An Analysis on Mobile Location-based Services

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Abstract. Mobile phones have the characteristics of ubiquitous, timely, location tracking, interaction, and personalization. Such special characteristics, which computer internet and traditional media would not have, make the market of mobile commerce be expected as a well-develop market recent years. With the advent of broadband mobile data capability, mobile carriers thus are well positioned to develop new data value added services and applications to meet customer demands. In addition, combine the broad bandwidth in wireless transmission with location positioning techniques, rich and various contents would be applied by service providers and users. While the mobile devices are getting more and more popular, mobile location based service (henceforth referred to as MLBS) on mobile devices are believed to be a good profitable opportunity to the service providers. Therefore, the main purpose of this study is figuring out the users' preferences toward MLBS. In this study, Analytic Hierarchy Process (AHP) method is applied to discover the users' preferences toward MLBS. Under such condition, MLBS providers can put efforts and resources on improving and providing prior services which were selected by users, after that average revenue per user would be expect to rise and the obstacles for MLBS development might be less.

Keywords: Mobile location-based services, Users' preferences, Location-based, Analytic hierarchy method.

1. Introduction

With the wide deployment of mobile communications and in the advent of 3G mobile communication systems, increased mobile bandwidth support a wide range of new mobile commerce services and applications, including faxing, large email messages, efficient Web browsing, maps for real-time navigation and basic multimedia. In addition, the enhanced mobile communication speed and bandwidth allows mobile consumers to surf the graphics-intensive websites. With the availability of mobile broadband communication, mobile carriers are all aggressively preparing for multimedia-related applications and services.

The origin of location-based services (LBS) started from E-911 regulation whose purpose was to improve the emergency responses to the wireless calls [1]. Nowadays, location-based technology is not only applied on emergency rescues, but also used in many aspects in public [2, 3]. The world population of global positioning system (GPS) enabled location-aware services subscribers will grow from 12 million in 2006 to a projected 315 million in 2011 with North American growth reaching 20 million users up from 500,000 users in 2006." [4] With the increase of users in worldwide, LBS market will be highly potential. According to market forecast reports, LBS market was predicted to grow rapidly during 2006 to 2010. The LBS market in Europe was expected to increase from $191 million to $622 million [5, 6]; U.S. market was expected to increase from $150 million to $3.1 billion [7]; Asia market was expected to increase from $291.7 million to $447 million [1]. However, the developing situation seems not as good as they expected. More specifically, not all of the services which service providers have capable to provide (or have already provided) would attract users. While the mobile devices are getting more and more popular, LBS on mobile devices are

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believed to be a good profitable opportunity to the service providers. Under such circumstance, it is quite important to understand users' preferences on various MLBS (Mobile location-based services).

In this study, Analytic Hierarchy Process (AHP) method is applied to discover the users' preferences toward MLBS. By reviewing related literatures and present MLBS providing situations, MLBS developing situation and related information would be regarded as the basis of building hierarchy of MLBS (mobile location- based service) categories. By applying AHP method and questionnaire survey, users' preferences toward MLBS would be discovered, and therefore, service providers can make efforts on improving and providing prior services which were selected by users. Even though the MLBS companies have put many efforts on establishing basic factors of developing MLBS, users' preference might become one of the important issues for the industry. By using AHP as the analyzing method, not only we can have the weights of every service and further conclude users' preferences on MLBS, but also can make the results valid by pairwise comparisons.

2. Mobile Location-Based Services

According to the GSM Alliance Services Working Group, MLBS were defined as the following categories [8]: emergency services, emergency alert services, home-zone billing, fleet management, asset management, person tracking, pet tracking, traffic congestion reporting, routing to nearest commercial enterprise, roadside assistance, navigation, city sightseeing, localized advertising, mobile yellow pages, network planning, and dynamic network control. Cheng, Lai, Lai, and Huang [9] mentioned MLBS had six categories, which were personal security, peer to peer/find me, navigation/point of interest look up/traffic, commerce/advertising/buying/billing, gaming/location based imaging, and asset tracking/field services. According to Tsai [3], MLBS were considered as tagging, tracking, tracing, and m-commerce. Chen and Lin [10] noted that MLBS were classified into three main categories, which were entertainment, information, and commerce. For the above classifications from different literatures, some of the services in different categories might cross to others in one classification. In this study, we conclude five MLBS categories, which are entertainment, information, navigation, commerce, and security and tracking. Each category has its attached services (Table 1). Besides, each service can be provided independently. Under this condition, MLBS users would subscribe the services independently.

