in the *resguardos* de Tumbichucue and Caldono, we used blackboards and chalks to design and evaluate the tools' dynamic.

The spinning top game was inspired from local games, played by children in their *resguardos*. The ideas of Matthew Kam were useful in this design [9,11]. We had the chance to observe different games during a celebration day in Tumbichucue. Rustic and accessible material is used to build different types of spinning tops, carts, and other toys. The spinning tops game is based on *phçxukwe çxuga*: kids have to repeatedly strike a wooden spinning top with a small fiber whip to make it spin as long as possible. As expected, during a competition, the goal is to make it turn more than the others. At the time of the observations, the local record in Tumbichucue was 1h40m.

[6] Sugar Labs: http://sugarlabs.org

Fig. 2. Nasa kid playing with a spinning top during a competition in the Tumbichucue (left). Collective evaluation of the design of the spinning top game in Caldono (right).

5 Cultural Dimensions

Through our experience, we have encountered some questions that have directed our research: *How to study our target culture?*, *How to select relevant characteristics that would impact the design and usage of computer interfaces?*, *How to apply them to the design of human-computer interaction?* and *Is it possible to highlight them through interaction?*

Nancy Hoft deals with similar questions and suggests the modeling of culture as a strategy to answer them [7]. Following her recommendations, we have developed a Cultural Model based on the work of Kluckholm and Strodtbeck [10], Hofstede [6], Victor [18], among others. Our proposal takes into consideration six wide cultural variables for the development of computer tools: *Language*, *Space*, *Environment and technology*, *Social organization*, *Notion of time* and *Nonverbal signs*. These characteristics and their relationship with the development of the maize game are described in [17]. This model was later evaluated through the design processes of the game of the spinning top and the global interface.

In this section, we summarize our observations about each characteristic, and how they have impacted the tool development processes.

5.1 Language

Besides the lack of a basic computer glossary in Nasa Yuwe, we have encountered other language-related challenges. For example, the lack of some Nasa Yuwe characters in available keyboards meant we had to look for a graphical input method for *çut pwese'je*, described in [17]. The current keyboard layout is based on the order in which kids learn the alphabet. The four groups-by-four groups organization is taken from the concept of the rhombus and its relationship with the number four (See Figure 1).

Moreover, we have proposed to use the spinning top game as a tool to help children learn arithmetic operations in Nasa Yuwe. However, we have found that it is still unclear, among linguists, how these operations are done. As far as we know, current bibliographic reference about numbers in Nasa Yuwe is limited to numbering [15]. Thus, further research is needed.

5.2 Space Structuring

Interfaces may have an essential spatial component, such as the Desktop, used in the common computer interface. We base our alternative interface design on different levels of Nasa space structuring, such as the hearth (*tulpa*), the house garden (*tul*) and the *resguardo*.

We think that a "collective space" in the interface would fit the collective-orientation that we think is present in the Nasa culture (see below). Thus, we could take advantage of networking capabilities and make it possible to collectively work through computers. For that, we propose an analogous interface to the hearth (*tulpa*). The Nasa three-stones *tulpa* is the central point of "traditional" houses. It is a place where family and close friends spend time together, especially after work journeys. During a collective design session, Nasa students and teachers also proposed to include a metaphor with the *resguardo*, to expand the area of interaction and be able to work with the whole community.

5.3 Environment and Available Technology

The Nasa context is mostly agricultural, so files, folders, desktops, trash bins and the concept of recycling are uncommon in this rural environment. The Desktop Metaphor's foundations are inconsistent with the Nasa mind set, resulting in a misunderstood metaphor by the Nasa people [2]. Our tools have been designed with the help of studens and teachers, taking into account the local environment and available material: maize, local toys, space structures, among others.

On the other hand, available technology imposes limitations and conditions the design. To cite two examples: the scarce equipment found in schools strengthens the necessity of sharing a single computer among several children, and the absence of Internet makes it unsuitable to create online tools. However, some computer rooms are equipped with local networks, which make it possible to design networked applications.

5.4 Social Organization

The social organization is a cultural dimension that embraces a wide range of variables. Here, we expose two of them: the educational context and the community-orientation.

Educational context. Since we focus on Nasa children and their schools, we needed to understand the particularities of the educational context. Nasa authorities aim to provide bilingual education, in Nasa Yuwe and Castilian, centered on agricultural activities and communal policies.

Community-orientation. It is manifested in, at least, two different aspects: territory and work preferences. The Nasa people live in *resguardos*, communal and inalienable lands that allow collective ownership. Furthermore, there exist three Nasa traditional types of collective work, more valued than other individual ways of working [14]. Therefore, the community is involved in a wide range of aspects of the Nasa way of living, from the construction of a new classroom, to the debate about the creation of a writing system for Nasa Yuwe [16]. Consequently, we have introduced our projects publicly and had more fruitful designs and evaluations when they were run collectively than with one single individual.

Likewise, we seek to highlight the communal character design tools that encourage the collective use of one single device. For example, the spinning top game is designed for up to four simultaneous players.

5.5 Notion of Time

Usability evaluation methods such as Thinking aloud, quantitatively measure time of task completion to evaluate the quality of an interface. However, as Winschiers has found in Namibia, we think that the Nasa people give a minor importance to the time. In a general rule, they would not care to spend a "huge" quantity of time to answer a question in our games. Consequently, we have avoided time limits in their design.

5.6 Non-verbal Signs

The rhombus and the spiral are important Nasa symbols, representing, among other concepts, one World view and time/life development, respectively. We use such symbols as layouts, metaphors and other interaction signs. The rhombus is easily visible in both prototypes of Figure 1.

We use the spiral and its relationship between the different social interaction levels, to link the *tulpa* and *resguardo* analogies in the interface.

6 User Reactions

For the moment, we have evaluated our work through qualitative observations of user reactions, which outcome is to summarized here.

"Collectively" works better. Our initial evaluations of the maize game were individually run, using "thinking aloud" based methods. However, kids seemed to be uncomfortable. They called other people around to join in the evaluation, which seemed to be a more natural way. From that moment, designs and evaluations were done collectively. Winschiers [19] and Medhi [13] have found similar reactions in Namibia and India, respectively.

Abstract ideas. Nasa people seem to be uncomfortable with abstract ideas, such as disappearing maize plants, used to describe the maize game dynamic, or plants

with eyes and nose, intended to be attractive for Nasa kids. When testing the game, a kid said "oh, those bad birds!", when he saw the first maize pop up. Teachers and kids have suggested that it would be better that an animal steals the maize when the user is wrong. Medhi also reports similar observations in this point [13].

Good reception. During the design evaluation using the blackboard or when playing with the maize game on the computer, children (and adults) laughed and made jokes about other players' answers. However, they show excitement and concentration when it was their turn. Most people clearly wanted to solve Nasa Yuwe challenges and to write "complex" concepts in their language, especially during the design of the spinning top game.

Moreover, several *mayores*[7] have expressed their interest in building a physical keyboard like the graphical one used in the maize game.

7 Conclusions

HCI Researchers have concluded that other cultural dimensions than language have to be taken into account in the design and development of computer tools. In our project, we have considered other variables, such as: *Space structuring*, *Environment and Technology*, *Social organization*, *Notion of time* and *Non-verbal signs* to construct tools for the schools of the Nasa Colombian native community.

Some of these dimensions might impact not only the interface itself, but also processes like development and evaluation, or even the usage practices. For example, the collectivist character of the culture has improved the development of the tools, students and teachers have collectively participated in the design, evaluated and provided new ideas.

Finally, with those tools we aim at helping in revitalisation efforts of language and culture. We hope that the inclusion of cultural variables in the interaction will help to give value to the culture, and reduce, for example, the social stigma felt by some native people when using their mother tongue.

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[7] *Mayores:* Elders, people considered as wise by the community.

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Interactive Media in Social Innovation

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Abstract. Interactive media is playing an important role in social innovation. Various types of interactive media platforms are affecting and changing the life of people in China in significant ways. This paper presents a detailed survey on the interactive features of these platforms. We found a trend that they are all supporting more and more interpersonal and social interactions, which in turn contributes to the increase of their stickiness and brings new dimensions to the services they are providing. We further analyzed this phenomenon by looking at interactivity from a communication science point of view. The purpose of this paper is to provide inspirations for the design and development of new social innovation systems based on the understanding of the users from a social cultural perspective. The analyzed characteristics of interactive media in China will also be helpful for cross-cultural social innovation research.

Keywords: interactive media, interactivity, social innovation, communication, social interaction, social influence, social relationship.

1 Introduction

Social innovation and service innovation are becoming more and more connected nowadays. This is especially prominent when the establishment and use of a service platform can change the social behavior patterns, routines, and practices and help to meet certain social needs or overcome certain social challenges. Many interactive media platforms in China are currently making such effects to the society to a great degree. It is thus worth taking a closer look at them in order to gain inspirations for the development of new social innovation ideas. We did a survey and analysis of twelve top interactive media services in China with a particular focus on their interactive features and how people utilize these features to interact with the media content and other users.

Since social/behavioral instead of technical understandings are what we are aiming at from this study, we here take a communication science interpretation of the term "interactive media". In the field of Human Computer Interaction (HCI), "interactive media" normally refers to the digital interfaces that support the interaction between the user and the computational system. However, as a term also widely used in

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communication science, it has a much broader connotation with the technical aspect as only part of it. Descriptively it refers to new technology-mediated communication format with which the user can interact directly with the media content and implicitly with other user(s). Attribute-wise, people play an active role in information acquiring, inquiring, producing and delivering with such media. People can also realize many self-development, social influence and social relationship goals through it [10]. When adopting this interpretation of "interactive media" from the communication science field, it is possible to constellating various new technology-mediated information formation and communication platforms into a unified one and look at them altogether from a social behavioral point of view. This will be helpful for researchers, designers and education practitioners in the HCI field forming a deeper understanding about people's needs for innovative service platforms from a broader social and cultural context. Besides the terminology, we also analyze these platforms from the three perspectives most commonly taken in communication science studies on media interactivity: the system functions, the communication processes, and the user perceptions. Indications of the survey and analysis to social innovation are then discussed.

