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Research Article

Design and Evaluation of Smart Mobile Services for Cross-Channel Shopping

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This study explores the potential of smart mobile services to enhance online and offline shopping. Three prototypes were designed and implemented on smart phones and smart watches. Thirty young adults participated in the experiment to evaluate these prototypes. The results indicate that satisfaction with smart services is influenced by characteristics such as innovativeness, current shopping behavior, and design of prototypes. Positive feedback was generally given towards smart mobile services, but there were mixed attitudes towards key features. First, participants with a utilitarian motivation liked the indoor navigation feature, but those with a hedonic motivation enjoyed exploration. Second, in the area of big data, participants wanted more control over recommendations and more protection of privacy. Third, participants wanted to make mobile payments but were concerned about security. Finally, developers of new technology for smart mobile services should consider practicability.

1. Introduction

The prevalence of e-commerce enables retailers to reach an expanded customer base, shopping anytime and anywhere. For instance, China was the world's second largest e-tailing market in 2011. The compound annual growth rate of the e-tailing market in China in 2011 was 120%, which outpaced every country in the world. Following that was the rapid growth of e-tailing in Brazil (34%) and Russia (39%), which outpaced the United States (17%) [1].

With such a high growth rate in the e-tailing market, there is a need for cross-channel shopping. On the one hand, as e-commerce thrives, many brick-and-mortar stores expand their online channel. Positive online shopping experience is expected to stimulate offline shopping sales. On the other hand, offline shopping still dominates the market. This trend was termed O2O commerce, which originally meant online-to-offline commerce [2]. However, this was later extended to cross-channel shopping.

Since then, O2O commerce has grown rapidly in China. Statistics of Google Trends show that the top three regions interested in O2O are Hong Kong, Taiwan, and mainland China [3]. Specifically, online searches of the keyword "O2O" in China have surged since 2014 according to statistics of Baidu index (Chinese version of Google Trends). Current activities of O2O commerce are generally at the macrolevel, focusing on business models for connecting smart phones to various products and on-site services (e.g., fresh sea food, car wash, and nail salon). However, numerous O2O start-ups have failed recently because there is a lack of deep understanding of real users' requirements. At the microlevel, little is known about how users react to cross-channel shopping. Therefore, this study aims to dig into user requirements of O2O shopping services.

2. Literature Review

Previous studies of online shopping had two branches. One branch mainly focused on the prior-purchase process, investigating people's preferences and choices of online shopping and offline shopping. When people chose between online shopping and offline shopping, they usually considered characteristics of products and services [4, 5], price difference [5, 6], convenience [6, 7], adventure/risk [5, 6], information availability [5, 6], information quality [4], system quality [4], service quality [4], personalization [7], and enjoyment [5].

To increase the willingness of shoppers to make purchases, practitioners first needed to understand users' shopping values [6, 8]. For people with a utilitarian motivation, usability of websites should be stressed, so that desired products can be found quickly. In contrast, people with a hedonic motivation shop for fun, inspiration, and enjoyment. The more consideration is given to these hedonic emotions in the design of websites, the more likely people would be to have enjoyable experiences [9], which could be even more important than utilitarian attributes [8]. Therefore, researchers went beyond usability to emotional design. Regarding personalization, current practices mainly focus on recommendation systems [10, 11], and few studies explored personalization based on users' personality traits and cognitive styles [11] to provide a personalized information structure [12].

Previous studies investigated factors that influenced mobile shopping intentions and behaviors. Factors (other than those in Theory of Planned Behavior (TPB) and Technology Acceptance Model (TAM)) influencing mobile shopping intentions include personalization [16], experience [17], innovativeness [17], trust [18], and personality traits [18].

Many advanced technologies were used on mobile devices; many new smart services were created. Near field communication (NFC) service was added to smart phones, which implemented the functions of house keys, travel cards, information tags, and mobile payment. It thereby created a new adventurous experience. The services brought different benefits and evoked different emotions among users, and users look forward to novel services with adaptive and personalized features [19]. The Radio Frequency Identification (RFID) technology has also been utilized to track location for indoor smart applications. The scenario and architecture were presented for an indoor location tracking service in an exhibition environment based on mobile RFID. Additionally, the prototype for a location tracking system had been designed and implemented [20]. Moreover, there have been other technologies used to implement smart services, such as iBeacon [21], location based services [22], and ZigBee [23].

In current smart services research, some research is at the prototype stage [21, 23], and some research has reached the implementation phase. Meanwhile, smart services involve many fields, such as health, life, and travel. To help the elderly, a practical application of smart mobility called Mobile Assistant for the Elderly (MASEL) was proposed. It can connect patients, doctors, pharmacists, and families and improve the quality of life providing detailed monitoring of medication needed by patients [24]. Travelers using buses care about their waiting time and how crowded the buses are. To solve these problems, a passenger demand prediction system for mobile users was presented. It can deliver bus and traffic information to mobile users in real time [25].