Table 1: Compiled chart of MLBS categories.

MLBS categories	Services / Reference	A	B	C	D	E	F	G	H	I	J	K	L
Entertainment	MLBS community		●			●							
	MLBS game		●					●					
Information	Nearby location checking	●		●	●			●	●		●	●	●
	Entertain information	●				●					●	●	●
	Local weather report				●			●	●			●	●
	Finding taxi						●	●			●		
Navigation	Traffic information	●		●	●			●	●		●	●	●
	Navigation	●		●	●			●	●		●		
	Map				●	●					●		
Commerce	Nearby Stores' coupons				●			●	●			●	●
	Mobile transaction	●			●	●		●	●				●
Security Tracking	Emergency rescue	●		●	●				●	●		●	●
	Roadside assistance	●									●		
	Tracking elders/children/pets/car/property	●						●		●	●	●	●

A：[8] Ververidis & Polyzos (2002)   E：[10]Chen & Lin (2004)   I：[14]Jiang & Yao (2006)
B：[11]Lin(2003)   F：[13]Scharl, et al. (2005)   J：[15]Hand, et al. (2006)
C：[2]Rao & Minakakis (2003)   G：[9]Cheng et al. (2005)   K：[16]Yang & Lee (2008)
D：[12]Kühn (2004)   H：[3]Tsai (2006)   L：[17]Chen, et al. (2008)

3. Research Method

3.1. Building MLBS Classification Hierarchy

There are five categories, which are entertainment, information, navigation, commerce, and security and tracking. Each category has its attached services. For entertainment, there are two services, which are MLBS community/friend-finder and gaming. For information, there are four services, which are nearby location checking, entertainment information, local weather report, and finding taxi. For navigation, there are three

services, which are traffic information, navigation, and Map. For commerce, there are two services, which are nearby stores' coupons/sales information, and mobile transaction/billing. For security and tracking, there are three services, which are emergency rescue, road side assistance, and tracking elders/children/pets/car/property.

3.2. Research Samples

According to FIND's report [18], about 70.47% of the mobile phone users are between 14-42 years old. It is obvious that young mobile phone users show more intention of using mobile-related applications. Therefore, such investigation can be inferred that young mobile phone users might have higher using frequencies than elders in Taiwan. Besides, according to [19], 63% of mobile value-added users were between 21 to 35 years old in Taiwan in 2004. MLBS is a new application in value-added services. In other words, MLBS is indeed one type of value-added service. Under such conditions, young mobile phone users who were between 14 and 42 years old were the objects of this study. Convenient sampling method was applied in this study.

3.3. Data Analysis

After deciding the focused survey objects, they would be asked to be the respondents for exploring users' preferences on MLBS. In order to make a decision in an organized way to generate priorities, we need to go through the following steps [20-23].

1. Define the problem. As which had been mentioned before, the purpose of this study was exploring users' MLBS preferences in Taiwan. In this case, the problem would be very simple, which was what kind of or which of the MLBS would be the prior preferred options for users in Taiwan.

2. Structure the decision hierarchy from the top (goal) of the decision, through the intermediate levels (criteria), to the lowest level. In this step, we constructed a hierarchy and its sets of criteria.

Construct a set of pairwise comparison matrices. Each element would be compared in pair. After establishing the matrix, we need to calculate the weight of every element. While having made all the pairwise comparisons, the consistency is determined by using the eigen value, λmax, to calculate the consistency index. Before we calculate the consistency index, we have to apply the weights to evaluate the consistency vector. In this part, every respondent would be asked to make comparison for the relative importance of each pair of the category. Within every category, the respondents would be asked to compare the services. At the end of this study, the respondents' opinions and preference on MLBS would be expected as valuable references for MLBS providers in Taiwan.

3. Use the priorities obtained from the comparisons to weigh the priorities in the level below. Apply this on every element. Then, each element would get a weight as an evaluation for their priorities.