2 Survey

We present in this section our survey on twelve media platforms that have strong interactive characteristics (See Table 2 in Appendix for their categorization and introduction). For the purpose of this study, we took a closer look at the interactive functions from all the platforms studied. Based on the type of interactions they are supporting, we put them into three categories: Human-Computer (HC) interaction, Human-Human (HH) interaction, and Human-Society (HS) interaction. The following table shows how the interactive functions are used across the studied platforms.

Of these functions (for function description, see Table 3 in Appendix), those listed under the HC interaction category bring convenience to users' access of the media content (e.g. Books/movies/music records), their utilization of the service (e.g. Online fitting room), and their self-entertainment through the platform. However, these functions only constitute of a small portion of the table above. Most of the interactive functions are supporting human-human and human-society interactions for different social functions: communication (e.g. Chatting with random strangers, Messaging), helping others (e.g. QA for others), participation (e.g. Discount on group shopping, Homework, Group and community building), collective opinions (e.g. Poll, Customer reviews, Selecting products for others), social networking (e.g. Friend searching, Friend adding, Activities, Local activities and groups), social influence (e.g. Role model making, Grassroots writers' page, Self-content uploading), social awareness (e.g. Favorites, Follow, @Information notifier, Reminder), etc. It is these social interactions that make possible many of the new ways of conducting shopping, friend-making, information sharing, and other activities.

Table 1. Use of the interactive functions across platforms: **a**-Tudo.com, **b**-Photo.163.com, **c**-T.sina.com, **d**-Taobao.com, **e**-Meituan.com, **f**-Dianping.com, **g**-Renren.com, **h**-Douban.com, **i**-Tianya.com, **j**-Tieba.baidu.com, **k**-Baike.baidu.com, **l**-Wenku.baidu.com

Function Type	Function Name	Frequency of Use													
		Use of Each Function by Site												Count	
		a	b	c	d	e	f	g	h	i	J	k	l		
HC Interaction	Media content random looping	x	x	x					x			x	x	6	13
	PC games				x			x		x	x			4	
	Books/movies/music records	x							x					2	
	Online fitting room				x									1	
HH Interaction	Messaging	x	x	x	x	x	x	x	x	x	x	x	x	12	43
	Favorites	x	x	x	x		x	x	x	x	x	x	x	11	
	Follow	x	x	x	x		x	x	x	x	x			9	
	Reminder	x	x	x	x		x	x	x	x	x			9	
	@(Information notifier)			x										1	
	Chatting with random strangers										x			1	
HS Interaction	Self-content uploading	x	x	x	x		x	x	x	x	x	x	x	11	107
	Personal page building	x	x	x	x		x	x	x	x	x	x	x	11	
	Commenting	x	x	x	x		x	x	x	x	x	x	x	11	
	Dynamic update	x	x	x	x		x	x	x	x	x			9	
	Role model making	x	x	x	x		x	x		x		x	x	9	
	Groups and community building	x		x	x		x	x	x	x	x			8	
	Content sharing			x	x			x	x	x	x			6	
	Famous company and celebrity public page			x			x	x		x		x	x	6	
	Content sharing to SNS platforms	x					x			x		x	x	5	
	Friend adding			x			x	x				x	x	5	
	Poll			x	x			x			x			4	
	Friend searching			x				x	x					3	
	Grassroots writers' page				x					x		x		3	
	Homework		x									x		2	
	QA for others				x					x				2	
	New member recommendation					x								1	
	Discount on group shopping					x								1	
	Time limit					x								1	
	Activities								x					1	
	Local activities and groups								x					1	
	Entitled forums										x			1	
	Selecting products for others				x									1	
	Doodling on the videos	x												1	
	Quality posts										x			1	
	Collaborative authoring											x		1	
	Professional users teaming up											x		1	
	Online games							x						1	

3 Analysis

Through the survey, we found the trend that strong interpersonal and social interactions are happening in all these platforms and it is this interaction at the social scope that brought many novel practices that never exist before. We here analyze this phenomenon from three aspects about interactivity most commonly studied in communication science.

3.1 System Functions

In the communication literature, studies about media interactivity from the system function perspective mostly focus on quantitative evaluations of low-level technical aspects of the system considering of their support for the action or process of interaction, such as "speed, range, timing flexibility, sensory complexity" summarized by Kiousis [6] and "responsiveness, (real-time) speed, timing flexibility, selection options, modification options, range, spatial independence, temporal independence and sensory complexity" summarized by Quiring [10]. With the development of technology, many of these attributes already become commonly possessed by most of the interactive media platforms and no longer worth further scrutinization. We here also look at interactivity from the system function point of view, but with a different focus of examining the social actions these functions support to accomplish and the new practices they help make happen.

Novel Practices	Social Actions	System Functions
Real-time update of information of interest	keep track of, keep posted, inform, maintain awareness of	Follow;@ (Information notifier); Dynamic update; Reminder
Information sharing at society level	share, create together, exchange, help people in need, collaborate	Content sharing; Content sharing through SNS platforms; Doc share; Collaborative authoring; Professional users teaming up
Self-expression towards public	speak out, have a say in, feedback to other people, modify content, comment, make one's convictions public, exert influence, impact public	Self-content uploading; Doodling on the videos; Commenting
Virtual life (personal and social)	community building, join in, talk with each other, contact, discussion, relationship development, interconnect	Personal page building; Group and community building; Friend searching; Friend adding; Chatting with random strangers
Decision making based on collective opinions	impact public, help people in need, make one's convictions public, feedback, vote, recommend	Poll; Customer reviews Selecting products for others
Social influence made possible by public opinion	impact public, exert influence, imitate	Grassroots writers' page; Role model making; Famous company and celebrity public page; Quality posts
Online/offline mixed large scale participatory activities	take part in	Discount on group shopping; Time limit; Homework; Activities; Local activities; Online game

3.2 Communication Processes

A relatively comprehensive definition about media interactivity is given by Kiousis [6] "Interactivity can be defined as the degree to which a communication technology can create a mediated environment in which participants can communicate (one-to-one, one-to-many, and many-to-many), both synchronously and asynchronously, and participate in reciprocal message exchanges (third-order dependency)." It is clear that the above-detected tendency of utilizing interactive media for social activities is nothing exceptional from the communication science point of view. However, this way of looking at interactive media from the communication process perspective does make it obvious to see how the users are able to play more and more active roles with higher and higher social impact along with the development of media technology. As illustrated in Fig. 1, starting from passively receiving content from the media (with the sender, the professional content developer, as an indirect character to communicate with), with the help of computers, users are able to actively choose the content to view.

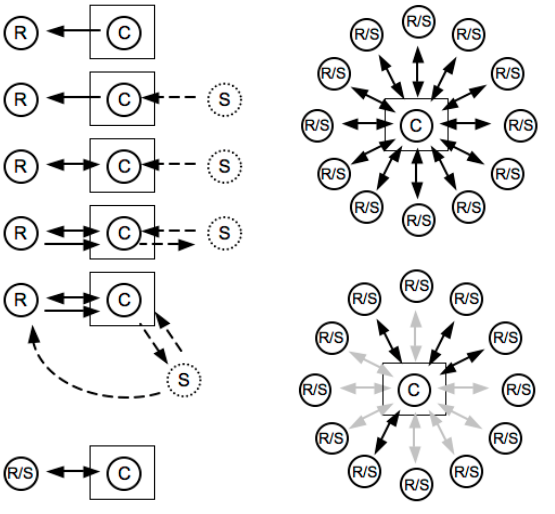

Fig. 1. Communication Process Perspective. S=Sender, R=Receiver, C=Content, rectangle surrounding C represents the media. From left to right, from top to bottom, the descriptions of the figure content are: Receiver-Media Interaction, Sender as the Implicit Content Developer, Receiver Active Information Acquiring through Computer-Mediated Media, Receiver Feedback to Sender, Receiver Becomes Content Developer and in turn the Sender, Technology-Mediated Sender/Receiver Network, User-defined Communication Paths.

They can also provide feedback to the content developer. Benefitting from Web 2.0 and other technologies, users are further able to become content developer, the role of receiver and sender merge into one. A technology-mediated network of sender/receiver entities is thus formed, in which content communicated expands from public to intra personal, interpersonal, or community agendas, feedbacks become open to public. User can also define communication subnet from the network by selecting people to share information with and people to keep an eye on.

3.3 User Perceptions

The intense social use of interactive media is consistent with the result of the research done by Oliver (2009) on users' subjective perception of media interactivity. The social dimension including social influence and social networking is the one people he interviewed associate the foremost with the concept of "interactivity".

In another study on perceived interactivity, Oliver (2008) stated that "Given technical options, a user's behavior is predominantly guided by subjective perception". I would say that technology advancement not only makes more and more functions supporting social interactions available for use but also contributes to people's perception update about what interactivity refers to, which in turn affects the way they use interactive media. With the continuous development of technology, many kinds of people's interaction with the media platform, such as navigating, selecting and modifying content, already become an integral part of the communication process and an integral part of people's perceptual experience towards interactive media. They are thus no longer of interest to or even not aware of by users in everyday life. Both the focus and the granularity of research on interactivity are also changing. However, different from an arbitrary switch of interest, it is the total control of those previously new features and concepts of interacting with the computers that gives people the freedom to utilize these platforms to fulfill their interaction needs at a broader scope, the interaction with others and with the society.

The young generation presents a more extreme case of the phenomenon mentioned above. As a population grew up with interactive media as part of their everyday experience, they may just take it for granted and naturally pick up the interactive platforms as a communication tool for their self-development and social interaction purposes without thinking much about the underlying interactive mechanisms. Besides this, long time evolvement with online activities also made them used to be part of virtual communities beyond the real family and community they reside in and used to integrate social interactions in the virtual world into their daily lives [9].

4 Discussion

This study surveyed and analyzed twelve popular interactive media platforms in China. We found a trend that social interaction is becoming a more and more important part during people's use of interactive media. At the same time, it is the social involvement at large scale that makes possible many novel ways of exploiting the services provided by these platforms. This is consistent with the result from studies done by Cho et al. [7] examining the influence of cultural difference on interactivity patterns. They found that people in countries of high context culture, such as Asian countries, have higher degree of motivation for social interaction and human-human interaction in their use of internet. This was explained from the cultural difference point of view that people from higher context culture tend to attach value to group identity, have homogeneous patterns of standards with high requirements and restrictions, and have a strong tendency to build life-time relationships [1].