The demand for smart services is increasing, and many users desire personalization services. So that users with smart devices can optimally utilize smart services, a smart service model was introduced. With the model, a smart service can be conveniently used to obtain real data from USN (Ubiquitous Sensor Network)/RFID in various smart spaces [26]. Similarly, a service recommendation model was proposed based on user scenarios using fusion context-awareness, and the scenarios can help provide the best services in advance [27].

In addition to the enjoyment of smart services, the issue of security has not been neglected. In order to detect diverse types of malicious code in smart phones and respond to advanced attacks, an intelligent security model for smart phones was proposed based on human behavior in mobile cloud computing. The model notifies users to respond to malicious attacks by using behavior-based intelligent analysis [28]. To improve the security of mobile banking services, an integrated framework for information was proposed [29, 30].

3. Design and Development of Smart Mobile Services

User-centered design (UCD) was used throughout the design and development of mobile smart services. UCD is widely used to develop information technologies and services. Design features based on users' needs are implemented, and users are involved in the iterative process of user study, design, and evaluation [31, 32]. Young adults are leading online shopping [33–35] and their attitudes towards innovative services influence other potential users who prefer to "wait and see" what others make of new products and services. *In China, the latest statistics indicated that the majority (73%) of online shoppers aged between 16 and 34 [36].* Therefore, a series of user studies were conducted to analyze the requirements of Chinese young adults. A structured interview and a scenario-based semistructured interview of 20 young adults, a focus group of seven young adults for up to 75 minutes, and a seven-day anthropology study of five young adults, resulted in the notes for the study. Based on these results, three prototypes were designed and developed.

3.1. Low-Fidelity Prototypes. Low-fidelity prototypes are generalized and include sketches, screen mockups, and storyboards, used to illustrate design ideas, screen layouts, and design alternatives [31]. Based on user requirements, this study explored possible designs to bridge online shopping and offline shopping. First, sketches were drawn to show initial ideas for smart services. Among them, sketches that received positive feedback were refined to be storyboards and on-screen mockups to further illustrate shopping scenarios and interaction details. For example, Figure 1 shows a typical scenario of shopping for clothes: Amy is fond of buying clothes online, but she usually finds that the size of the clothes purchased is not suitable. Therefore, she wants to use a smart mobile service to accurately check if clothes fit her size. Additionally, she wants to share the fitting effect with her friends and ask for their opinions. Then, the best-fit clothes, which got positive feedback, are delivered to her door.

3.2. High-Fidelity Prototypes. High-fidelity prototypes provide a functional version of the system that users can interact with, showing the user interface (UI) layout and its navigation. High-fidelity prototypes can be used to experience the look and feel of the final system [31]. Different from final production variants, high-fidelity prototypes focus on