However, Expert Choice 2000 was applied to calculate weights and Consistency Index. After gathering the questionnaires, the pairwise comparison data would be established on the software which was named Expert Choice 2000. The data were further calculated by SPSS 12.0 to get the results.

4. Empirical Study

The purpose of this study was discovering users' preferences toward MLBS. In order to fulfill this study's purpose completely, descriptive statistics and MLBS preferences will be resulted in the following sections.

4.1. Sample Characteristics

The study collected 463 questionnaires. Due to the consistency index (C.I.) in the second part of the questionnaire (MLBS preference), 173 questionnaires were not apply in the result. In other words, the number of effective questionnaires was 290.

Within the 290 respondents, 112 (38.6%) were males, and 178 (61.4%) were females. The number of the respondents' age from 19 to 22 years old was 228 (78.6%), which was also the most one. The numbers of respondents' academy degrees were two (0.3%) junior high school students, four (1.4%) high school students, 262 (90.3%) college students, and 23 (7.9%) graduate school students. The numbers of respondents'

professions were 274 (95.4%) students, 2 (0.7%) information technology related career, one (0.3%) education related career, seven (2.4%) service industry, and six (2.1%) medical/nursing career.

4.2. Respondents' Preference on MLBS

4.3. Respondents' Preference on MLBS Categories

In the second part of the questionnaire, respondents were asked to respond the pairwise comparison based on their preference toward MLBS. The data were established on a software name Expert Choice 2000. By applying Expert Choice 2000, the weight of each category and services would be gathered. In order to compare with other variables, the weights were further transferred into SPSS 12.0. The results showed that navigation (0.21434) was the most preferred category within the five MLBS categories. The second preferred category was entertainment (0.20744). The third preferred category was security and tracking (0.20164). Then, information (0.19891) was the forth preferred. The last category was commerce (0.1777).

4.4. Respondents' Preference on Services

For the services, the sequence from the first preferred to the last are as the following series, which are MLBS community/friend-finder (0.10402), gaming (0.10342), nearby stores' coupons/sales information (0.09585), mobile transaction/billing (0.08185), navigation (0.08111), map (0.07894), tracking elders/children/pets/car/property (0.07343), road side assistance (0.07027), emergency rescue (0.05797), nearby location checking (0.05782), entertainment information (0.05726), traffic information (0.05429), local weather report (0.04877), finding taxi (0.03507).

5. Discussions and Conclusions

The development of LBS has been more than ten years. The key parties in MLBS industry have put a lot of expectations on it. Nevertheless, in previous years, LBS were mainly applied on emergency rescue and personal security. Mobile telecommunication companies (include relevant industries), for example Nokia, Google, Apple, and etc., have put efforts on extending related functions on LBS. MLBS software platforms were established recently. The study of development trends of location based services in the era of mobile broadband stated that Apple App Store and Google Android are the main application download platforms, and also the indications of MLBS market. For both of Apple App Store and Google Android, navigation category and entertainment category are download the most times by users, which also indicates users need these two categories the most.

Recently, community (i.e. facebook, twiter, etc.) and GPS navigation are popular in publics. Android Market download ranks and the top eight LBS innovations in global prove that community related services are the most popular service and have been downloaded by users the most times [24]. However, it is not possible to apply these applications if users do not have relevant devices. MLBS provide similar functions to users. There are popular applications in global, which are navigation, travel, and community related categories [25]. Compare with this study, location and community seem to be the key elements for MLBS. Besides, users do more things on their mobile phones rather than just voice communication. Especially, most of the respondents are students (young ages), they may more prefer on entertain-related applications. Gaming, community/friend-finder may become users' entertainments if they are outdoors. Nearby stores' coupons/sales information might become useful applications for users when they are shopping. Online shopping market trend and consumer behaviour [24] applied in-depth interview method and focus group method to investigate users' preference on internet and digital consuming in Taiwan. The result showed that college students preferred on community and gaming service.

This study focused on young mobile phone users in Taiwan. Among the respondents, we mainly focused on students. According to respondents demographic, the main group was between 19 and 26 years old. Under the circumstances, the result and conclusion are better applied on the young users who are about 19 to 26 years old. Further, most of the respondents were in the south of Taiwan. Future research can contain every age much evenly to find out the differences between ages.

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