Besides the main trend towards social interaction through interactive media, there are several other characteristic aspects worth mentioning. People exhibit a general trust to feedbacks and comments from others. Among all the people some are interested in becoming role model through the social mechanisms provided by each platform while others are interested in making their admired ones to become role models. The communication settings of these platforms make it easy for people to have direct contact with celebrities. "Follow" function is adopted by most of the interactive media platforms and is intensively utilized by people to keep aware of the trend in order to better adjust and position themselves in the society. These phenomena can also be explained correspondingly by the collectivism, high power-distance, and high avoidance of uncertainty characteristics of Chinese culture along the cultural dimensions defined by Hofstede [3].

Different from technical innovations, besides meeting certain social needs, social innovation also aims at shaping new social practices. The trend of intense social interaction happening in interactive media and the other social behavioral patterns of the users analyzed in this paper are thus useful for the reflection on social interaction and social relationship structures for the insemination of new innovation ideas. Specifically, they suggest but are not limited to the following understandings: It is often the case nowadays that new technologies are introduced during the implementation of novel social innovation ideas, rather than the reverse; citizens are now playing a more and more active role in the social communication process; it would be crucial to find the way to utilize the collective power of people in the engendering of social practices; virtual social community and social network is becoming a concrete unit that can drive the development of social innovation; there are deep cultural roots in China for the formation of social leader/follower relationship and the formation of trustworthy social group among people of likely mind. Creative applications of these understandings may be further deducted when it comes to concrete scenarios.

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Appendix

Table 2. Categorization and introduction of platforms studied

Category	Name	Brief Introduction
Self-media	Tudou.com	Established in 2005, Tudou.com is one of the earliest video sharing website in the world and one of the most influential ones in China. It attracts about 25 million visitors every day and has strongly motivated users to create their own media content, upload their works, and interact with others.
	163.com	Photo.163.com is the largest and one of the most popular online albums in China where users can browse, download and comment on photos. It encourages users to create and share their own works and communicate with others. It also enriches photographic culture in China and makes people play a more active role in photo shooting and appreciation.
	T.sina.com	T.sina.com is the most popular micro blog in China where registered members can post short messages, pictures, videos, and links to their personal pages. It greatly enhances information circulation in the society.
e-Commerce	Taobao.com	Taobao.com is a virtual shopping platform set up by Alibaba Group in 2003. It serves individuals, small businesses and major companies and is now the largest Asia-Pacific internet retailer, with its business across C2C and B2C. In 2010, Taobao.com has attracted more than 200 million registered members and greatly stimulated consumption.
	Meituan.com	Established in March, 2010, Meituan.com is a group shopping platform which provides different product for sale with group discount when there are enough number of customers book the coupon for that product before the deadline.
Customer Reviews	Dianping.com	Dianping.com was founded in 2003 and is now the largest customer feedback sharing website in China which are widely utilized in more than 30 major cities. Comments on dianping.com are now becoming a commonly used reference source.
Social Networking	Renren.com	Built in 2005, Renren.com is now the largest social network service website in China and has more than 100 million registered real-name members attracting about 24 million visitors each day. People find there new friends and keep in touch with old ones.

Table 2. (*Continued*)

Category	Name	Brief Introduction
	Douban.com	Established in 2005, Douban.com has more than a million registered users. It combines commenting, marking, and recommendation of books, music and movies together with SNS, which enable users to express themselves, acquire information and build friendships with others.
Forum	Tianya.com	Founded in 1999, Tianya.com is the earliest virtual community in China, which has more than 32 million registered members. It serves as a place for users to discuss about topics that are popular or critical to various aspects of the society and life.
	Tieba.baidu.com	Built in 2003 on top of the most popular Chinese search engine Baidu.com, Tieba.baidu.com is one of the largest forums in China, which has many sub-forums around various specific topics.
Knowledge Sharing	Baike.baidu.com	Officially established in 2008, Baike.baidu.com is the largest free knowledge sharing platform in China where users can collaboratively create and edit the definitions of knowledge items of a full spectrum.
	Wenku.baidu.com	Set up in 2009, Wenku.baidu.com is a platform for sharing documents like teaching materials, references, and novels. To download, users need to first gain virtual money through document uploading or critiquing.

Table 3. Description of the interactive functions

Function Type	Function Name	Description
HC Interaction	Media content random looping	To help users get access to media content they may be interested in by displaying randomly selected pieces.
	Books/movies/music records	For users to bookmark or store the books/movies/music that they have read/watched/listened to.
	Online fitting room	For users to preview the effects of clothes that they are interested in by letting them to try out the clothes on virtual models.
	PC games	To provide users with small PC games for them to relax and have fun while carrying out main tasks with the websites.
HH Interaction	Messaging	For users to leave messages on others' personal pages discussing about products, current issues, music, audio or video clips, etc. Messages will be visible to everyone.
	Favorites	For users to store texts, video or audio files they are interested in on their personal pages for further reference or appreciation.
	Follow	For users to "follow" others whom they are interested in in order to always get posted with their latest activities including status updates, materials uploading and sharing etc.
	Reminder	To send reminders to users when there are others commenting on their works, answering their questions, replying to what they have said, or trying to add them as friends or "follow" them.
	@(information notifier)	For users to "@" others at information points that they want them to know. Those being "@" will automatically receive the intended content.
	Chatting with random strangers	For users to chat with registered members randomly brought up by the system. Users can also narrow down the random recommendation to people in forums that they are interested in. IDs of both sides are displayed to help provide background info of them to each other.
HS Interaction	Self-content uploading	For users to upload diaries, micro diaries, documents, pictures, videos or audio clips to various platforms which will be available for others to view or download.
	Personal page building	To provide registered users with a space to build their own personal pages where they can upload photos, diaries and other materials.
	Commenting	For users to leave comments on documents, music, videos, products, others' comments and etc. or to grade them with stars.
	Dynamic update	To display on a user's personal page recent activities such as video, dairy, document uploading by the user him/herself and by people whom he/she pays close attention to.

Table 3. (*Continued*)

Function Type	Function Name	Description
	Role model making	To choose users who have made big contributions to the activities hosted by the platform to be the role model for others in order to create celebrity effect and bring in the competition mechanism.
	Groups and community building	For users to form or join groups and have discussions in the group forums on topics they are interested in.
	Content sharing	For users to share own materials or "republish" materials that have been published by others. The contents shared will be displayed on the personal pages of the user's friends and people who "follow" him/her.
	Famous company/celebrity public page	For celebrities or famous companies to set up their public pages and use them for promoting and personal influence building purposes.
	Content sharing to SNS platforms	For users to share documents, videos and audio clips with friends on SNS platforms such as Renren.com, Kaixin.com etc.
	Friend adding	For users to add others as friends when they agree to so that their friends' latest activities can be shown on their personal pages.
	Poll	For users to initiate polls in order to hear public opinions about certain issues.
	Friend searching	For users to search for friends through their names, schools, hometowns, ages or other information.
	Grassroots writers' page	To select and present on the platform quality articles written by normal users. Those whose articles are chosen will get paid as if they are invited writers.
	Homework	To regularly give out tasks with different themes and requirements for users who are interested in them to work on. High quality submissions will be placed in the recommended homework section.
	QA for others	For users to answer questions initiated by others. Those who provide the best answerers will get virtual reward offered by the initiators.
	New member recommendation	For registered members to recommend new members and get coupons for the recommendation.
	Discount on group shopping	To offer lower prices for products or services when there are buyers of certain number making orders as a group.
	Time limit	To set the time limit for group shopping and give pressure to the potential buyers.
	Activities	To host various activities for users inside the virtual community.
	Local activities and groups	To display information such as salons, exhibitions, and concerts of a chosen city and to recommend groups that local people like to join.
	Entitled forums	For users to be members of entitled forums about certain stars, products, subjects and so on so that they can be kept posted and can discuss about the forum topic with other members more conveniently.
	Selecting products for others	For users to give suggestions to others based on links, pictures and prices they provided about the items they are interested in purchasing. Besides specific suggestions, the requester will also get from others a favorability rating and poll result regarding items of their interest.
	Doodling on the videos	For users to add descriptions, subtitles and pictures to existing videos and share with their friends the modified works.
	Quality posts	To mark posts that are evaluated as high quality ones by the users.
	Collaborative authoring	For users to collaboratively create and edit definitions, meanings and contents of words, theories, and events etc.
	Professional users teaming up	For users specialized in certain fields to join the "tadpole group" and have a wider range of rights to edit and maintain contents, and to assist with forum administrators.
	Online games	To host easy-to-play online games which can enhance social networking through entertainment.

Design for Social Emotional Interaction in China: Light-Tech Driven Design and Prototyping Applied in Design Education and Research

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Abstract. Nowadays China is undergoing a development at top speed. The consumption capacity and acceptance to social service products are expanding every year. Especially, the social innovation and service design products based on light-tech and low-cost are very well received. As a very old oriental nation, Chinese have typical characteristics such as implicative, indirect, etc. As well as young people in China who were impacted by western culture in recent decades very like contracted and fashionable design. These provide very good keywords and references for social emotional interaction design in China. This article aimed at Chinese style emotional and interpersonal communication traits to discuss the concept of social emotional interaction design in Chinese design education and research, and advance a method of light-tech driven prototyping used to realize social emotional interaction prototypes. At the end of the article we gave some cases to show our researches and practices in our lab and courses.

Keywords: social emotional interaction, light-tech driven prototyping.

1 Background

With the development of social activities and information technologies, the needs of social interactive products increase progressively in all over the world. In China, more and more products are designed for intelligent life space, social network service, e-learning and digital entertainment, and hence the design research institutes regard social interactive products design as one of their most important education target. On the other side, some information technologies such as the internet of things (IOT), cloud computing, artificial intelligence, augmented reality, etc. will be integrated into social interactive products more often than before. So how to well apply and integrate these techniques in our lab and course practices to aid social interactive products' design is also becoming a very critical topic.

In this article we propose two concepts: social emotional interaction design and light-tech driven design and prototyping. The former is a subclass of social interactive design. It's also the main target in our past two years' research and teaching. The latter is a set of technical solution we applied in our lab research and course teaching.

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On the design layer, we emphasize sociality, culturality, emotionality, and artistry factors for the social emotional interaction. On the technique layer, the light-tech resolution is proved to be able to comply with the circumstances of lab research and educational purpose and the trend of future social emotional interaction design.