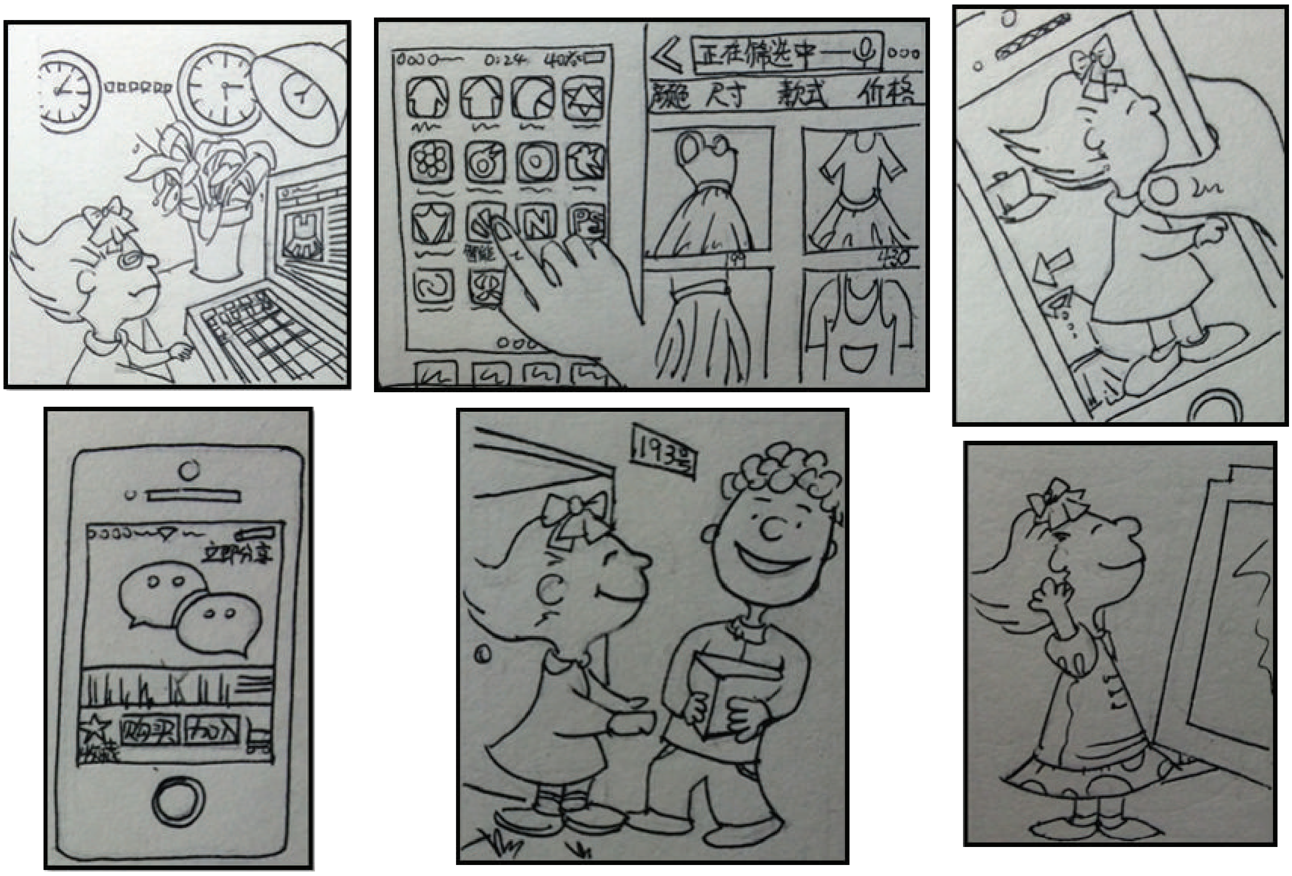


Figure 1: Storyboard.

Table 1: Features of three smart mobile services.

Prototype	Device	Key features
SmartMall	Smart phone (MI2)	Indoor navigation Game-style shopping Activity-based discount
SmartWatch	Smart watch (Moto 360)	Recommendation based on Internet of Things Indoor and outdoor navigation Mobile payment
SmartFit	Smart phone (MI2)	3D fitting Image search

the front end of an application that is usually visible to the user in the form of an interface. They seldom involve back-end development such as accessing server-side databases or remote services [37]. To develop high-fidelity prototypes, Axure, Justinmind, Dreamweaver, and Corel VideoStudio Pro were used. In particular, the focus was whether key user requirements were clearly reflected in the prototype. Each prototype went through around eight iterations. In the final version of the prototypes, key features are summarized in Table 1 and explained in detail in the following paragraphs.

SmartMall (shown in Figure 2) aims to help improve the efficiency of searching for a specific product and enhance the enjoyment of shopping. To achieve this goal, three key features were incorporated into the prototype. First, it can automatically push the layout of the mall to users. When users search their desired products, SmartMall will guide them to the right location. This indoor navigation feature can be implemented through Wi-Fi positioning technology. Second, SmartMall applies a game experience to make the shopping experience fun. This was inspired by the treasure hunt game. The "little red dot" represents treasure, and when users find the treasure, they are required to play a simple game such as identifying differences in pictures. If the users win, they get a recommended product based on personal purchasing history or a special coupon. This game-style shopping feature could use NFC tags to launch games. Third, SmartMall automatically record users' shopping time and activities. The longer they stay in the mall or the longer the distance they walk, the higher the discount is when they check out. This activity-based discount feature can be implemented with the help of the pedometer of smart phones.

SmartWatch aims to change positive interaction to active interaction, making mobile devices smart, like an assistant. In a prior-purchase process, many people are not aware of a shopping need (e.g., running out of eggs) and often forget to include items on the shopping list for an activity (e.g., travel). To solve these problems, three features were incorporated into the prototype. First, SmartWatch was based on Internet of Things (IoT) and could automatically detect things such

(a) (b) (c)

Figure 2: SmartMall indoor navigation. Note: digits 1 and 2 represent little red dots; the smiling face represents the user's current location; and the red coordinate icon indicates the location of the target products.

(a) (b) (c)

Figure 3: (a) Personal data loading, (b) Recommended shopping list. (c) The optimal route. Note: based on the Internet of Things, consumption of daily products is recorded, and the shopping list and optimal route to a mall are generated.

as how much milk is left and how many pills are left. Then, as shown in Figure 3, SmartWatch can make a shopping list based on users' personal data and demands, and it could also remind users to buy products that they are not aware of. During the shopping process, when a users' smart watch is close to the target products, it will push relevant information (e.g., reviews and price comparisons) to users through near field communication technology (shown in Figure 4). There are many technologies able to implement this function, such as beacons, RFID, and NFC technology. NFC technology was recommended because it is widely integrated into smart phones and supports mobile payment, and other techniques may also be considered. Second, a SmartWatch can automatically gather the users' personal preferences by recording their emotional changes (e.g., frowning and head shakes). This can be implemented with the help of face tracking and gaze estimation technology using the smart phone's camera. SmartWatch can generate the optimal shopping route based on the user's shopping list and it can be updated in real time. Third, at the end of shopping, users do not need to wait in line—the mobile payment system automatically pays the bill (shown in Figure 5). NFC technology can be used to support mobile payment.

In addition, this smart watch could display information on the back of users' hands to overcome the problem of limited display area. This technology is already commercially available. For example, Cicret smart bracelets use this technology to make the arm a skin touch screen, thereby increasing the operational area of the screen.

SmartFit aims to help people judge the fit of clothes presented online. Two features were incorporated into the prototype. First, a virtual human model can be created.

Table 2: Questionnaire construction.

Demographics	14 items measuring age, sex, education, shopping frequency, and so forth
Independence	10 items adapted from Sixteen Personality Factor Questionnaire [13]
Shopping behaviors	29 items measuring innovativeness [14], absorption (i.e., the extent of focusing on work, avoiding distraction from daily life), single tasking and multitasking, attitude towards recommendations, attitude towards shopping quickly, personalization, and enterprising
Satisfaction	10 items of System Usability Scale (SUS) [15]

(a) (b)

Figure 4: Proximity-based reference information. Note: when SmartWatch is close to products it pushes related information through NFC to aid in purchase decisions.

(a) (b)

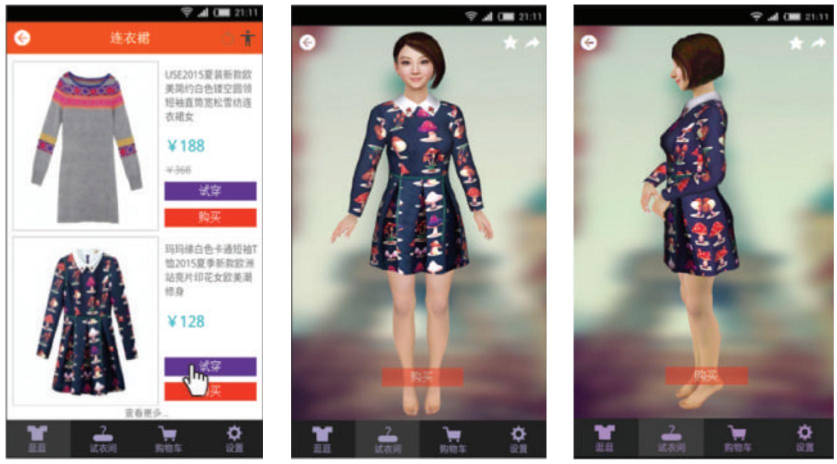
Figure 5: Using SmartWatch to check out at a mall. Note: SmartWatch automatically pays for the products.

Augmented reality technology could be used to create a virtual human model. Data of the human model can be from two-dimensional code scanning or manual input. When users buy clothes online, SmartFit could generate the 3D fitting effect between the human model and clothes (shown in Figure 6). To implement this feature, technology is used from the three-dimensional displays of Microsoft and Samsung [38, 39]. Although 3D fitting technology has been applied to platforms such as Wii and Kinect, they were tailored to the shopping scenario. SmartFit combines the shopping platform with 3D fitting technology. In the future, it could incorporate additional details of fit, such as the tightness of shoes and clothing elasticity. Second, another highlight of SmartFit is its image search function (shown in Figure 7). Users can take a photo and SmartFit will automatically search for similar clothes. This feature could be implemented by adding an image-based information retrieval system to a mobile phone [40] or by using similar technology from the application "Snap Fashion." SmartFit also has a sharing feature for users who want to ask for friends' recommendations.

4. Evaluation of Smart Mobile Services

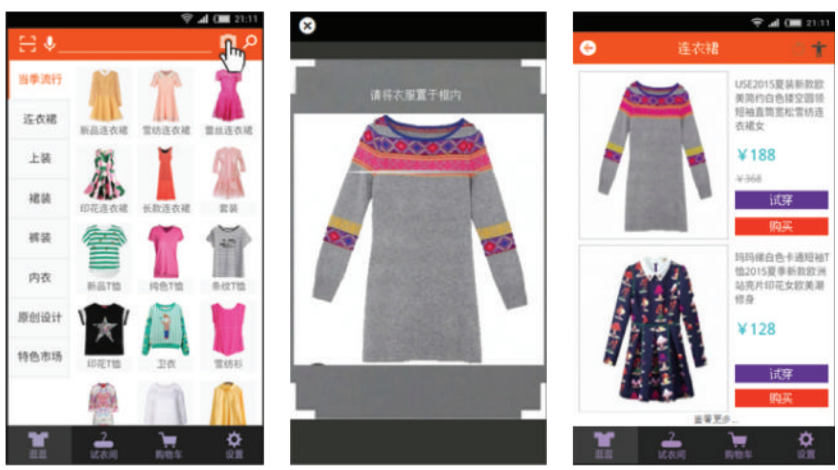
An experiment was designed and conducted to evaluate three prototypes and to explore the potential of smart mobile services to enhance the online and offline shopping experience.