2 Social Emotional Interaction Design

2.1 Concept

The concept of social emotional interaction (SEI) design is derived from three domains of research:

Social Emotional Development (socio-emotional development). This is original a research domain in psychology. Socio-emotional Development covers changes in a person's emotions, relations with others, self-concept, and personality, which is a stable way of thinking, feeling, and behaving. We each have an image of 'who we are,' our self-concept, or identity. It is made up of many different parts, things like ethnicity, intelligence, skills, family, and socioeconomic status. Descriptors that come after the phrase 'I am…' refer to your self-concept. Thus, it is an overall description of your abilities, traits, and personality. It is the type of person who you believe you are, which may differ from the type of person who you want to be. As you develop, your identity is constantly being modified by experiences and thoughts [1].

Co-experience. Co-experience focuses on how people make distinctions and meanings, carry on conversations, share stories and do things together. Understanding these interactions can make opportunities for co-experience designed into interactions of products and services.

Focusing on the design process, Hugh Dubberly and Shelley Evenson have proposed a five-cycled framework for creating the experience: (1) connecting, the initial connection which makes effective and affective impressions; (2) becoming oriented, the overview or preview of things available, allowing exploration and supporting learning in the early stage; (3) interacting with the product, the completed activities to obtain direct experiences, including such as establishing expectations, acquiring and using skills, delighting the senses, etc.; (4) extending perception or skill and use, the persons' expectations and experiences are raising continually and finally they become masters along with being more and more familiar to the product, a significant loyalty relationship between users and products achieved at the same time; (5) telling others or advocating, the person actively teaches the usage of the product and communicates their satisfaction to others [2].

The other framework of co-experience was also advanced by Jodi Forlizzi and Katja Battarbee. They deem that experiences with products will take on social dimensions and meanings when user experiences involve social interaction together. Experiences become a part of social interaction, and then meanings of individual experiences emerge and change. When something happened or something new is actively creating in period of product using, co-experience can be a measurement to evaluate social interaction. Storytelling, reinterpreting and recalling are all able to create co-experiences. People can find new meaning when they use a product together and

experiment new modes and technologies used in interaction. Jodi Forlizzi and Katja Battarbee have proposed three methods to create co-experience also: Lifting up experiences, Reciprocating experiences and Rejecting and ignoring experiences [3] [4].

Social and Emotional Interface. There is a panel in CHI 2002 which theme is Future interfaces: social and emotional. This panel addresses 'science fact' for future social-emotional interfaces. They discuss new theory and upcoming interface technologies that enable or augment social-emotional interaction between people and computers, and between people via new forms of computers. The theme is rooted in: (1) findings that human-computer interaction is social and emotional even when interfaces are not designed with such interaction as a goal, and (2) advances in technology, enabling computers to recognize, express, and respond to emotional and social information [5].

Today, the social communication mode of human being is evidently changed by the development of information technologies. More and More communication activities are via computer and networks, instead of the traditional face to face communication mode. The gap of physical space is never a problem for communicating information from one person to another person, but it still results in difficult to precisely and effectively express our emotions, experiences, feelings and status from us to others. The social emotional interaction (SEI) design is a kind of design in which tries to resolve this problem. We deem there should be three key factors must be stressed and included in the SEI design:

Human-Product Interaction. A product designed for social emotional communication should resolve a problem of interpersonal communication, as well as provide good human-product interaction and emotional experiences to users.

Interpersonal Communication. The SEI design should be an interactive design for multi-users. It is not a sort of simple human computer interaction. Actually it should be a kind of indirect human to human interaction. The computer and network are just intermedia.

Localization and Contextualization. The SEI design should be a user-centered design. It should be suitable for local culture, geography and technical competence and meet the requirements of usage, emotion and socialization for local people.

2.2 Users in China

Interpersonal Communication Features. China has long history and unique culture with a vast territory and enormous population. Chinese people have their own characteristic features on the aspect of interpersonal communication such as liking jollification, strong group psychology, preferring to take part in associations, strong regional thinking, etc. Therefore we should pay more attention to analyze Chinese users' psychology, conduct the differentiation design according to users' different hobbies and regions they live.

Emotional Features. The emotional features of Chinese people are implicative and connotative as a whole. But there are still obviously different between young people and elderly people. For young people, they are more individualized and fond of

chasing fashionable and cutting-edge things. Their visions of love are more open than elderly people. For elderly people, they usually regard family love very highly and deem that everything should obey certain rules. So our social emotional design products should also pay attention to people's different emotional features in order to win a place in the business market.

Consumption Features. Chinese people have the virtues of thrift. They stress importance of saving money. But many young people often consume excessively and result in overdraft also. On the other side, the elderly people generally have conservative thinking for spending money.

3 Light-Tech Driven Prototyping

3.1 Concept

Based on features above, we propose a concept of light-tech driven prototyping (LDP) to create SEI products for Chinese people.

The original definition of "low-tech" refers to traditional manual technology before the Industry Revolution. In recent years it is used in the field of architecture design that means simple and easy design. Low-tech design stresses that we should maximize the usage of natural resources locally. Here is the other concept so called "light-tech" extended from "low-tech". Light-tech emphasizes that we not only should simply use of recyclable architecture materials, but also manage to design for applying these resources most efficiently [6]. Nowadays we are in the era of information, the concepts of low-tech and light-tech can also be applied to design innovative social interactive products. In such kinds of design, we use appropriate manual technology combined with mature electronic technique and information technology to create low power consumption, low-cost and sustainable SEI products.

3.2 Principles

Some principles should be obeyed in LDP and LDP based products:

Low Power Consumption. LDP should be low power consumption. The products based on LDP should work well in power grid for civil use. Microprocessor Control Unit (MCU) is usually the core of a LDP based product. For example, the ATmega48PA/88PA/168PA/328P series of MCU used in Arduino, which is a very popular open-source interactive hardware platform, accord with the concept of low power consumption. At 1MHz, 1.8V, and 25℃, the specification of ATmega series is as follows:

- Active Mode: 0.2 mA
- Power-down Mode: 0.1 μA
- Power-save Mode: 0.75 μA (Including 32 kHz RTC) [7]

Low Cost. The proceeding of LDP should obtain raw materials locally as many as possible. Use manual technology and light machining to finish the whole processing of production in order to save the cost of products.

Sustainable. The LDP should guarantee the product available and work well as long as possible and can be upgraded by simply replacing modules or components.

Environmental Protection and Obtain Raw Material Locally. The LDP should guarantee the product meets the requirements of environmental protection, reduces the output of harmful waste or gas, and save as many cost of production and transportation as possible.

4 Research and Education Framework

The integration of SEI and LDP concept is a set of unique design thinking and methods in interaction design. The SEI relevant theories are the basis of design, and the LDP relevant techniques are the methods to achieve the goal of design. The figure below shows the basic relationship between SEI and LDP.

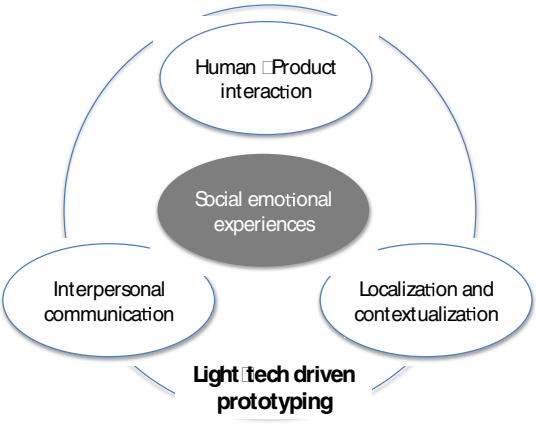

Fig. 1. Relationship between SEI and LDP

There are some divisions used to establish a design theme in our lab research and course teaching. One is interaction scale division which divided into three parts: room sized, body sized and hand sized [8]. The second one is interaction intention division such as for passing emotion, for expressing emotion or for communicating emotion. The third one is interaction expression ways division such as none-lingual expression, cross-cultural expression, contextualized expression or socialized expression, etc.

In our lab research and course teaching, we usually comply with following design steps to form an iterative work flow.

Prophase Survey and Concept Design. In the phase of prophase survey and concept design, we mainly use target user analysis, questionnaire investigation, field research and brainstorming to put forward some basic design targets. Some cases show this phase as follows.

Contextualization and Storytelling. Aim at these design targets, we attempt to simulate the real usage circumstances of the product, observe user behaviors in simulated environment and record the outputs. Via comparison of different outputs, we finally confirm specific usage context and interaction patterns. Some cases show this phase below.

Interaction Design and Configuration Design. With detailed usage context and interaction patterns, we will refine the interaction design for the product; make product diagram and structural drawing; define the technical specification and components the product should include.

Quick Prototyping. According to the technical specification and product drawing, we make a prototype of the product for following usability evaluation. In our experiences, LDP concept is quite fit for realizing quick prototype for small-scale, low-cost SEI products. It also very applies to educational and research purpose in design departments, institutes, colleges in university.

Usability Evaluation. In the last phase, we use prototype to evaluate user behaviors, record users' feedbacks and analyze outputs. The whole processing of SEI design and prototyping is iterative. The result obtained from usability evaluation should be used to improve product design and enhance the capacity of the product.

5 Case Study

This section shows some products' prototypes combined with concepts of SEI and LDP. Those prototypes are designed in our undergraduate courses and conducted by our teachers, lab assistants and students. For undergraduate level design and practice, students are emphasized to conduct the SEI design concept and use LDP based practice methods to construct (or integrate) creative product prototypes. Some specific technologies and methods we recommend include: (1) physical computing technology, a typical light-tech which is very suitable to realize simple hand, body and room sized interaction products, (2) behavior analysis and usability evaluation methods to target users such as between user, within user and mixed user tests, and (3) contextual storytelling for quick prototyping, etc.

Some of final outputs of our course are very close to real form of products, whereas others are more conceptual and not enough robust in technical level. But all of them are good combinations of SEI design concept and LDP practice methods.

5.1 'Emotional Lamp'

Emotional lamp is a kind of intelligent appliance or exhibition installation for passing the current state of us to others. It is also able to detect remotely if there are somebody in certain space or not. Emotional lamp uses camera sensor and visual recognition technology to detect people (e.g. people's emotional expression, or color and pattern of peoples' clothes) and transmit signals via embedded MCU modules or IPV6 network directly to local devices or the far-end (a common server or cloud computing based server). The receiver controlled by an Arduino based module in local or in remote will turn on devices (e.g. lamp, siren, screen, etc.) when signals received.

Specifics of Emotional lamp design:

– *Interaction scale: room sized*
– *Interaction intention: expressing emotion and communicate emotion*
– *Interaction expression ways: none-lingual, contextualized and socialized*

Fig. 2. Prototype I: Intelligent appliance with camera embedded inside (detect facial expression)

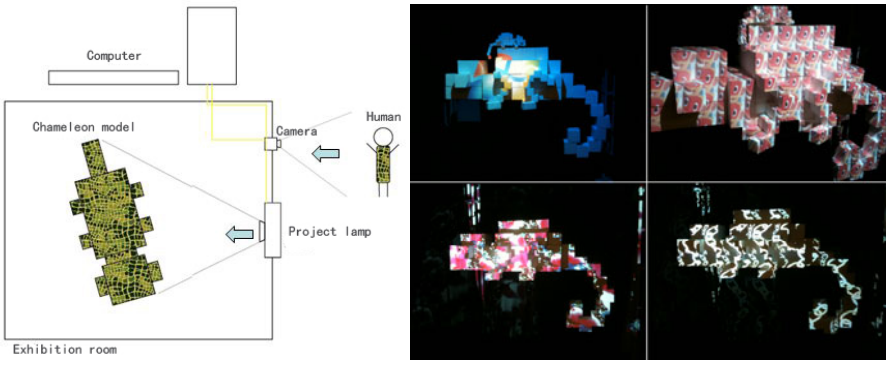

Fig. 3. Prototype II: Exhibition installation in public space (detect color and pattern of clothes)

5.2 Interactive Toy Design for Kids' Social Emotional Development

Following is a set of toy design prototype. The main structure of the toy is made by handiwork. A micro RFID module is embedded into it as the sensor and reader. When children put different cards or models on the game board, the computer, which connected to the game zone, will receive the id of them. According to the id, the computer will play different interactive content to users. This toy is benefit for kids' social emotional development when many kids play together or play with parents.

Specifics of Interactive toy design:

– *Interaction scale: body sized*
– *Interaction intention: passing emotion and communicate emotion*
– *Interaction expression ways: contextualized and socialized*

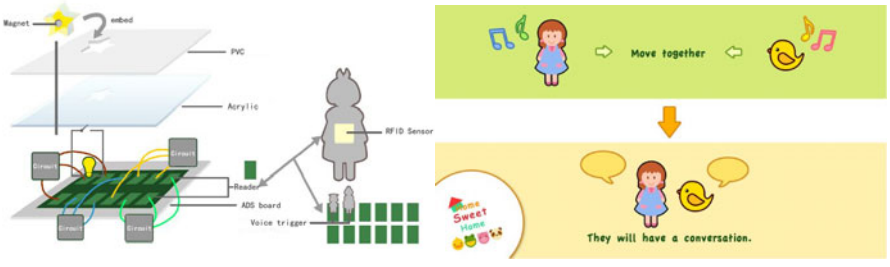

Fig. 4. Schematic diagram of interactive toy

Fig. 5. Prototype of interactive toy

5.3 Vocal Glove for Deaf and Old People

This is a conceptual design product. We conceive that embeds a module with curvature sensors and a vocal component into the common glove to realize the simple communication between deaf or old people and common people. We assume signals detected from curvature sensor can be mapped to the gesture language one by one, and the gesture language is mapped to voices stored in the vocal component, so that the deaf or elderly people can only make gestures and then the glove will play corresponding voices to the common people.

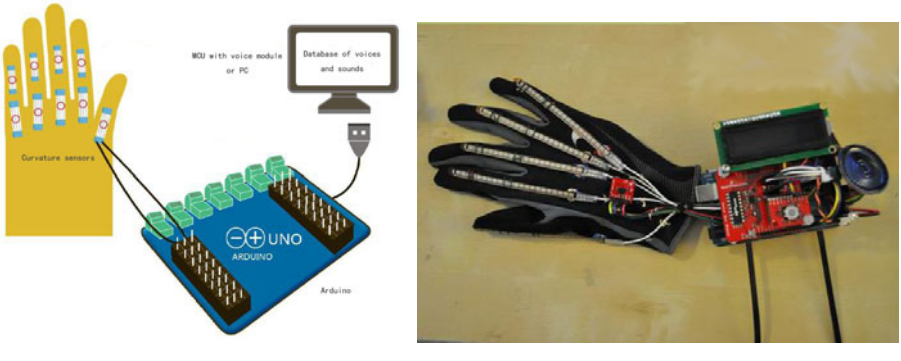

Fig. 6. Schematic diagram and prototype of vocal glove

Specifics of Vocal glove design:

– *Interaction scale: hand sized*
– *Interaction intention: passing emotion and communicate emotion*
– *Interaction expression ways: cross-cultural, contextualized and socialized*

6 Conclusion

Although we consider that the integration of SEI and LDP is an effective approach to design social interaction products, but the prototypes built by LDP based methods are only the threshold of real SEI products after all. How to guarantee these prototypes can be extended to real products? We reckon it lies on two aspects at least: (1) more objective analysis of user experiences and behaviors can make us avoid creating impractical SEI design, (2) LDP concept is advocating 'light-tech neither only for saving costs, nor for refusing high-tech solutions. Using appropriate techniques to realize our design is forever better than blindly chasing costs-saving or high-tech.

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A Case Study: Behavior Study of Chinese Users on the Internet and Mobile Internet

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Abstract. With the fast-paced development of the Chinese internet environment, people have learned to use the internet, and recently, the mobile internet. Users grown up in such an environment will have different interests, ways and reasons of using, and information needs. In order to obtain a better understanding on Chinese internet and mobile internet user behavior and examine the differences among the age groups of 20s, 30s, and 40s, an ethnographic study was conducted in Xi'an, China. This paper is a case study illustrating the various user behaviors on the internet and mobile internet for different age groups of people.

Keywords: Internet, Mobile Internet, User Behavior, Chinese, Ethnography.

1 Introduction

In China, most people came in contact with the internet in the late 90s. Later, the internet industry increased dramatically during the years 2004-2008. In the past two to three years, the mobile internet has surfaced to the spotlight. According to CNNIC, China's internet users have grown exponentially, and by the end of 2009, the number of internet users had reached 384 million. China became the nation with the most internet users in the world, in which 346 million users accessed the internet through broadband while 233 million users connected to the internet through cell phones.

Along with the growth of internet and mobile internet industry, the internet has become a part of daily life for Chinese people of all ages, from young children to retired elders. Within such a diverse population of internet users, the age group of 20 to 29 covers the highest percentage, 66.3%. This age group of users grew up in the internet era and thus most of them heavily rely on the internet. They are also the earliest adopters of the mobile internet. Most of these users are currently college students, who all frequently use their cell phones to surf the internet.

Due to the widespread availability of cell phones and computers, users can conveniently access the internet at any time and any place. As a result, users are extending their behavior of using traditional internet to the mobile internet. Therefore, their behavior in using mobile internet is definitely correlated to their behavior in using the traditional internet.

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To better comprehend the user behavior on the internet and mobile internet, we initiated a user research study in Xi'an, China. The first step of this analysis is focused on the behavior for different age groups of users. When they access the internet, what are they interested in? What kind of information do they seek in both internet and mobile internet?

2 Methodology

According to the best practice suggested by Kuniavsky [1], the research plan was drafted to collect information to validate research hypothesis. The research plan consists of ethnographic interviewing and web surveys. Ethnographic interviews were first conducted in Xi'an to address the above questions. Afterwards, a web survey on customer concerned issues was administered as the second step of the research. This paper focuses on the first step.

Users were recruited in Xi'an and had used the intertnet for at least 5 years. It was vital that we found study participants that fit the profiles of our targeted users to ensure they represent the needs and behaviors of real users. We chose people who were born after 1960, 1970, 1980, and 1990, to form different age groups each with 5-6 users. In China, due to economic development, people born in different times have some unique social behaviors. We would like to see how this would impact on their behavior on internet/mobile internet.

In order to have diversified users, we set up the screening based on their education or professional background. The table below indicated the various types of users that joined in the interview study.

Table 1. Demographical Information of Users Participating in Study

Age Group (years old)	**40-50**	**30-40**	**20-30**	**<20**
Total Number	4	5	6	4
With MS Degree	1	1	2	
With BS Degree	1	2	2	2
College level	2	2	2	2
Male	2	3	3	2
Female	2	2	3	2

The interview questions were related to human needs. It was an extended study on human needs for internet/mobile internet. According to Maslow's hierarchy of needs, the human needs can be described as below.

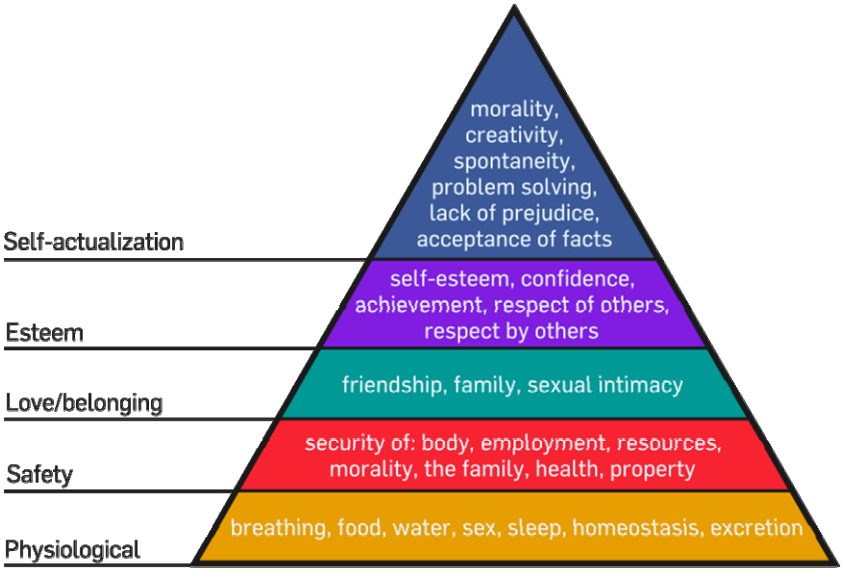

Fig. 1. Maslow Hierarchy of Needs [2]

Human needs are a powerful resource of explanation of human behavior and social interaction [3]. To understand user behavior on the internet and mobile internet, the human needs in the internet era should be studied. The interview questions investigated how users solved problems through the internet/mobile internet, what kinds of problems they've faced, and their needs in daily life, emotion, spirit, culture and communication, etc. To make sure the information we obtained were true, all the interviewees voluntarily participated the study and signed consent forms. We also chose comfortable and relaxing environments familiar to participants, such as restaurants or their homes and offices.