4.1. Independent and Dependent Variables. The independent variable is the type of smart mobile service. It is a within-subject variable with three levels: SmartMall, SmartWatch, and SmartFit. Apart from that, demographic information, shopping behavior, and independence were recorded through a questionnaire (shown in Table 2). These variables were included into the data analysis and excluded from further analysis if their influence was not significant. The dependent variable is subjects' satisfaction towards the proposed smart mobile service. Each item used a five-point Likert scale, anchored from "totally disagree" to "totally agree." In order to check internal consistency, two pairs of reverse questions were included.



(a) (b) (c)

Figure 6: 3D fitting. Note: when users click the fitting button, SmartFit shows the effect of putting on the clothes.



(a) (b) (c)

Figure 7: Image search. Note: when users click the image search button, SmartFit scans the image and acquires the closest-matching goods.

4.2. Participants and Tasks. Thirty college students participated in the experiment. Their education level and gender were balanced. They were between 21 and 29 years old (mean = 23.27, SD = 2.28). In practice, the sample size in related studies ranged from 7 to 40 [41–43]. Theoretically, the required sample size could be computed through statistical power analysis. It is a function of significance criterion (α), population effect size (ES), and statistical power (β). ES could be derived from values based on social behavioral studies recommended by Cohen [44] and statistics (e.g., the partial eta square) computed from ANOVA with one within-subject variable and one between-subject variable. The necessary sample size for the statistical power of 0.8 [44] calculated through a statistical power analysis program G^*Power is 26 (partial eta square = 0.067, ES = 0.267, and $\alpha = 0.05$).

Participants watched the video demonstrations on a touch-screen notebook computer (ThinkPad S1) and used prototypes on a Moto 360 and an MI2 Phone. *For the SmartWatch, certain interaction was shown on the notebook computer. For example, smart watch was used to implement the voice search, and the results on the back of the band were presented on notebook computer*. Participants were able to watch the demonstrations as many times as they liked. After that, they filled in the questionnaires regarding their satisfaction. At the end of the experiment, they were interviewed as to their opinions and concerns about each prototype. There were two interview questions: "*What are your favorite features of this prototype?*" and "*What features of this prototype you do not like and why?*"

4.3. Equipment and Procedure. A ThinkPad S1 Yoga notebook computer, equipped with Windows 8.1, a screen size of 12.5 inches, and a resolution of 1920 ∗ 1080, was used. An MI2 smart phone, equipped with Android 5.0.2, a screen size of 4.3 inches, and a resolution of 1280 ∗ 720, was used. Two pilot tests were conducted and the questionnaire was revised.

Table 3: The correlation between satisfaction of each prototype and other variables.

	SmartMall		SmartWatch		SmartFit	
	r	p	r	p	r	p
Absorption	0.456	0.013*	0.409	0.031*	−0.297	0.125
Innovativeness	−0.369	0.053	−0.431	0.022*	0.106	0.591
Online shopping frequency	0.14	0.476	0.125	0.527	0.421	0.026*
Whether like play medium game	−0.461	0.014*	−0.456	0.015*	−0.112	0.57
Whether like play game	−0.307	0.112	−0.425	0.024*	0.134	0.498

*Significant at 0.05 level.

Table 4: The influence of innovativeness on satisfaction with each prototype.

Source	SS	df	MS	F	p
Innovativeness	491	1	491.0	4.33	0.0474*
Prototype	232	2	116.15	1.705	0.1917
Innovativeness ∗ Prototype	464	2	231.78	3.403	0.0408*

*Significant at 0.05 level.

It took each participant approximately 60 minutes to complete the formal experiment. The experiments were conducted in the Human-Computer Interaction Laboratory of Chongqing University. Firstly, the experimenter briefly introduced the experiment, and each participant signed a consent form. Secondly, subjects filled in the questionnaire with background information, independence, and shopping behaviors. Next, in the formal experiment process, participants watched video demonstrations of smart mobile services which were filmed in field to mimic the actual usage and used the prototypes. Furthermore, to avoid a learning effect, the order to use the three prototypes was counterbalanced. That is, participants were randomly divided into six groups, and each group was assigned to a different order to use three prototypes. Finally, participants filled in the system usability scale. Figure 8 shows participants interacting with prototypes.

5. Results and Discussion

Reliability of the questionnaire was checked. First, if participants' responses to the two pairs of reverse questions were not consistent, their questionnaires were excluded from further analysis. Two participants were excluded. Then, reliability of items (Cronbach's alpha) was computed. Twelve items with poor reliability were deleted.

The questionnaire had good reliability. The overall reliability score was 0.734, and the reliability for each factor was 0.797 (single-tasking or multitasking), 0.649 (attitudes towards recommendation information), 0.799 (shop quickly), 0.855 (personalization), 0.886 (innovativeness), and 0.863 (enterprising).