3 Findings

In this paper, the findings were only based on the first stage of the study, the ethnographic interview in Xi'an. The investigation included documenting the typical user behavior, especially their reactions to the problems that occurred to them, and their strategic and tactical approaches when using the internet/mobile internet. Through the interview, we could create the user need framework. From different types of user interests, we will be able to set up a further survey to research more on user internet/mobile internet behavior.

Based on Maslow's Hierarchy of Needs, we studied the extended needs related to communication, psychology, art, culture, new technology, education, career planning,

food safety, medical and other life resource, etc. To overview the topics that interviewees were concerned about, we summarized it in the following list.

Table 2. Topics Discussed Relating to Human Needs in the Study

Needs	Topics
Physiological	1. With the mass migration of people from the countryside to cities during China's economy growth, many people are disconnected in the cities. Therefore, they use the internet to obtain information on necessities such as renting homes and finding jobs. 2. Making comparisons over the internet to find things with good quality and cheap prices
Safety	1. Communication is critical for people within society. 2. Many people born after 1980 frequently change jobs. They do not know how to select their careers and face changes during the financial crisis. 3. Working Pressure: Many people's life styles were centered between two points, where they worked and where they lived. There is insufficient spare time for entertainment, exercise, shopping, socializing, etc. 4. Low Living Standards: People are concerned with the rising cost of living and basic livelihood, such as food, homes, etc. 5. Environment and Ecosystem: People worry about the deteriorating environment due to pollutions and rapid population growth. 6. Food Safety: Cases of counterfeit or bad food prompt many people to search the internet for food safety issues, methods, and experiences. 7. Health/Well-Being: Due to the inconvenience of health care in China, many people search and obtain medical information through the internet.
Love/Belonging	1. Many people have troubles with child education. They don't know how to better communicate with their kids. 2. People born after 1980 moved to the first tier cities to work and live, due to the job opportunities and city resources. They have less or no time to talk to their family. 3. Filial Duties: With the aging of society, many young people found that they were unable to support their parents. 4. Dating and Marriage: Limited time and working pressure causes issues for dating, getting married, or sustaining the marriage.

Table 2. (*Continued*)

Esteem	1. People are impacted by expectations of different social groups. 2. People are pressued by the needs to be recognized by family members, peers, boss, and even strangers. 3. Competition: People wish to win in the virtual life (internet gaming) or real life.
Self-Actualization	1. Different culture background and tradition would have different culture needs. The knowledge of liberal arts would influence on the human behavior. The instinct sensory also impacted on human needs. 2. With the internet growth, technology brought users convenience, but also brought users different types of questions.

From the needs listed above, the major needs that users talked about were in the second category of human needs. Based on the interview results, we can use another way to summarize Maslow's human needs. The new user need framework is drawn below. A higher percentage means a greater number of people mentioned these issues.

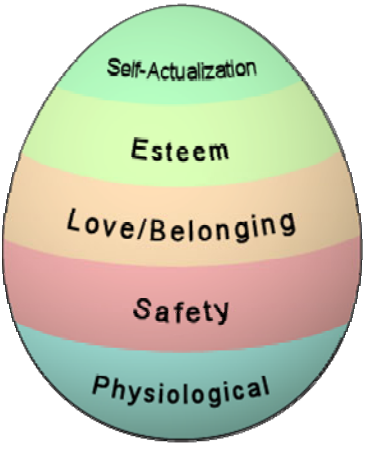

Fig. 2. Human Needs Framework

In general, internet/mobile internet users are more concerned with category 2-4, instead of Maslow's triangle structure. Within these internet/mobile internet users, what are differences between the age groups?

3.1 Age Group between 40-50

This group of users received diversified education because of China's economic development. Those with college level education use the internet to view news and

financial information, communicate through email, and work with office software to improve productivity. However, a majority of them use landline phones or cell phones to talk to people instead of using IM, texting, chat, etc. Apart from a small portion with higher education, this group was quite similar when using the internet, compared with the age groups of 30's and 20's.

The main reasons to use the internet are:

- Accessing Information
  - browse news or financial information
  - not intensive users, but only visit choice familiar websites
- Communication
  - communication is very conservative
  - inclination towards traditional communication tools
  - communicate within a small circle of friends
  - does not use internet to expand social network
- Health
  - pay attention to health issues
  - use internet to research about diseases and prevention
- Continuing Education
  - challenged by new web products
  - use the internet to learn web terminology and applications
- Entertainment
  - repeatedly play just a few games, during spare time
  - unwilling to test new games

3.2 Age Group between 30-40

These are the users that benefit from the internet, although they are not the mainstream of users. They use the internet to improve their productivities. They are the most practical users, always seeking answers to detailed questions regarding problems in daily life.

The main reasons to use the internet are:

- Accessing Information:
  - read current events
  - ask practical questions on forums
- Communication
  - exchange personal experience, such as child education and taking care of elder parents
  - like to discuss ideas with people of similar background or experience
- Health
  - acquire information about diseases, treatments, and prevention
  - tendency to look at health problems of people around them
- Continuing Education
  - familiarize with newest web activities and terminology to avoid being left behind
  - eager to learn micro knowledge though random times

- Entertainment
  - use the internet to relax
  - play games to enrich their lives

3.3 Age Group between 20-30

People of this age group are the mainstream users for internet and mobile internet. The influence of the internet can be found in every aspect of their routine life. They use the internet to support their work, maintain their social network, answer their questions, and solve their worldy issues.

The main reasons to use the internet are:

- Accessing Information
  - view suggestions and review before purchasing online
  - check out the newest fashion
  - compare online products
- Communication
  - discuss with friends for opinion and recommendation on fashion, products, etc.
  - regularly connects with internet friends
  - use mobile device to follow micro blogs and forum threads
- Health
  - suffers from psychological pressure from the society, such as the unbalanced economic development, surging house prices, marriage problems, career planning, etc.
  - seeks relief and escape from reality through internet
- Food Safety
  - inquire for information on nutritious diet
- Continuing Education
  - yearn to travel abroad for further education
  - search online for famous schools and their classes in North America, Europe, etc.
  - hope to arrange education for their young children
- Career Planning
  - understand how to select their career
  - adapt to changes due to financial crisis
  - desire advice from knowledgeable and accomplished people
  - browse job offering websites and information related to the enterprise
- Dating and Marriage
  - meet people online through dating and matchmaking websites
  - use internet to understand issues related to dating and marriage
- Entertainment
  - use mobile devices to read micro novels and play games
  - surf websites to watch movies, television shows, etc.
  - download songs and follow famous celebrities

3.4 Age Group under 20

People under the age of twenty are the discovery users for the internet and mobile internet. They prefer to be unique, by decorating their personal space in the internet, listening to popular music, and doing things their own way. They worship individuality, distinctive personalities, and are extremely addicted to the internet and mobile internet, often online whenever they can.

The main reasons to use the internet are:

- Accessing Information
  - gather information for their education and finding answers because they are unwilling to read books
  - shopping online
- Communication
  - constantly conversing with friends about everything and anything
  - show off possessions to internet friends
  - uses cell phones to communicate with friends and follow internet trends
- Education:
  - skilled with all new media and applications
  - familiar with many types of technology
- Entertainment
  - play many online games as pastimes
  - listen to music through websites and mobile device
  - fond of watching videos online

4 Conclusion

In the internet era, human needs have moved towards a higher level than before. People are more concerned with things relating to the scope of safety and love/belonging. Between these two categories, different age groups of internet/mobile internet users have different methods of using the internet/mobile internet, as well as distinctive focused interests and objectives. There are several possible reasons that may contribute the variance, such as society development, influence of popular applications in the market during different times, education levels, and amount of time spent on the internet and mobile internet, etc. Further progression of this study will include conducting a survey to verify the interview results and to explicit more on the possible reasons for the difference.

The study of user behavior on the internet and mobile internet is not only about a user research, but also about an innovative design for mobile internet products. With the increasing of internet speed and availability of powerful smartphones, mobile internet is fusing into users' life. Mobile internet users come from the internet users, which may lead their different user behavior in using the mobile internet, due to the different age groups. However, from the interview results, the majority of mobile internet users were under 30 years old. As the most adaptive and discovery users, they have similar behaviors, such as chatting, accessing quick information, and playing

games through their mobile devices. With the pervasiveness of smart-phones, people from different age groups will join the mobile internet market, which will require a further study as the diversified users pool into the mobile internet market.

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Design Ethics Education in Taiwan: A Study of Syllabi of Ethics-Related Courses

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Abstract. This paper aims to identify the scope and content of ethics components in the curricula of regular 4-year undergraduate design programs in Taiwan by investigating the syllabi of ethics-related courses. Of the 148 universities and colleges in Taiwan, there were 117 regular 4-year undergraduate design programs in 61 institutions during academic years 2008 and 2009. A list of ethics-related courses was obtained from two web-based curricular databases of the Ministry of Education (MOE), which consists of 38 unique syllabi from 29 design programs in 17 institutions. Each of them was then processed by qualitative method taking advantage of the standard format of syllabus in Taiwan. The contents classified into four generic parts: 1) course objectives, 2) course contents, 3) teaching methods, and 4) assessment methods. Of the 38 syllabi, five topics, Design, Profession, Law, Society, and Life, were identified from the parts of course objectives and contents. In the parts of teaching methods and assessment methods, seven and nine methods were identified respectively. The results reveal what and how we treat ethics as a topic in design education in Taiwan. The paper concludes with some suggestions on further research of design ethics education.

Keywords: Design Ethics, Design Education, Syllabus, Ethics-Related Courses.

1 Introduction

Design education has a history of about 50 years in Taiwan and the design profession has become popular and well recognized in society since the 1980s due to Taiwan government's significant effort and enterprises' increasing emphases on design [1-2]. While we focus on the outer dimension of design education, i.e., the innovative and applicable techniques, the inner dimension of how we cultivate future designers is relatively rarely discussed. Since Victor Papanek raised the ethical issues in design practices and education 40 years ago [3], gradually a number of scholars have continuously kept on discussions and studies in the related issues. From critiques on the ideology of design to social phenomena [4], to the explorations of design theories and practices for ethics, social responsibility, and global justice issues [5-9]. All of

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them recognize the vital importance of ethics as a topic in design but researches describing current practices in design ethics education have scarcely been formally documented. Among the few available researches, Szenasy reports her teaching experience on ethical design education [10], discussing what actually the objectives, teaching methods, course contents, and assessment methods are used in design ethics education.

On the other hand, ethics education in other disciplines such as Business, Engineering, and Medicine, is relatively well-explored from the topics of content, pedagogy and curriculum to teaching tool [11-18]. Though some of them might be driven by conditional motivations for their specific circumstances, there is a common awareness within these disciplines, which include Design discipline, of a need for ethical sensitivity to the consequences of their actions in the complex, globalized marketplace and society. In response to the need, many design programs in Taiwan require ethics education.

This paper aims to identify the scope and content of ethics components in the curricula of regular 4-year undergraduate design programs in Taiwan by investigating the syllabi of ethics-related courses. The approach of studying syllabi is by its nature "input-based", that is, the contents devoted wholly or partially to ethics education would reveal, at least, a significant formalized effort toward the ethical cultivation of designers.

2 Methods

Existing design programs belonging to the Design Field according to the Standard Classification of Education (SCED) of the Ministry of Education (MOE) in Taiwan include four major types of design programs (TDP), namely industrial/product design (T1), graphic/visual communication/digital media design (T2), spatial/interior design (T3), and general/synthetic design (T4). These programs were collected from the Internet for further study of the syllabi. Data was obtained as follows: first, a list of institutions which provide ethics-related courses was compiled from the searching results of two web-based databases, the Curriculum Upload Systems for General and Technological & Vocational Universities which were built by Ministry of Education and the data was regularly uploaded from all universities and colleges in Taiwan. Search range is from academic year 2008 to 2009, and the criteria were set in two rules: 1) search all course titles containing "ethics" and program titles containing "design", 2) search all course titles containing "design ethics".

The obtained results were merged into one and then manually excluded duplicate courses, non-design programs, master programs, and programs of extension education. Of the 148 universities and colleges in Taiwan, there were 117 regular 4-year undergraduate design programs in 61 institutions during academic years 2008 and 2009. The 4-year curricula of all these targeted design programs were then further examined by searching for the word "ethics" from their websites to ensure that the obtained data was up to date.

Table 1. Number of Design Schools and Programs in Taiwan in 2008-2009

	Design school	Design program	Type of design program (TDP)			
			Industrial/ product design (T1)	Graphic/visual communication/digital media design (T2)	Spatial/ interior design (T3)	General/ synthetic (T4)
Number -	61	117	32	49	14	22
Ethics-related courses	21	33	12*	11*	7	3

* There are 2 programs with 4 ethics-related courses for different years, thus the course number of T1 and T2 are 14 and 13, respectively.

A list of 33 design programs in 21 institutions containing 37 ethics related-courses was completed for syllabi collecting. Four of the 37 ethics-related courses in the list, belonging to different institutions were inaccessible or unavailable from their websites (Table 1 shows the details). In order to get broader ideas, in the remaining 33 courses, different syllabus contents for the same course in the same program because of different teachers were counted separately. Finally, a total of 38 unique syllabi were collected for content analysis and codification. Data were then processed by a qualitative method. The reason for using a qualitative approach is to get a bigger picture on what has been taught to undergraduates. The processes were as follows: first, based on the standard format of syllabus in Taiwan, the contents of syllabi were classified into four generic categories: 1) course objective, 2) course content, 3) teaching method, and 4) assessment method; however other additional statements (e.g. those pertaining to class times, locations, and instructors) were ignored. In addition, the texts in the parts of course objectives and course contents were read and open-coded, resulting in a comprehensive list of elements. The elements were then analyzed to subsume them to their respective natural and, where possible, non-overlapping topics.

3 Results and Discussions

Of the 38 syllabi, five topics were identified from the parts of course objectives and contents (Table 2 shows the details). The topics are: 1) Design, 2) Profession, 3) Law, 4) Society, and 5) Life. In the parts of teaching methods and assessment methods, seven and nine methods were identified respectively. Each of the results would be discussed in detail in the following sections.

3.1 Course Objectives and Contents

The objectives and contents in the Design topic vary greatly. The components in this topic vary from general cross-disciplinary themes (e.g. anthropology, ecology, and

sociology) and logical thinking, to more specific design themes such as design theories, history, and practices, and experience sharing in the design profession. The topic of Profession chiefly focuses on preparing undergraduates with good attitudes and conducts, and required knowledge and skills for the job in general (not necessarily being designers). The topic of Law discusses two major types of regulations for two different purposes. The first is introducing the laws related to the design profession, mainly Intellectual Property Right, Copyright Act, and Trademark Act. These are all very directly related to design practices and designers' interests. The second part relates to the daily life of the undergraduates. The topic of Society focuses on cultivating students with social manners and personal devotion and service to school and/or community. The Life topic is to help students understand the meaning of life and to develop the attitude to self-respect and self-realization. The proportion in terms of allocated time of teaching of each topic in a course is different. 34 out of the 38 syllabi provide weekly teaching schedules with teaching contents described. There are three kinds of combination of the topics in a course. A total of 73% of the syllabi focuses on one main topic with only 1 or 2 weeks on other topics. The main topics are Design (36%), Life (28%), Profession (16%), Society (16%), and Law (4%). The second combination (21% of all syllabi) contains two topics and the ratio between these two is approximately1:1 or 1:3. In this combination, the Profession topic usually associates with Society or Law, and Design topic tends to pair with Law in the course. The third combination (6% of all syllabi) contains three topics in a course, mostly of Design, Profession, and Law, or Profession, Law, and Society.

The influence from other disciplines, Business and Medicine, was found in the topics of Profession and Life. Since design activities often involve these two disciplines, and the development of ethics education in these disciplines is more mature than that of design, thus the influence can be positive and useful. The five topics represent different perspectives on what to teach undergraduates to orientate their role in the society: a specific profession, a job duty/title, a citizen, a social actor, and a human being. For design students and professionals, no doubt that design is a specific profession, and of course, a citizen in a community and a human being in the world; the pattern of the development of design in the 20th century is that design began as a trade activity [19], which defined design as a job duty. Not to mention the call from Papanek to turn designers into an active social actor. In fact, designer plays these five roles (or more) in different contexts. Just as Buchanan argued that design must be seen in a context of consequences that occur in many areas of human experience [20]. The diversity of the results reflects not only the complexity that designers engage in, but also the design educators. It might be even more severe in Taiwan. Code of ethics is considered an effective content in related studies [13] [14] [16], but couldn't be found in the collected syllabi since there is no written code of ethics in the related professional organizations of design in Taiwan. Hu reports that in Taiwan, most of the stakeholders had never heard of or engaged in the design codes of ethics and, most designers are not members of any related professional society [21]. These are all highly related to the development of design ethics education waiting for better understanding.

Table 2. The Components of Course Objectives and Contents (n=38)

Design topic
The relation between design and relevant disciplines (e.g. anthropology, ecology, sociology, marketing, and management)
The relation between design and human individuals/society/third world
Implementing design theories into practice (e.g. Green design, Sustainable design, Universal design, Barrier- free design, Sick house syndrome, and Eco-design)
Design movements and thoughts (Industrial Revolution, Arts & Crafts, Art Nouveau, Bauhaus & Design Trends, Modernism vs. Postmodernism)
Introduction of ethics and the logic operation of ethical behavior in design.
Analysis and reflection on design issues through systematic and scientific methods
Establishing ethical conduct/moral, circumspect and ethical decisions
Developing independent design thinking
Design cases analysis
Design profession experience sharing (in speeches or seminars)
Profession topic
The proper work attitude, concept, and conduct towards jobs, duties, and to colleagues, subordinates, superiors
An introduction of basic concepts, principles, and practices of ethics
The differences between ethics, laws and morals.
Understanding the professional ethics from other disciplines (e.g. Basic ethics, business ethics, information ethics) and related issues, e.g., corporate social responsibility, justice
Understanding the required knowledge and skills for workplace (e.g. the management principles related to workplace, communication skills, and teamwork)
Understanding the trends of employment/career planning
The critical thinking, reflection and problem solving skills.
Law topic
Understanding design-related legal regulations (e.g. Intellectual Property Right, Patent Act, Copyright Act, Trademark Act) and their application in design practices
Understanding the legal system and legal requirements related to daily life (e.g. civil law and criminal law)
Introduction of good citizenship (e.g. understanding the meaning of democracy, respect for human rights, and compliance with legal regulations)
Society topic
Establishing a life value of helping people, and developing the spirit that benefit others as well as oneself
Developing proper etiquette and enthusiastic attitude in life
Clean the campus
Reflection on the value and meaning of life
Life
Understanding the issues of bioethics (e.g. abortion, euthanasia, suicide, death penalty, organ transplant, genetic engineering, and animal right)
Understanding the meaning of life/respect and cherish life/developing a ethical personality
Enhancing the ability of social adaptation
Inspiring the concerns for other human beings, animals and the environment

The curriculum setup also differs from each other topic (Fig. 1 Shows the details). The courses focus on Design topic tend to be a professional (73%) and required (82%) course. The topics of Profession (75%) and Law (71%), though mostly required, the types of both courses are either professional or liberal. Courses focus on