5.1. Satisfaction with Smart Mobile Services. The SUS score for each prototype is shown in Figure 9. Participants generally had positive feedback towards the three smart mobile services. However, there was no significant difference among the three prototypes according to the result of a one-way repeated ANOVA.

To explore the relationship between satisfaction and the other variables, correlation analysis was conducted (shown in Table 3). User satisfaction was correlated to user characteristics such as absorption for SmartMall and SmartWatch, participants' innovativeness for SmartWatch, and shopping frequency for SmartFit. Apart from demographics, there is one factor correlated to satisfaction: innovativeness. Therefore, the following sections further investigate their influence on satisfaction.

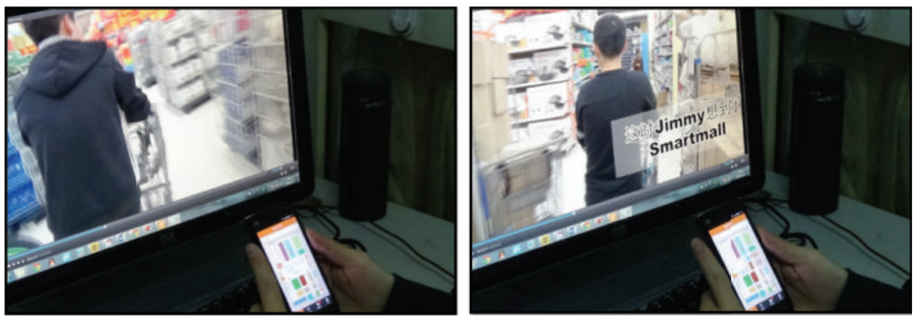
To dig into to the correlation between innovativeness and satisfaction, the data pattern of each prototype was explored. As shown in Figure 10, the influence of innovativeness on satisfaction seemed to differ among the three applications. To verify this, an ANOVA test was conducted, where the application is the within-subject variable and the innovativeness is the between-subject variable. The results (shown in Table 4) indicate that the interaction between innovativeness and the prototypes was significant.

Specifically, as shown in Table 5, innovativeness did not influence participants' satisfaction with SmartFit. However, it influenced their satisfaction with SmartWatch; participants with higher innovativeness had lower satisfaction. This is contrary to previous findings that consumers with higher innovativeness are more likely to adopt mobile shopping [17]. One possible reason for the inconsistency lies in the prototype design. The findings from the previous study [17] were based on the results of a questionnaire survey without details about the interface, whereas the high-fidelity prototypes used in this study provided abundant interaction details. Participants with higher technology innovativeness were generally more interested in new technology. Participants had more knowledge about new technology and were more aware of potential downsides. This was backed up by the interview results: SmartWatch needed users' privacy data such as personal habits, social contacts, and behaviors of family members. Eleven participants worried about the security and privacy of SmartWatch, and seven out of them had high innovativeness (above the median). Apart from that, six participants worried

Table 5: Main effect of innovativeness on participants' satisfaction with each prototype.

Dependent variable		Innovativeness					F	p
		Mean	SD	df	SS	MS		
Participants' satisfaction	SmartMall	69.643	9.419	1	338.9	338.9	4.107	0.053*
	SmartWatch	66.161	10.701	1	595.9	595.9	5.936	0.022**
	SmartFit	69.732	7.915	1	19.7	19.73	0.296	0.591

**Significant at 0.05 level; *significant at 0.1 level.



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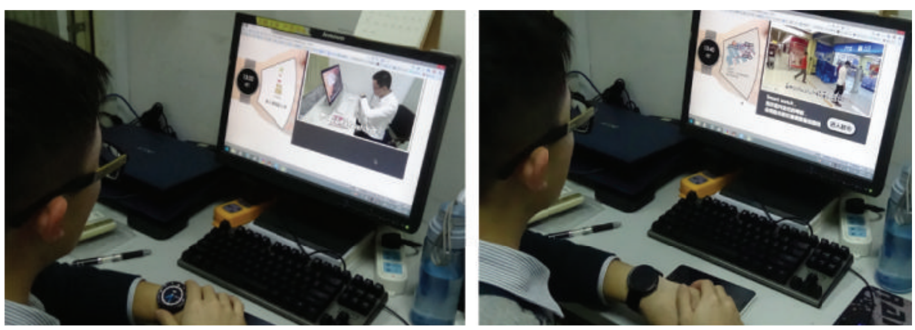

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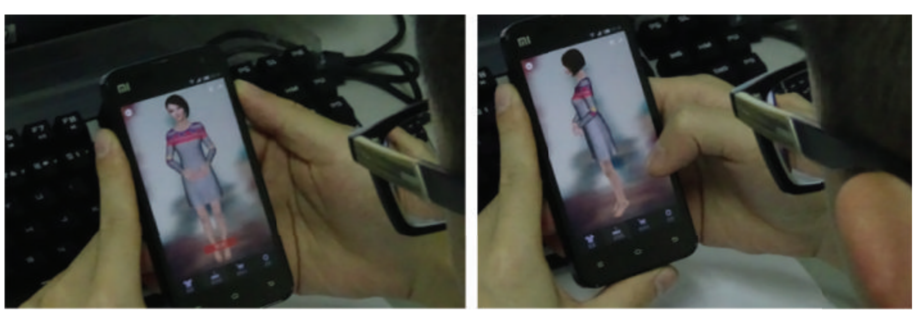

(c)

Figure 8: Participants interacting with prototypes.

about the accuracy of recommended results, and three out of them had high innovativeness.