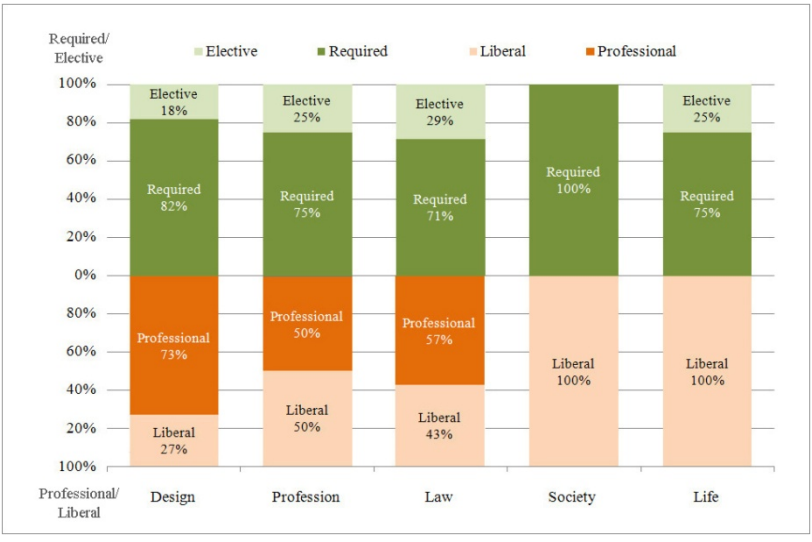

Fig. 1. Curriculum Setup –Type of Course (n=34)

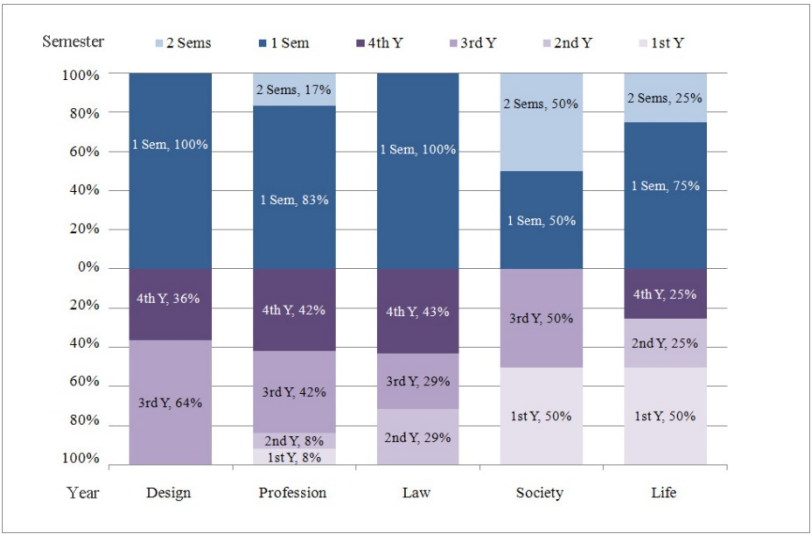

Fig. 2. Curriculum Setup – Semester and Year (n=34)

the Society topic are all liberal but required. The situation is broadly the same in the Life topic, only 25% is elective.

Fig. 2 shows that nearly all courses are provided in a semester (Design 100%, Profession 83%, Law100%, and Life 75%) except the Society topic is evenly divided by two different settings (one and two semesters). The topic focuses on Design is all

provided in the third (64%) or fourth (36%) year of the program and the situation of Profession is almost the same, 42% in third and fourth year respectively, except a small part in the first and second year. The rest of the three topics are provided dispersedly in the 4-year curriculum. Generally speaking, the results are coherent with a relevant study by van de Poel et al. [16]. It's reasonable and appropriate to provide ethic courses in the third or fourth year of the curriculum. By then students are more mature to confront with ethical issues, and able to oversee their field of study as a whole.

3.2 Teaching Methods and Assessment Methods

Seven teaching methods have been indentified from the 38 syllabi. Fig. 3 shows the frequency of each method. On average, each individual course uses 2.4 (range =1–4) methods, and most of the courses use at least 2 of them in a class (mode=18). There are two methods which were used in most of the courses: lecture (f=35) and discussion & report (f =30).

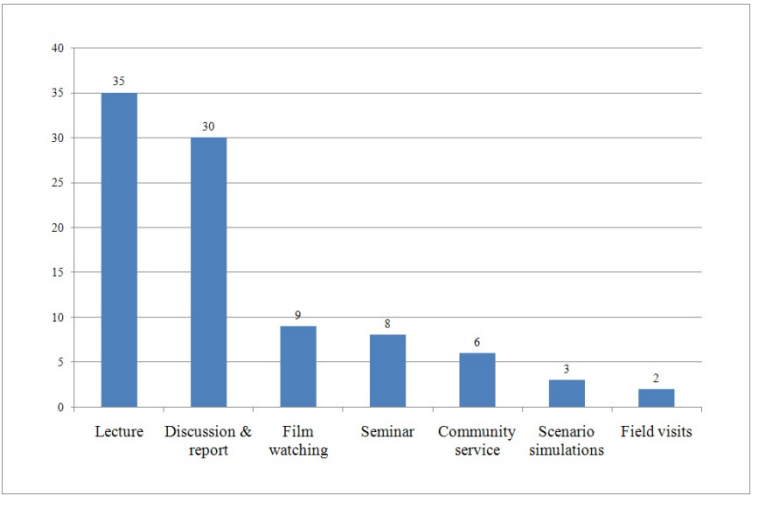

Fig. 3. Types and Frequencies of Teaching Methods (n=38)

The use of teaching method during the semester was described in the 34 syllabi in their weekly teaching schedule (Fig. 4 Shows the details). Not surprisingly, lecture (63.5%) was used most of the time in the class, the second is discussion & report (22.7%), and the rests (13.7%) are used as supplements in teaching, e.g. inviting practitioners to share experiences on the ethical topics (seminar). The results tally with relevant studies [13] [17] that discussion is a frequently used method, and a good way to guide and spur students to an ethical thinking [10].

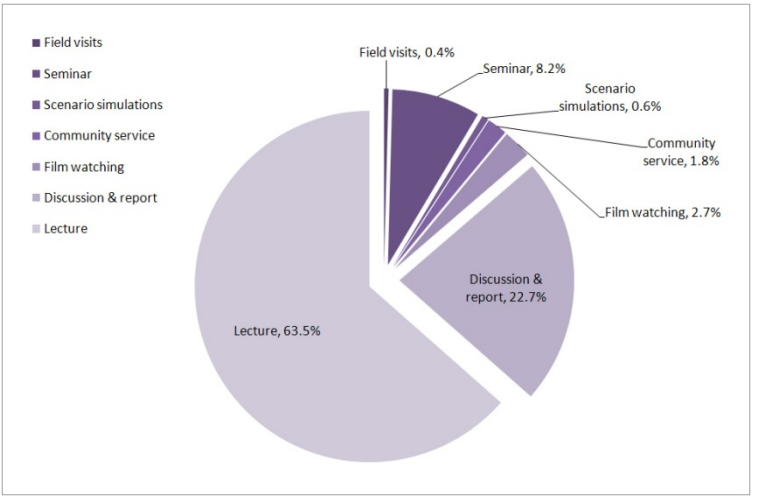

Fig. 4. The Use of Teaching Methods (n=34)

Nine assessment methods were indentified from the 38 syllabi. Fig. 5 shows the frequency of each method. On average, each individual courses uses 2.71 (range =0–6) methods, and most of the courses use 4 of the assessment methods in a class (mode=10). The top 4 methods were attendance (f=21), class participation (f=15), examination (f=15), and written report (f=15). The results also conform to a related study by Herket [13]. In addition, the fact that attendance and class participation are commonly used in ethics course imply that the teaching effects on ethics is hard to evaluate thus the strategy of teaching ethics is encouraging more participation thereby affecting the concepts and behaviors.

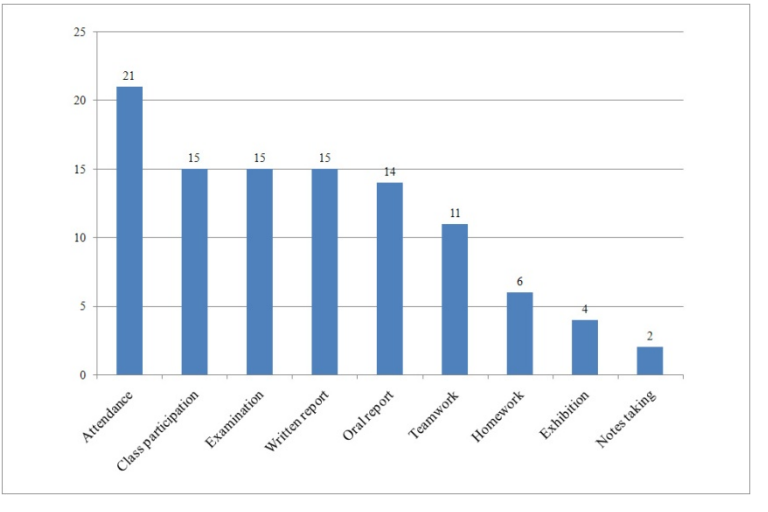

Fig. 5. Types and Frequencies of Assessment Methods (n=38)

4 Conclusions and Further Research

This is a preliminary study of design ethics education. The results are not seeking for answers, instead, helping to ask (or find) the right questions. It might tell nothing about the quality of such instruction or how well undergraduate design students understand ethical responsibility as a result. However, it achieved the aim that it reveals the circumstance of what and how we treat ethics as a topic in design education in Taiwan. Thereby, we conclude with some suggestions on the agenda of research on design ethics education.

First, the findings show that ethics in design education is far from homogeneous among design schools in Taiwan. Compared with the ethics education in other disciplines such as engineering or medicine, the opinions of how to educate future designers to orientate their role in the society vary considerably. There is still no consensus on the scope and content for ethics in design. Nevertheless, there are well-developed ethics educations in other disciplines, e.g. Business, Engineering, and Medicine, providing important examples and point of reference for us to make our own choices. The advantage is that design is involved with all these disciplines. Based on the results and the references we may draw up an ideal ethics curriculum for design program and seek for opinions and consensus in the design field.

Design does not yet have an accrediting organization that stipulates strong moral norms in ethics education. In Taiwan the notion of design as a profession is less dominant than in other countries such as Japan, US, and UK. Most of the stakeholders have never heard of or engaged in the design codes of ethics and, most designers generally are not members of any related professional society. The call for paying serious attention to design ethics education rose in society once a while only when significant events occurred but soon been forgotten. These phenomena are all critical, and highly related to the development of design ethic education which should be investigated follow up.

Ethics education is a part of character formation. As Buchanan mentions that talking about character and character formation faces many challenges, still he urges that we must move into these turbulent waters [20]. Design is playing an important part in our life from many aspects individually and globally. We consider this a major challenge with respect both to teaching and to research, but inevitably need to be done responsibly.

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