Apart from innovativeness, other variables which might influence satisfaction were investigated through ANOVA. Three influential variables were identified. First, participants with higher absorption (above median) hold a higher satisfaction with two prototypes (SmartMall: $F = 7.224$, $p = 0.001$; SmartWatch: $F = 4.918$, $p = 0.005$). This is consistent with the results of the interview. Among the three prototypes, two have the common feature of indoor navigation. On the one hand, of the 17 participants who expressed that they liked indoor navigation in the interview, 12 of them had a positive or neutral absorption. On the other hand, of the 10 participants who expressed that they disliked indoor navigation in the interview, 6 of them had a negative absorption.

Second, participants who liked shopping quickly had lower satisfaction with the SmartFit ($F = 4.442$, $p = 0.008$). This is consistent with the results of interview: there are eleven participants who did not like the feature of 3D fitting of SmartFit, and nine out of them tended to shop quickly. One

Table 6: Influential factors on participants' satisfaction with each prototype.

	Independent variable	Std. error	Adjusted R^2	Standardized coefficients	t
SmartMall	Absorption	1.312	0.365	0.447	2.91*
SmartMall	Attitude to play medium game	1.783		−0.443	−2.884*
SmartWatch	Absorption	1.458	0.398	0.423	2.82*
	Innovativeness	0.457		−0.349	−2.161*
SmartFit	Shopping quickly	1.045	0.357	−0.477	−3.086*
	Online shopping frequency	0.705		0.448	2.897*

*$p < 0.05$.

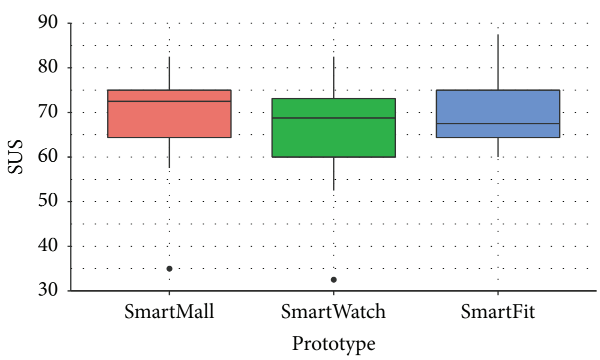

Figure 9: The SUS scores for the three prototypes.

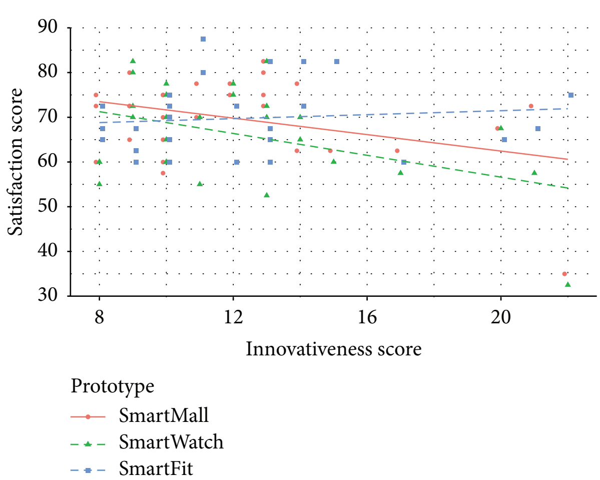

Figure 10: Prototype scatter diagram showing innovativeness and participants' satisfaction. Note: liner regression lines were added.

possible reason is that participants who like to shop quickly usually do not want to explore and compare various 3D fitting effects.

Third, participants with a higher online shopping frequency had higher satisfaction with SmartFit ($F = 3.198$, $p = 0.022$). During the interviews, 16 participants liked the function of image search of SmartFit, and 10 of them had higher online shopping frequency. A possible reason for this is that SmartFit made the search experience convenient and efficient through the image search service.

To identify the key influential factor/item, multiple regression analysis was conducted. The results are shown in Table 6. The regression models were significant (SmartMall: $p = 0.001$, SmartWatch: $p = 0.002$, and SmartFit: $p = 0.002$) and could explain a medium proportion (ranged from 35.7% to 39.8%) of variance in satisfaction scores. For the SmartMall and SmartWatch, absorption was the most influential factor of participants' satisfaction, whereas the most influential factors of satisfaction with SmartFit were the attitude towards shopping quickly. Apart from that, participants who were used to play medium games had lower satisfaction with SmartMall because the game used in the prototype was too simple for them.

5.2. Attitude towards Key Features of Smart Mobile Services

5.2.1. Indoor Navigation. Participants' attitude towards indoor navigation depends on their shopping motivation. The majority of participants gave positive feedback to this feature (17/24 for SmartMall and 13/22 for SmartWatch). They thought that it could save time and was convenient. This satisfied their utilitarian motivation [45]. However, ten participants had negative feedback. They were reluctant to read the display of the smart phone and the smartwatch. Instead, three participants preferred asking the salesperson, and one participant thought that indoor navigation is unsuitable for people who are familiar with the mall. Apart from that, six participants did not want to follow the recommended routes. This set constraints for them because they preferred wandering and exploration during shopping. Consistent with previous studies, users with hedonic motivation enjoyed the shopping process [46].

5.2.2. Game Experience. Participants' attitude towards a game-style shopping experience depends on their shopping habits. The majority of participants gave positive feedback to this feature (17/24 participants). They thought that the game brought more pleasure to their current shopping experience, and the coupon and discount were practical and gave them a sense of achievement. However, the rest of participants had neutral feedback. Two participants thought that the game was not user friendly, and three participants enjoyed wandering and did not want to buy products along the predefined shopping route. Also two participants worried about that the treasures were not what they needed, and it might be too commercial to enjoy the game experience.

5.2.3. Recommendation. Participants' attitude towards recommendations depends on the accuracy and frequency of recommendations. Thirteen participants held a positive attitude towards this feature of SmartWatch. Among these participants, two participants thought that it would be better if SmartWatch could recommend specific commodities; eight participants wanted SmartWatch to add the feature of price comparison. When SmartWatch recommends products that are similar to the user's choice, it can compare prices with nearby supermarkets. However, 11 participants had negative feedback toward recommendations. Six participants worried about the accuracy of recommendations, and they were afraid that their personal data would be disclosed. Consistent with previous studies, users worried about privacy risk, and it would influence their behavior [47]. Furthermore, five participants were concerned about the high frequency of recommendations, and they wanted to have more control on the timing of the recommendations.

5.2.4. Mobile Payment. Participants' attitude towards mobile payment depends on the level of security risk. Despite the fact that the majority of participants gave positive feedback to this feature (19 participants for SmartMall, 17 participants for SmartWatch), all of the participants were concerned with the potential security risk of mobile payment. Some participants worried about the security of SmartMall, while others worried about the security of SmartWatch. It is consistent with previous findings that consumers were concerned about online payment security [7, 47].

5.2.5. 3D Fitting and Image Search. The participants' attitude towards 3D fitting and image search depends on the technology feasibility. The majority of participants gave positive feedback to these features (16 participants for 3D fitting, 16 participants for image search). They thought it was a good method to solve the trouble of misfit when shopping online. Among these participants, five participants suggested adding more delicate fitting experiences (e.g., indicating how much space is left between the clothes and the body). However, 11 participants had negative feedback towards 3D fitting. Three participants thought that existing 3D fitting technology could not fully satisfy their requirements, and four participants worried about the accuracy of a digital manikin. Moreover, four participants considered manual data input to be troublesome. Moreover, nine participants had negative feedback regarding image search. Four participants thought that it was difficult to acquire images for clothes of interest, and three participants worried that the match result was not accurate.

6. Conclusion

This study explored the potential of smart mobile services to enhance the online and offline shopping experience. Three prototypes based on user requirements were developed and evaluated by young adults. The results indicate that user satisfaction with mobile smart services is influenced by their characteristics and the design of prototypes.

Regarding user characteristics, first, the higher the level of participants' innovativeness, the lower the acceptance of certain smart mobile services. Second, participants with high absorption paid more attention to the convenience of certain smart mobile services. Third, participants who like shopping quickly cared about the simplicity of certain smart mobile services. Finally, participants with a high frequency of online shopping needed new online search technology badly.

Regarding the design of smart services, the results indicate that participants generally have positive feedback towards smart mobile services, but they still have mixed attitudes towards key features of smart mobile services. First, participants with a utilitarian motivation like the indoor navigation feature, but those with a hedonic motivation enjoy exploration. Second, in the era of big data, participants want more control over recommendations and more protection of privacy. Third, participants are badly in need of a mobile payment system, but they are concerned about security. Finally, developers of new technology for smart mobile services should consider feasibility.

This study is an explorative study of mobile smart services. Young adults' needs and their opinions of key features could be of reference value for practitioners. However, the results should be interpreted with consideration for two reasons. First, the participants in this study were Chinese college students with low income, so results of this study may not be generalized to other populations. Second, the high-fidelity prototypes were not equivalent to final products, so the lack of fully functional interaction may influence the participants' attitude.

Competing Interests

The authors declare that there is no conflict of interests regarding the publication of this paper.

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